THE

BOTANICAL GAZETTE

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A Revision of the North American Species of Fissidens.*—I.

CHARLES R. BARNES.

After examining critically the North American species of Fissidenteæ, I conclude that the group as elaborated in the Manual of Mosses of North America, by Lesquereux and James, includes too many nominal species, and that it would be better to combine some forms which have been separated as poorly defined species. In this revision I attempt to make the distinctions between species more nearly equivalent to those which the best systematists demand between species of phanerogams. The descriptions of the Manual are necessarily condensed and are not clearly diagnostic. I therefore present complete descriptions so far as material at hand permits, and embody the most obvious diagnostic characters in a synoptical key. I also offer some critical remarks upon difficult, doubtful or excluded species.

For the synonymy of all species occurring in Great Britain, I refer to Braithwaite's British Moss-Flora, and supply only references to American works and collections. In species not British full synonymy is given.

In description I have substituted *leaf-cells* for the unmeaning term "areolation," and *rhizoids* for "radicles." I use the terms *vaginant lamina*, *vertical lamina* and *inferior lamina* to designate respectively the sheathing or conduplicate portion of the leaf, the whole of the vertical blade, and the part of it below the costa.

Whenever possible, I include in the descriptions measurements of the leaf-cells of the vertical lamina and of the spores, instead of the indefinite expressions "large" or "small." Measurements of height are in all cases exclusive of the fruit.

* Read before the A. A. A. S., Buffalo meeting, August, 1886.

FISSIDENS HEDWIG.

Fissidens HEDWIG: Fund. Musc. 2. 91. — SULLIVANT: Mosses of U. S. 24. — LESQ. & JAMES: Man. 81.
Dicranum AUCT.
Skitophyllum DE LA PYLAIE: Desv. Jour. Bot. 6. 133.
Schistophyllum LINDBERG.
Octodiceras BRIDEL: Sp. Musc. 1. 162.
Conomitrium MONTAGNE: Ann. Sci. Nat. II. S. 245.—SULLIVANT: Mosses of U. S. 25.— LESQ. & JAMES: Man. 89.

Plants large or small, simple or branched, gregarious or cespitose, terrestrial or aquatic: leaves distichous, conduplicate below, often equitant and clasping, the back produced into a prominent vertical wing with a sub-percurrent or excurrent costa; cells parenchymatous, all chlorophyllose: flowers monoicous, pseudo-dioicous or dioicous: fruit terminal or lateral; pedicel usually long; teeth sixteen, long, deeply bifid with the unequal divisions rough, or short and perforate; calyptra cucullate, mitrate or conic; operculum conic or rostrate.

HABITAT: On the ground, rocks or trees, or in water; in all parts of the world but chiefly tropical, not alpine.

A very large genus of over three hundred described species, represented in North America by twenty species, which may be characterized and arranged in a fairly natural order as follows:

§ 1. **Eufissidens** MÜLLER: Syn. Musc. 1. 50. — Plants terrestrial or submersed but not floating: leaves soft, of one layer of cells.

* *Fruit terminal.*

\+ *Monoicous, male flowers axillary.*

Leaf-cells small, densely chlorophyllose, in distinct rows 1. **limbatus.**
Leaf-cells larger, not densely chlorophyllose, nor in distinct rows. . . . . 2. **bryoides.**

\+ + *Dioicous or monoicous with the male flowers terminal on a rooting branch at the base of the female stem.*

++ *Leaf-cells 1½–2 times as long as wide, large, distinct.*

Plants less than 1 mm. high, leaves 2 or 3 pairs . . 3. **Closteri.**
Plants 2–4 mm. high, wholly hyaline, leaves 3–5 pairs . 4. **hyalinus.**

++ ++ *Leaf-cells almost or quite isodiametric, often obscure.*

¶ *Leaves with a narrow border, at least on vaginant lamina.*

Marginal leaf-cells not papillose . . . . . . 5. **incurvus.**
Marginal leaf-cells papillose.
Costa percurrent . . . . 6. **Ravenelii.**
Costa ceasing below apex . . . . . . 7. **Garberi.**

¶¶ *Leaves without a border.*

Acute, cells densely chlorophyllose, obscurely papillose . 8. **Donnellii.**

Obtuse, cells pellucid, operculum conic . . . . . 9. **obtusifolius.**
Apiculate, operculum with acicular beak . . . 10. **osmundoides.**

¶¶¶ *Leaves with a thick reddish border.*

Plants submersed, rigid . . . . 11. **rufulus.**

* * *Fruit lateral.*

+ *Leaves without a border.*

Obtuse, entire, plants 2–5 cm. high, fruit sub-terminal . 12. **polypodioides.**
Rounded at apex, irregularly serrate, 1–2 cm. high, fruit sub-basal . . . . 13. **sub-basilaris.**
Mucronate, regularly serrulate, fruit basal or sub-basal . 14. **taxifolius.**

+ + *Leaves bordered by several rows of paler, often incrassate, cells.*

Capsule cernuous, leaf-cells minute . . . . . 15. **Floridanus.**
Capsule erect or inclined, flowers dioicous, leaf-cells obscure . . . . 16. **decipiens.**
Capsule erect or inclined, flowers monoicous, leaf-cells distinct . . . . 17. **adiantoides.**

§ 2. **Pachyfissidens** MULLER: Syn. Musc. 1. 45.—Leaves rigid, composed of more than one layer of cells, opaque.

Plants growing in water or very wet places . . . 18. **grandifrons.**

§ 3. **Octodiceras** BRIDEL: Sp. Musc. 1. 162.—Plants aquatic, filiform, floating.

Plants large, much branched, pedicel shorter than the capsule . . . . 19. **Julianus.**
Plants small, little branched, pedicel longer than the capsule . . . . 20. **Hallianus.**

1. F. limbatus SULLIVANT: Pac. R. R. Rept. 4. 185. t. 1.

LESQUEREUX: Trans. Am. Phil. Soc. 13. 3.—Mem. Cal. Acad. 1. 7.—BOLANDER: Cat. 37.—WATSON: Bot. Calif. 2. 374.—LESQ. & JAMES: Man. 82.—MITTEN: Jour. Linn. Soc. 21. 556.

COLL.: SULL. & LESQ. Musci Bor. Am. 2 ed. 105.

Plants small, 2—5 mm., yellowish green or in wet places bright green, gregarious: stem simple: leaves on sterile plants 8–12 pairs (on fertile plants fewer), oblong lanceolate, apiculate r somewhat acuminate; border hyaline, widening from apex to base except on inferior lamina, very wide at base of vaginant lamina; costa thick, sub-percurrent; cells small, $8–12\times12\mu$, arranged in rows, densely chlorophyllose, sub-quadrate, more irregular in vaginant lamina, which is one-half to three fourths the length of leaf: flowers monoicous; male gemmiform, axillary; female terminal: fruit terminal; pedicel 6–10 mm. long, flexuous, yellowish-red; capsule green, sub-oval, unsymmetric, cernuous; teeth red, inserted below the mouth, much introflexed, deeply split; lid red, conic-rostrate, one-half length of capsule; spores $12–16\mu$, usually 14μ.

HAB.: California; near San Francisco (*Bigelow, Bolander*); San Gabriel and Pasadena (*Allen*).

2. F. bryoides HEDWIG: Musc. Frond. 3. 67. t. 29.

BRAITHWAITE: Br. Moss-Fl. 1. 71. t. 10 E.—SULLIVANT: Mosses U. S. 24.—LESQ. & JAMES: Man. 81.—MITTEN: Jour. Linn. Soc. 21. 554.

COLL.: DRUMMOND: Musci Am. I. no. 113 in part.—SULLIVANT: Musci All. no. 185.—SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 82.

Plants small, gregarious or somewhat cespitose: stems simple or fasciculate at the base, ascending: leaves 3–many pairs, rather remote, lanceolate or oblong lanceolate, abruptly apiculate; border thickish, pale, usually confluent with the excurrent costa; vaginant lamina one-half length with broader border, inferior lamina narrowed and decurrent; cells roundish-hexagonal, distinct, 12–16×16–20 μ, in vaginant lamina 14–20×20–24 μ: flowers monoicous; male numerous, axillary, gemmiform, pedicellate, antheridia few, small; female terminal, vaginant lamina of perigonial leaves broadly ovate, erose, that of the perichætial leaves with a broad border: fruit terminal; seta red or purplish, 4–6 mm. long; capsule erect, oval or elliptical, brown; teeth cleft one-half length, divisions very scabrous; operculum conic rostrate, short, red; calyptra cucullate; spores 20–26 μ.

HAB.: On the ground: Canada (*Macoun*); New York (*Barron, Peck*); New Jersey (*Austin*); Columbus and Cincinnati, Ohio (*Sullivant*); Rocky Mts. (*Drummond*); Sierras (*Lemmon*).

Var. **cæspitans** SCHIMPER: Syn. Musc. 2 ed. 111.

BRAITHWAITE: Br. Moss-Fl. 1. 72.—LESQ. & JAMES: Man. 82.
F. Curnovii MITTEN: Jour. Linn. Soc. 21. 556.

Plants 2–3 cm. high, more robust than the species, loosely cespitose in broad soft tufts, pale green: stems branching sparsely by innovations, interwoven by rufous purple rhizoids: leaves with a prominent border ceasing at the minutely serrulate apiculus: capsule pale.

HAB.: Wet rocks, New River, White Mts., N. H. (*Prof. O. D. Allen*).

3. F. Closteri AUSTIN: Bull. Torr. Bot. Club 5. 21.

SULLIVANT: Icon. Musc. Suppl. 44. t. 29.—LESQ. & JAMES: Man. 81.—MITTEN: Jour. Linn. Soc. 21. 558.

COLL.: AUSTIN: Musci App. Suppl. no. 479.

Plants very minute and almost stemless, less than 1 mm. high, gregarious: leaves two or three pairs, the lower smaller, broad ovate, the upper two or three times longer; border none; vaginant lamina ovate, one-half length, apical lamina narrow; costa strong, ceasing below the apex; cells rectangular, more or less irregular at margin and near apex, 8×15–20 μ, those of the vaginant lamina 14–16×20–40 μ: flowers monoicous or pseudo dioicous; male gemmiform, attached to the female by rhizoids or separate, antheridium single: fruit terminal; capsule erect, oblong, tapering gradually to the thick seta 1.5 mm. long; operculum conic-rostrate, the beak only covered by the conic calyptra; teeth when dry strongly reflexed around the flaring mouth; spores 8–12 μ.

HAB.: On the ground: Closter, N. J. (*Austin*).

4. **F. hyalinus** WILSON & HOOKER: Jour. Bot. 1841. 89. t. 2.

SULLIVANT: Mosses U. S. 24.—Icon. Musc. 34. t. 21.—LESQ. & JAMES: Man. 84.—MITTEN: Jour. Linn. Soc. 21. 558.

COLL.: SULLIVANT: Musci. All. no. 180.

Plants minute, 2–4 mm. high, pale green, whole plant more or less hyaline, gregarious: stem simple or branched at the base: leaves 3–5 pairs, upper much larger, very thin and soft, oblong-lanceolate, acute, entire, bordered by a single row of very narrow elongate cells; costa none; vaginant lamina less than one-half length; cells large, 32–48×68–100 μ, thin-walled, elongate-hexagonal, chlorophyll bodies few: flowers dioicous; male unknown; female terminal, two-leaved: fruit terminal; seta 1–2 mm. long; capsule oblong-oval, erect, thin; teeth closely articulate, cleft to middle; operculum rostrate, calyptra covering the beak only; spores 14–20 μ.

HAB.: Rocky ledges at Bank Lick, near Cincinnati, Ohio (*Lea*, 1839; station lost); on ground in deep ravines near Painesville, Ohio (*Beardslee*).

5. **F. incurvus** SCHWÄGRICHEN: Suppl. I, part 1. t. 49.

BRAITHWAITE: Br. Moss-Fl. 1. 69. t. 10 C.—JAMES: Trans. Am. Phil. Soc. 13. 109.—LESQ. & JAMES: Man. 82.—MITTEN: Jour. Linn. Soc. 21. 557.

COLL.: SULL. & LESQ.: Musci Bor. Am. 2 ed. no. 104.—AUSTIN: Musci App. no. 101, in part.

Plants small, 2–5 mm. high, gregarious or sub cespitose: stem simple, slender, ascending: leaves 4–10 pairs, straight or decurved, not imbricate, oblong-lanceolate to linear-lanceolate, apiculate; border narrow, almost or quite wanting at apex, widening at base; costa percurrent or sub-percurrent; vaginant lamina one-half length or more; inferior lamina narrowed to the base; cells small, 12–14×14–19 μ, angular-rounded, of the same size but more irregular in vaginant lamina: flowers monoicous; male gemmiform, at the base of stems from which they sometimes separate (pseudo-dioicous): fruit terminal; seta long, red, flexuous; capsule thick, oval, erect, cernuous or arcuate-incurved, pale brown; operculum prominent, conic-rostrate, red; teeth not deeply inserted, very scabrous; calyptra pale; spores 13-17 μ.

HAB.: On rocks, especially sandstone; not rare in Canada and states east of the Mississippi river; collected also in Texas (*Hall*) and Vancouver Is. (*Macoun*).

Var. **minutulus** AUSTIN: Musci App. n. 102.

F. minutulus SULLIVANT: Musci All. no. 183.—Mem. Am. Acad. n. s. 3. 58. t. 2 A.—Mosses U. S. 24.—Icon. Musc. 37. t. 24.—LESQ. & JAMES: Man. 85.—MITTEN: Jour. Linn. Soc. 21. 556.

COLL.: HOOKER & WILSON: Drum. Musci Am. II. nos. 39, 40. (*fide* Sulliv. ms.)—SULLIVANT: Musci All. no. 183.—SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 80 in part.—AUSTIN: Musci App. no. 102.

Plants minute: 1 mm. or less high: leaves narrowly oblong-lanceolate, undulate; some or all narrowly bordered: capsule thin, erect or inclined.

HAB.: On rocks; widely distributed in the Eastern States and Canada; collected also in California (*Mrs. S. R. Mann*).

Var. **exiguus** AUSTIN: Musci App. no. 103.

F. exiguus SULLIVANT: Mem. Amer. Acad. n. s. 3. 60. t. 2 B.—Mosses U. S. 24.—Icon. Musc. 36. t. 23.—LESQ. & JAMES: Man. 84.—MITTEN: Jour. Linn. Soc. 21. 557.

COLL.: SULL. & LESQ.; Musci Bor. Am. 1 ed. nos. 79, and 80 in part.—AUSTIN: Musci, App. no. 103.

Plants small: leaves without border except on vaginant lamina: capsule erect or inclined; operculum conic-rostellate.

HAB.: On rocks, Canada, central and eastern States; Colorado (*Brandegee*).

6. F. Ravenelii SULLIVANT: Mem. Amer. Acad. n. s. 4. 171. t. 2.

SULLIVANT: Mosses U. S. 24.—Icon. Musc. 39. t. 25.—LESQ. & JAMES: Man. 85.—MITTEN: Jour. Linn. Soc. 21. 557.

COLL.: SULL. & LESQ. Musci Bor. Am. 1 ed. no. 81.—2 ed. no. 102.—AUSTIN: Musci App. Suppl. no. 481.

Plants minute, 2–4 mm. high, yellowish or dirty-green, gregarious: stem simple: leaves 2–10 pairs,[1] oblong-lanceolate, acute, minutely-denticulate; border none except in the vaginant lamina of the upper leaves of fertile stems where it is broad, prominently and irregularly dentate; costa flexuous, hyaline, percurrent; vaginant lamina one-half length; inferior lamina tapering, reaching the base; cells very small, 8 μ, obscure, round quadrate, minutely papillose, each with about two papillæ: flowers dioicous; male plants very small, with 2–3 pairs of leaves; female plants rarely with more than 6 pairs: fruit terminal; seta 4–5 mm. long, yellowish; capsule oval or oblong, when dry urceolate, the cells protuberant; operculum red at base, with a short, inclined beak; spores 10–13 μ.

HAB.: On damp bricks or on the ground in wet places: Society Hill, N. C. (*Curtis*); Charleston, S. C. (*Ravenel*); Magnolia, Fla. (*J. Donnell Smith*).

7. F. Garberi LESQ. & JAMES: Proc. Amer. Acad. 14. 137.

AUSTIN: Bull. Torr. Bot. Club 7. 5.—LESQ. & JAMES: Man. 86.—MITTEN: Jour. Linn. Soc. 21. 558.

Plants minute, 1–3 mm. high, bright green, gregarious: stem simple, rarely dichotomous: leaves 4–8 pairs, sometimes falcate, oblong, obtuse, rarely short-acuminate, the upper four times longer than broad,

[1] SULLIVANT says (Icon. Musc. 39): "7—15 (18—20 in sterile stems)," but does not figur any plants with more than eight. Cf. Icon. Musc. t. 25, Mem. Amer. Acad. n. ser. 4. t.

margin minutely denticulate with doubly papillose cells; border none, except on the lower half of the vaginant lamina of the perichætial leaves, where it begins abruptly and consists of two or three rows of larger, rectangular-rhomboidal cells; costa flexuous, hyaline, ceasing below apex; vaginant lamina one-half length; inferior lamina tapering to the base; cells small, 6–8 μ, obscure, round-quadrate to round-hexagonal; flowers terminal, probably dioicous or pseudo-dioicous: fruit terminal; seta equaling or exceeding the stems; capsule erect or sub-erect, elliptical, pale brown, red at the orifice; teeth densely articulate, rufous at base, divisions yellowish; operculum conic-rostrate.

HAB.: On trees, rotten wood, rocks and shells: Florida (*Garber, J. Donnell Smith, Austin*).

8. **F. Donnellii** AUSTIN: Bot. Gaz. 4. 151.

LESQ. & JAMES: Man. 85.—MITTEN: Jour. Linn. Soc. 21. 557.

Plants minute, 2–3 mm. high, dark green, gregarious: stem simple: leaves 3 or 4 pairs, the lower oblong-ovate, the upper much elongated, narrowly lanceolate, crenulate-serrate; border none; costa ceasing just below apex; vaginant lamina one-half length; inferior lamina tapering and ceasing before reaching base, or reduced to a mere line; cells small, 12–16 μ, angular and irregular, each with a single obscure papilla: flowers dioicious, terminal; antheridia 4–6, paraphysate; archegonia unknown: fruit terminal; seta very short; capsule unknown.

HAB.: Base of a cypress tree in a swamp, Caloosa, Fla. (*J. Donnel Smith, Austin*).

9. **F. obtusifolius** WILSON: Lond. Jour. Bot. (1845) 4. 196. t. 9.

SULLIVANT: Mosses U. S. 24.—Icon. Musc. 35. t. 22.—LESQ. & James: Man. 86.—MITTEN: Jour. Linn. Soc. 21. 558.

COLL.: SULLIVANT: Musci All. no. 181.—SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 78.—2 ed. no. 99.—AUSTIN: Musci App. Suppl. no. 480.

Plants small, densely gregarious, bright green: stems simple or branched, sometimes with an innovation just below seta, fertile 1–2 mm. high, sterile longer: leaves 4–12 pairs (the fertile stems with rarely more than 6), the lower oval, the upper oval-oblong, obtuse, entire; border none; costa barely reaching the apex, or vanishing below it; vaginant lamina two-thirds length; inferior lamina tapering and ending above base; cells pellucid, round hexagonal, distinct, 10–14 μ: flowers dioicous, terminal; antheridia 4–6, paraphyses few: fruit terminal; seta light yellow, 2-3 mm. long; capsule thick, oblong, obconic at base; teeth short, orange below, divisions hyaline, granulose; operculum conic, beak very short; spores large, 20–26 μ.

HAB.: On wet rocks or stones: Holmesburg, Pa. (*James*); Ohio, Cincinnati (*Lea*), Sugar Grove (*Sullivant*), Clifton, Clarke county, (*James*); Canton, Ill. (*Wolf*); Texas (*Hall*).

10. F. osmundoides HEDWIG: Sp: Musc. 153. t. 40.

BRAITHWAITE: Br. Moss-Fl. 1. 73. t. 11 A.—SULLIVANT: Mosses U. S. 24.—LESQ. & JAMES: Man. 87.—MITTEN: Jour. Linn. Soc. 21. 558.

COLL.: DRUMMOND: Musci Amer. I. no. 112.—SULLIVANT: Musci All. no. 179.—SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 86.—2 ed. no. 109.—AUSTIN: Musci App. no. 104.

Plants of medium size, 1–5 cm. (rarely even 8–10 cm.) high, more or less densely tufted, frequently matted by the brown tomentose rhizoids, olive- or dark-green: stems simple or branched below: leaves numerous, approximate, not imbricated, increasing in size toward the apex of stem, sometimes crisped when dry, oblong-lanceolate, serrulate especially towards the apex; border none; costa vanishing just below the rounded, apiculate apex; vaginant lamina ½–⅗ length; inferior lamina narrowing slightly toward the base, not decurrent; cells large, 12–24 × 16–32 μ, oval-hexagonal: flowers dioicous, terminal: fruit terminal; seta yellowish to dark-red, ½–1 cm. long; capsule sub-erect or inclined, light- to red-brown, oblong; the conical operculum with its long, acicular, straight (rarely bent) beak equaling the capsule; calyptra plurilobate at base; spores 20–28 μ.

HAB.: Common in all situations: Lower Canada, Eastern and Central States; White Fish Bay, Lake Superior (*Gillman*); Grandfather Mt. (*Sullivant*); Rocky Mts. (*Drummond*).

11. F. rufulus BRUCH & SCHIMPER: Bry. Eu. Fiss. Monog. Suppl. II. t. 102.

SCHIMPER: Syn. Musc. 1 ed. 106.—2 ed. 120.—MILDE: Bry. Siles. 84.—BRAITHWAITE: Br. Moss-Fl. 1. 74. t. 11 B.

F. ventricosus LESQUEREUX: Mem. Cal. Acad. 1. 7.—SULLIVANT: Icon. Musc: Suppl. 45. t. 30.—WATSON: Bot. Calif. 2. 374.—LESQ. & JAMES: Man. 84.—MITTEN: Jour. Linn. Soc. 21. 556.

Plants large, robust, 2–5 cm. high, loosely and widely cespitose, blackish below, the young branches dark green: stem erect, branching dichotomously at the base, the branches simple or sparingly divided, with rhizoids among the leaves: leaves numerous, crowded, somewhat imbricate, cultriform or scalpelliform, entire; border thick, reddish, ceasing just below the apex; costa strong, percurrent; vaginant lamina ½–⅗ length, ventricose, margin flexuous near apex; inferior lamina tapering regularly to the base; cells thick-walled, polygonal, 8–12 × 8–16 μ: flowers dioicous, terminal; male plants shorter: fruit terminal; seta short, scarcely exceeding the leaves, thick; capsule thick, erect, elliptical, pale below, reddish above; teeth erect, coarsely articulated, upper portions spirally thickened; operculum short-conic; calyptra cucullate; spores oval, large, 24–32 μ.

HAB.: On submerged rocks in streams: Mendocino City, Cal. (*Bolander*); Silver Creek, Oregon (*Hall*).

Columbia College Herbaria.[1]

N. L. BRITTON.

The botanical collections of Columbia College have been accumulating since about the year 1820, a few specimens indeed bearing still earlier dates. These oldest were among the first plants collected by Dr. Torrey, and were the nucleus of the Torrey herbarium. During Dr. Torrey's connection with the College, from 1860 to his death, in 1873, specimens accumulated very rapidly, but were nearly all classified by him and mounted under his direction. In 1874 the very extensive collection of the late Professor Meisner, of Basle, Switzerland, specially rich in South American, Asiatic and Australian species, and supplementing the Torrey herbarium to a remarkable degree, together with the herbarium of Dr. A. W. Chapman, of Florida, containing nearly all species described in the "Flora of the Southern United States," were purchased by Mr. John J. Crooke, of New York, and presented to the college. At this time and until about three years ago the collections were under the care of Mr. P. V. LeRoy, who acted as curator. Nearly all his time was spent in mounting the Chapman and Meisner herbaria, and other specimens obtained through purchase or exchange. About two years since the personal bryological collection of the late Mr. C. F. Austin was purchased. It contains all of Austin's types of mosses and some of his Hepaticæ, though unfortunately the bulk of his hepatological material was allowed to leave the country.

Until the autumn of 1878 the college herbarium was located in a building on Madison avenue, which was occupied also by several of the professors. This was at that time torn down and replaced by a new building erected for the department of arts, and the botanical collections were transferred to another old building, where they remained until last autumn. Neither of these ancient edifices were fire-proof. Indeed, it was well known that nothing could save them in case of fire, and the utmost anxiety was felt by those who had the preservation of the vast botanical collections at heart.

On the completion, last year, of the new library building, one of its rooms was assigned to the botanical department. Its furniture was completed in November last, and the task

[1]Read before the Botanical Club of the A. A. A. S., Buffalo meeting, 1886.

of transferring the herbaria was at once begun, and is now practically completed, though much work in arranging and distributing specimens is yet to be done, and for the first time these invaluable scientific collections are secure. It is too soon to say that this disposition will be final. It isolates the plants from the other natural history collections in the museum building on Fourth avenue, and when this shall have been extended it may be deemed wise to deposit the herbaria in the extension, and thus bring them close to the museums of geology and palæontology containing Professor Newberry's immense collections in palæo-botany. The present disposition makes them absolutely secure from fire, which is a source of great satisfaction.

The room now devoted to the botanical collections is sixty feet long, twenty-two feet wide, and sixteen feet in height. It is lighted by day through large, high windows at each end, by the incandescent electric light during evenings and gloomy weather, being an expansion of the system used throughout the library and law school. The herbarium may be consulted till 10 o'clock every evening throughout the year excepting Sundays. The collections, comprising the Torrey, Meisner, and Chapman herbaria, Austin's mosses, and a mass of miscellaneous material, make in all about 175,000 mounted sheets, representing not less than 70,000 species, of which some 6,000 are cryptogams. To accommodate them are 174 running feet of cases, seven feet high, so that any specimen may be reached from the floor without a step-ladder. The cases are of polished oak, handsomely finished and varnished. Each has two plate glass doors opening the entire height, secured by the Jenks' lock and fitting very closely to exclude dust. There are forty-eight compartments to a case, each six inches in height in the clear, separated vertically and laterally by one-half inch oak boards. This height gives the greatest economy of room consistent with stacking the specimens without fear of damaging them. In all there are 1,728 compartments. I find that on the average each will comfortably accommodate about 150 mounted sheets, including genus and species covers, and the present cases on this estimate provide space for about 260,000 sheets, and by crowding, about 300,000. Should the herbarium remain in this room and outgrow this number, there is space in the upper part of the room for an equal number of cases, constructed on those now in place, which are strong enough for this arrangement. In the botanical arrangement, the sequence of orders and genera of Phanerogamia strictly follows that of Bentham and Hooker's "Genera Plantarum." The arrangement of species is geographical, and all the American ones are put in special genus and species covers and placed alphabetically. If there are specimens of plants native or naturalized in America, from other regions, they are put in the same cover as the American specimens for comparison. American genera of more than four species are given species covers and the genus cover dispensed with; genera of four or a less number of species are placed in a single genus cover. It may be objected that the alphabetical arrangement is unscientific, as it destroys natural relationships, but the advantage of easy reference overbalances this disadvantage, and while studying a genus it is a small undertaking to group the species temporarily in any desired order. The arrangement of genera of the cryptogamous groups is also alphabetical, and the American species are similarly distributed. Each second or third compartment is supplied with a pasteboard cover, hinged so as to drop down over the exposed ends of the sheets. To this is attached the name of the order, printed in large, black letters, and the names of genera to be found in the compartments. As the fronts of the cases are glass, it may be seen exactly where any genus is located before opening the door. After much hesitation it has been determined to unite all the separate collections into a single great botanical series. This brings all the specimens of a kind together, and appears to be the most advantageous arrangement. As it is important, however, to know the origin of each specimen, each sheet is appropriately stamped, and the Torrey herbarium, in particular, is carefully identified.

The botanical library is placed around the walls at one end of the room; it comprises about 2,000 bound volumes and an equal number of pamphlets, and is rapidly increasing in bulk. Books on general science, such as the *American Journal of Science*, etc., are on the main college library floor, but can be obtained in five minutes through the aid of a telephone, a page and an elevator. Woods, fruits and miscellaneous botanical material, microscopical preparations, etc., are placed in drawers or in wall cases. Large working tables in each end of the room complete the equipment.

Notes on Umbelliferæ of E. United States. I.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE I.)

Our species of Umbelliferæ have always been more or less perplexing, chiefly on account of the attempt to discriminate them without mature fruit. For this reason, it has seemed to us a helpful thing to take up certain Umbelliferæ and present characters that can be used with reasonable certainty. It is well known that the best characters are obtained from the mature fruit, hence it is safe to give as general advice that no attempt be made to determine species of Umbelliferæ in its absence. Of course there are certain forms that can be recognized without fruit, but the rule holds good. The fruit should be examined both as to its surface and transverse section, and these taken together furnish reliable characters. It hardly needs to be said that the fruit is made up of two carpels and that it is superficially marked by more or less prominent ribs. Five ribs is the normal number for each carpel, one being dorsal (the commissural side being ventral), two lateral (nearest the commissural side), and two intermediate. These ribs may be connected by reticulations or not, may be developed into prominent wings or corky ridges, or may be suppressed entirely. Secondary ribs may also be developed in the intervals between the five primary ribs. Thin transverse sections should be made as near the middle of the carpel as possible, and the varying number, position and size of the oil-ducts, the outline of the seed section, the nature of the pericarp, and the rib sections, will be found to furnish most satisfactory characters. In figure 2, *a* indicates the oil-ducts, *b* the seed section, *c* the pericarp, *d* the commissural face. Frequently groups of thick-walled or smaller cells occur, usually subtending the ribs and even indicating their position in the absence of surface appearance. These groups, which will probably be helpful in classification, may be called "strengthening cells" for convenience.

In the following series of notes all the species east of the 100th meridian will be illustrated, at least by the tranverse section of the carpel.

SANICULA L.—Fruit globular, covered with hooked prickles: carpels without ribs, each with 5 oil-ducts (2 ventral and 3 dorsal) (figs. 1, 2 and 3).—One to three feet high, with 3 to 7-parted leaves; radical long-petioled; cauline short-petioled or sessile; their divisions sharply cut and serrate. Involucre and involucels few-leaved. Flowers greenish or yellowish. May to August.

1. **S. Canadensis** L. Spec. 235. Leaf-divisions 3 to 5: sterile flowers comparatively few, short pedicelled: style shorter than prickles: oil-ducts mostly large, occupying nearly the whole thickness of the pericarp; seed-section deeply sinuous in outline (figs. 1 and 2).—Common throughout the region.

2. **S. Marylandica** L. Spec. 235. Leaf-divisions 5 to 7: sterile flowers numerous, longer pedicelled: style much longer than prickles: oil-ducts smaller, in thicker pericarp; seed-section nearly entire (fig. 3).—Common throughout the region.

OSMORHIZA Raf.—Fruit linear-oblong, long tapering at base, deeply grooved at commissure, bristly: carpels with 5 prominent primary ribs, each subtended by a well defined group of strengthening cells, section nearly pentagonal, no oil-ducts; seed-section more or less deeply concave on the inner face (figs. 4, 5 and 6).—One to three feet high, with aromatic roots. Leaves ternately compound; leaflets ovate, strongly toothed or cleft. Involucre and involucels few-leaved. Flowers white. May to June.

1. **O. longistylis** DC. Prodr. iv. 232. Slightly pubescent or smooth: styles slender, nearly as long as the ovary (not the fruit): seed-section deeply and broadly concave (figs. 4 and 5).—Throughout the northern states and westward.

2. **O. brevistylis** DC. Prodr. iv. 232. Villous pubescent: styles conical, very short: seed-section less deeply and more narrowly concave (fig. 6).—Throughout the northern states and southward to N. Carolina. It is a question whether the specific name *O. dulcis* Raf. may not have the prior claim. The western *O. nuda* Torr. has the seed-section still less concave and strengthening cells less developed and well represents a third member in the series as here arranged.

CONIOSELINUM Fisch.—Fruit oblong, flattened dorsally, smooth: carpels with 5 prominent primary ribs, the lateral ones extended into broad wings; oil-ducts 1 to 4 in the intervals, 4 to 8 on the commissural side; seed slightly concave on the inner face (figs. 7 and 8).—One to five feet high, sometimes smaller, smooth. Leaves 2 to 3-pinnately compound, with inflated petioles. Involucre and involucels few-leaved, the former sometimes wanting, the latter awl-shaped. Flowers white. August to October.

1. **C. Canadense** Torr. & Gray, Fl. i. 619. Leaflets pinnatifid: lateral wings nearly as broad as the seed; oil-ducts 2 or 3 in the intervals, sometimes 1 or 4.—Swamps and cold cliffs from Vermont to Minnesota and northward, also southward along the high mountains to N. Carolina, and in Indiana.[1]

The discovery of a quantity of fine fruiting specimens has enabled us to make a careful examination of fruit characters. Bentham & Hooker have referred this species to Selinum, which is characterized by single oil-ducts in the intervals, rarely 2. Their decision, however was based upon immature fruit, while our recently collected specimens show 2 and 3 to be the usual number of oil-ducts in the intervals, sometimes 1, and rarely 4. This fact would put the species in Ligusticum as defined by Bentham & Hooker. Its characters of broad lateral wings, inflated petioles, and pinnately compound leaves, however, make it so distinct from our own Ligusticums that it seems proper to retain the genus Conioselinum for this species. Possibly Conioselinum Fischeri is properly referred to Selinum. C. Canadense, if it could be included under Selinum, would belong to the broad lateral-winged section Euselinum, but with the oil-ducts of Ligusticum it must either stand as an intermediate genus between Ligusticum and Selinum or these two genera must be merged into one. But Conioselinum is more closely related to the Angelica group than to the Selineæ. In fact, its broad lateral wings and only somewhat prominent dorsal and intermediate ribs at once separate it from Selineæ and include it among Angeliceæ even to a superficial observer, a relationship which the minute structure of the fruit confirms. It is a question whether it should not be included with Angelica and Archangelica in a single genus. The only characters which serve to separate it from them are the much more dissected foliage (which does not count for much) and the absence of prominent bundles of strengthening cells beneath each rib, especially conspicuous under the lateral ribs. These characters can be made to separate Conioselinum from the other members of the Angelica group, but whether they should be considered generic or sub-generic is a matter of doubt. It seems best for the present to consider this genus as intermediate in its characters between Selineæ and Angeliceæ.

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[1] Botanical Gazette, xi. 338.

ERIGENIA Nutt.—Fruit much flattened laterally, nearly round, notched at base and apex, thin between the incurved carpels, smooth: carpels very thin-walled, with 5 small primary ribs; oil-ducts one to several in the intervals, 9 to 11 on the commissural side, which is drawn out (neck-like in section) into the narrow commissure; seed-section deeply two-lobed on the inner side, longitudinal section semilunar (figs. 9 and 10).—Low, diffuse, glabrous, from a deep round tuber, in early spring. Leaves ternately decompound, segments oblong. Involucels foliaceous. Flowers white.

1. **E. bulbosa** Nutt. Genera, i. 188. Span or so high: leaves radical except those subtending the imperfect umbels.—W. New York and Pennsylvania westward into the Mississippi valley.

CRYPTOTÆNIA DC.—Fruit linear-oblong, flattened laterally, somewhat grooved at the commissure, smooth: carpels with 5 small obtuse primary ribs; a single oil-duct beneath each rib and in each interval, 2 to 4 on the commissural side, which also contains two bundles of strengthening cells (in addition to those of the carpophore) besides those subtending each rib; seed-section roundish, slightly concave on the inner face (figs. 11 and 12).—One or two feet high, smooth. Leaves thin, 3-foliolate. Involucre none; involucels minute or none. Flowers white. June to September.

1. **C. Canadensis** DC. Mem. Umbel. 42. Leaflets large, ovate, 2 to 4 inches long, pointed, doubly serrate, lower ones lobed: fruit often becoming curved.—Canada to Minnesota and south to N. Carolina and Mississippi.—In this species the carpellary walls have two distinct layers, the outer being almost made up of the very broad bundles of strengthening cells, the inner composed of a single layer of large parenchyma cells set palisade fashion, and in which the oil-ducts always occur (fig. 13). This peculiar character, differing from any other umbellifer studied, serves to strengthen the position of Cryptotænia as a genus distinct from Pimpinella, to which Bentham and Hooker consider it too closely allied, as in Pimpinella there is no such inner layer and the bundles of strengthening cells are very small and widely separated.

EXPLANATION OF PLATE I.—Fig. 1. Fruit of Sanicula Canadensis. Fig. 2. Section of carpel of same: *a*, oil-ducts; *b*, seed section: *c*, pericarp; *d*, commissural face. Fig. 3. Section of carpel of S. Marylandica. Fig. 4. Fruit of Osmorhiza longistylis. Fig. 5. Section of carpel of same. Fig. 6. Section of carpel of O. brevistylis. Fig. 7. Fruit of Conioselinum Canadense. Fig. 8. Section of carpel of same. Fig. 9. Fruit of Erigenia bulbosa. Fig. 10. Section of carpel of same. Fig. 11. Fruit of Cryptotænia Canadensis. Fig. 12. Section of carpel of same. Fig. 13. Section of carpel wall of same. Figs. 1 and 4$\times 2\frac{1}{2}$; 7, 9 and 11$\times$5; transverse sections$\times$ 27; 13$\times$125.

BRIEFER ARTICLES.

Death of Dr. Wigand.—By the death of Prof. Albert Wigand, of Marburg, Hesse, the scientific world has lost a strong and able friend. He died in Marburg, October 22d, after a severe illness, at the age of sixty-five years. For many years he has held the position of professor of botany and director of the botanical garden connected with the university of that place. Being the only professor of botany in the university, his work was naturally subdivided; as director of the garden and lecturer in the pharmaceutical institute and of general botany, he had not much remaining time to devote to any one branch of the science, as so many German professors have done. Hence his name is not so well known to American scientists. Many of them, however, know him as one of the last of the German botanists who may be said to belong to the old school. In fact, it was his lot to live during one of the transition periods of science, and he was among the few who refused to fall in with the general current. He suffered from this more or less by the isolation which such conservatism always brings, but in no way did this serve to diminish his ardor for his work, or his usefulness in leading others to an enthusiasm in the pursuit of truth in a degree which few teachers are able to reach. Among the evidences of the former are numerous works and papers which he found time out of his busy life as teacher, from time to time to publish. In respect to the latter statement it is perhaps enough to say that he reckoned among his students such men as Eichler of Berlin, and Pfeffer of Tübingen. Whatever may be said concerning his peculiar views on certain points, it is quite certain no teacher could have been more careful and conscientious in presenting them to his hearers, simply as his own views, in carefully distinguishing between mere theories and established facts. Certainly none who ever came within the radius of his influence can doubt the sincerity of his character, his devotion to truth and entire consecration to its interests.—EMILY L. GREGORY.

The Genus Iris.—It is well known to botanists that Professor Michael Foster, the distinguished physiologist of the University of Cambridge, has for several years paid particular attention to the genus *Iris*, has in cultivation all the species and varieties he has been able to obtain, and has carefully studied the principal forms from seedling states through their whole development and in critical cases from generation to generation. He may be supposed now quite thoroughly to understand the Old World species; and those of North America have not been neglected. But several are still in doubt or obscurity; and few of them, even those of the Atlantic States, have been sufficiently studied alive, although this is nearly indispensable. Professor Foster, according to the wishes of botanists who recognize the need of the undertaking and his unequaled fitness for it, is disposed to undertake an elaboration of the species; and he has appealed to me for aid in the difficult matter of procuring ripe seeds or living roots of certain American species and forms which are not in his extensive collection. He particularly wants I. tridentata and I. tripetala from the Atlantic side of our continent, I. Hartwegi, I. Beecheyana, I. macrosiphon, as well as two recent species of Watson, I. tenuis and I. bracteata, from the western portion. For these and for any other rare or local forms—for all wild Irises, except our common eastern species—an appeal is now made. Seeds and roots contributed to the botanic garden of our Cambridge will be thankfully received and cared for, and a goodly portion promptly transmitted to Professor Foster in Cambridge, England, where we may expect them to be fully investigated. For, in a letter to me Professor Foster writes, "I do not like to come to any conclusion about a plant until I have had it under my eyes alive, and know its whole story from seed to seed again. I mean I do not feel that I have really got hold of the form until I have done this, though of course one can learn a good deal short of that. Hence I am anxious to get hold of living plants. Your North American forms are most interesting when the morphology and geographical distribution are worked together, and in connection with the Asian forms."

Note that seed, to be of any good, should be thoroughly ripe; and that living roots are in best condition for transmission in early autumn.

ASA GRAY.

On petiolar glands in some Onagraceæ.—At a recent meeting of the Academy of Natural Sciences of Philadelphia, Mr. Thomas Meehan remarked that stipules were unknown in Onagraceæ, but in Ludwigia (Isnardia) palustris there were two minute conical gelatinous glands, at the base of each leaf, that appeared to be stipular. They existed in series of specimens representing the Atlantic and Pacific coast, and from Europe, those from California being larger than in specimens from other localities. They are found in all the species of Ludwigia and Jussiæa that he had been able to examine. In these they appeared petiolar rather than stipular. In the dried specimens of Circæa a dark spot indicated the position occupied by the glands in other species. They mostly varied in form and exact position with the species, and only for having been wholly overlooked by describers might have afforded some good specific characters. The discovery he regarded as interesting, as confirming the views of those botanists who had brought Turneraceæ, in which the petiolar glands were known to exist, in close relation with Onagraceæ.

In the specimens of Ludwigia palustris, dried to exhibit with this communication to the academy, a single capsule only, cut across for examination, projected the seed into his face while the capsule was being examined with a lens, indicating a projecting power not before known to exist in the species.—T. M.

The Square Bamboo.—Some of our readers may remember an article in *Nature*, for August 27, 1885, giving some account of the square-stemmed bamboo, which has recently been brought to light by Dr. Macgowan, who sent a notice of it. and also some living plants, to Kew. It appears to be a veritable species and not a monstrosity. Most of what is known about it is recorded by Dr. Macgowan, a medical missionary who has long lived in China, in the *Chinese Recorder*, April, 1885 and 1886. "It grows wild in the north-eastern portion of Yunnan, on the sequestered mountains." Dr. Macgowan last summer sent a beautiful cane made of it, with silver mounting, on which the name of Gray is inscribed in Chinese characters, and the interesting present reached the botanist to whom it was presented on the morning of his seventy-sixth birthday.

EDITORIAL.

THE BOTANICAL GAZETTE extends its best wishes to botanists for the new year and expects to record a year of unusual activity among American botanists. It is a time for good resolutions, and botanists should not be behind in this matter. The GAZETTE has made more good resolutions than ever before, but to carry them all out must depend in a large measure upon the hearty co-operation of fellow workers. The various associations of this country and our botanical periodicals have brought us together in a compactness of organization and friendliness of feeling that is the promise of great things. The resolution we would like to have each botanist make with the new year is to do some good work and see to it that none of it goes unrecorded. Our various departments furnish ample room for all forms of communication, large or small, formal or informal, and we want botanists to use them. We will try to keep our readers abreast of the work in this and other countries, but we want their co-operation in every direction. We would call attention to the department of "Notes and News," and ask all botanists to send us any unpublished scraps of information they may meet concerning the work or movements of botanists. Among "Open Letters" we would give place to any expressions of opinion, or any discussion that may be of general interest. In short, we welcome all botanists to all departments of the GAZETTE, excepting the editorial, and even that can be freely discussed in "Open Letters." It is hardly necessary to add that all departments of botany must feel absolute freedom in applying for space, and no one need complain of a failure to obtain a reasonable hearing.

PROBABLY no former report of the U. S. Commissioner of Agriculture has contained such a hopeful outlook for applied botany as that for 1886. Commissioner Colman deserves the credit of having brought this phase of agriculture into prominence as a subject of economic importance meriting development. His well chosen words in the report regarding the study of forage plants, the parasitic diseases of plants, and the biology of forest trees, as prosecuted during the past year, and the need of more ample provision for their continuance, will meet with the most hearty approval of every botanist who is interested in seeing the results and the methods of science turned to the service of the cultivator.

OPEN LETTERS.

Mr. C. G. Pringle.

On the twenty-seventh of November for a few hours I had the pleasure of the company of Mr. C. G. Pringle, of Charlotte, Vermont, who is on his way home from northern Mexico, where he has again spent the summer collecting plants. All who have seen his specimens know that he is a prince among collectors. He reports the season as unfavorable for his work, though he estimates that he has secured at least 1,000 species. Next year he anticipates going on to higher grounds in the same country. He thinks it is a rough, dangerous way to live, some of the time among people who would not hesitate to kill him merely for his clothes, still he is full of enthusiasm and likes his work. There is a perpetual fascination in finding new things as well as in meeting with old friends among his plants. Mr. Pringle appeared in good health and spirits. The time passed too quickly to hear all he had to tell of his journey and his acquaintance with botanists in various parts of America.

Michigan Agricultural College. W. J. BEAL.

Herbarium Case.

In the herbarium case which was constructed for the Ark. Ind. Univ., to facilitate getting genus covers out of the pigeon holes, a two inch auger hole was bored in the bottom of each apartment in the center and one-half inch from the front. By inserting two fingers beneath the shelf the contents of the pigeon hole above are readily raised, and by slipping the other hand in, easily removed. This plan works nicely and has the merit of not disfiguring the front of the shelves, as the holes can not be seen, also leaves all the space on the front for labeling if desired.

Orono, Maine. F. L. HARVEY.

Dr. Edward Palmer.

Dr. Edward Palmer has just returned from Guadalajara, Mexico, where he has made a large and valuable collection of plants, which he will proceed to distribute among his patrons as soon as possible. He has also collected seeds of economic plants which he believes will be of value for cultivation in the arid districts of Texas, New Mexico and Arizona.

Washington, D. C. GEORGE VASEY.

CURRENT LITERATURE.

House Plants as Sanitary Agents; or, the relation of growing vegetation to health and disease, comprising also a consideration of the subject of practical floriculture, and of the sanitary influences of forests and plantations. By J. M. Anders, M. D., Ph. D., etc. Philadelphia: J. B. Lippincott Co., 1887. 12°, pp. 334.

Dr. Anders is already known to many of our readers, through his papers on this subject in the *American Naturalist* and elsewhere. The present book is an amplification (we had almost said a diffusion) of those papers, with suitable changes and additions. The theses of the book are that house plants act as sanitary agents by (1) adding moisture to the air by transpiration; (2) producing ozone; (3) by their positive therapeutic value in certain diseases; (4) by their appeal to the æsthetic side of our nature. The latter claim no one will dispute. But it is not clear that house plants materially affect the quantity of ozone in the dwelling, nor do the experiments of the author at all demonstrate this. Indeed they seem to be rather indefinite, and read too much like experiments carried on to prove a previously assumed theory. Equally questionable also is the therapeutic value of ordinary house plants. The conclusions from the facts are not necessary ones, because of the innumerable opportunities for the action of other causes. It is well known how difficult it is to determine the therapeutic value of a substance administered directly; how much more to determine the value of one factor in a patient's environment!

We may concede the value of house plants in increasing the percentage of moisture in the air of a room, but it is questionable whether the effect of forests is appreciable in this direction. Indeed the whole question of the influence of forests on climate must be considered as yet problematical. Throughout the book the author has shown himself possessed by his subject, and he has ransacked every nook and corner to find support for his main idea. The reader must, therefore, estimate for himself the relative values of the authorities quoted, and must take with a grain of allowance many of the deductions.

Aside from slack proof-reading, the book is well manufactured.

Zur Systematik der Torfmoose, von Dr. Julius Röll in Darmstadt. Separat-Abdruck aus *Flora,* 1885, 1886. 8°. pp. 108.

We have already noticed the publication of this work as it appeared in *Flora* (see this journal, 1886, p. 127). It now appears as a reprint in pamphlet form, and unfortunately re-paged. We shall, in the next number, describe the original paging, so that those who have occasion to quote from it may not be confused by this alteration.

The author first establishes what can hardly be controverted, viz the great variability of the characters used for specific distinctions, and insists that the peat-mosses (Sphagna) do not show either constant species or typical forms, the intermediate forms being of equal value with the so-called typical forms. Instead of the present so called species, he would therefore establish "form-series" (*Formenreihen*), which should be distinguished by the most easily recognizable characteristics. Since these distinctions between form-series would be at best conventional, he thinks they should be settled by a committee of sphagnologists.

The bulk of the paper is made up of the description and arrangement of such form-series as seem to him best characterized. Almost an infinite number of forms are recognized and described. For example: under *Sphagnum acutifolium* Ehrh. (*in part!*) are placed *twelve varieties and thirty-seven forms!* Now as a matter of biological research this is all very well, and it certainly shows exhaustive study on the part of the author, not only in the closet but in the field. But as a practical system of classification we can not see that it is a marked improvement upon previous works. Every systematist surely regards his species as a series of forms more closely related to each other than to those of another form-series. But few would hold that these forms are sufficiently fixed or permanent to be worth describing, and still fewer will believe that they are definite enough to be recognizable by others. And this last is the sole object of descriptive botany!

Catalogue of Canadian Plants. Part III.—Apetalæ. John Macoun, Dominion Botanist. Geol. and Nat. Hist. Survey of Canada.

This part completes the exogens and the first volume of this fine catalogue. The Gymnosperms are in their proper place, and the genus Salix (of which there is, of course, a large display of species) shows the help of Mr. Bebb, as do all the rest of the Apetalæ the assistance of Dr. Gray and Mr. Watson. A large portion of this part is taken up with additions and corrections to former parts, and a complete index places this volume in a most compact shape for use. Prof. Macoun is to be congratulated upon so successful a conclusion, and has the wishes of American botanists that the second volume may not be long delayed.

Die Formen der Bakterien und ihre Beziehungen zu den Gattungen und Arten. Von Dr. Ferdinand Hueppe. Wiesbaden: C. W. Kreidel. 1886. 8°. pp. 152. Illustrated.

It is as essential in bacteriology, as in other departments of natural science, to possess a solid morphological basis in order to accurately interpret physiological and biological data. So much study is at present devoted to questions of great pathological moment that utilitarian and scientific interests alike suffer for want of well established fundamental conceptions of the morphology of bacteria. In this work treating of "forms of bacteria and their relation to genera and species," the author proposes to suppy the need, so far as present information permits.

The work is dedicated to Drs. Ferdinand Cohn and Anton DeBary, and historically is mainly concerned with the growth of bacterial concepts from the time of Cohn's *Untersuchungen* to DeBary's *Vorlesungen*, 1872 to 1886. A few words are given to the early history of the subject, beginning with Leeuwenhoek, the discoverer of bacteria (1675), after which the epoch-making classification of Cohn (1872) ushers in the discussion of the comparative value of natural-history species, form species and physiological species.

The readiness with which certain bacteria pass from one form to another early attracted attention, and shook the belief in specific distinctions, raising the question, if various forms were not simply phenomena of growth, and if all bacteria should not be relegated to a single species or genus. The subsequent idea of monomorphic and pleomorphic forms led to expansion of the bacterial concept, and reinstated the idea of the existence of genuine species. Variability, the modifications due to change of function and of food supply, the significance of zoöglœa, the several classes of growth-forms, and the formation and germination of spores, successively receive attention, followed by a classification of genera on the basis of fructification, and a discussion of the phylogenetic relationship of bacteria.

Such in brief is the outline of the work. Only a consultation of the work itself, however, can adequately reveal the full yet careful handling which the subject has received. It is an excellent treatise, and will prove a welcome one to a wide circle of readers and students.

NOTES AND NEWS.

TSUGA CAROLINIANA Eng. is figured in *Gardeners' Chronicle*, December 18, 1886.

MR. MATSUMURA, professor of botany in the Imperial University of Japan, is a pupil of Dr. Sachs.

WE ARE ABLE to give, in the present number, a short account of Dr. Wigand as a botanist and teacher, from the pen of one of his pupils.

DR. T. J. W. BURGESS has published in a quarto pamphlet of 10 pages (reprinted from Trans. Roy. Soc. Canada), recent additions to Canadian Filicineæ.

A NEW WORK on the "Fresh-water Algæ of the United States," by Rev. Francis Wolle, is in press. It will contain 150 plates, with over 2,000 figures.

THE CELERY FUNGUS (Puccinia bullata), during this last autumn, has been very prevalent in parts of England, in some cases every plant in a market garden being swept off by it.

DR. CHAS. E. BESSEY describes (*Am. Nat.*, Dec., 1886,) Psoralea tenuiflora as "another tumble-weed," occupying "ditches by the side of the railway," in S. Nebraska, in great masses.

DR. PAUL MORTHIER, of Neuchâtel, Switzerland, is dead. He was the founder of the Swiss Botanical Society, and has had the honor of being remembered in a familiar genus of fungi.

PROFESSOR RODOLFO LANCIANIA, of Rome, delivers a course of lectures on Roman archæology at the Johns Hopkins University during January, the second one of which is devoted to the flora and parks of ancient Rome.

THE FACT that some ovaries swell and ripen without ripening seed finds an explanation in the suggestion that the pollen-tube lives as a parasite upon the cells of the style, and so causes an extra flow of nourishment.

H. N. RIDLEY has concluded his list, in the *Journal of Botany*, of the monocotyledonous plants of New Guinea, collected by Mr. H. O. Forbes. New species abound, interesting among which are two new palms, and two new screw pines.

THE ENGLISH fungus forays for 1886 proved less successful than usual, owing to a scarcity of fungi and unpropitious weather. The Essex Field Club appears to have done the best, although the two days' search had to be made under umbrellas.

DRUGS AND MEDICINES for September, No. 2 of Vol. 2, has recently appeared, and, as heretofore, is a mine of botanical and medical information. The last part of the article on Magnolia, the first on Lobelia, and all on Asimina, fill up the number.

DR. H. G. BEYER, U S. N., has been verifying and extending the researches of Hueppe and Lister on the microbe of lactic acid fermentation, which he thinks has to do with the souring of milk, while Laurent of Belgium has been studying the microbe of bread fermentation, called Bacillus panificus.

THE AMERICAN (formerly Michigan) Horticulturist has been merged into the *Popular Gardening*. Under the editorship of Mr. Charles W. Garfield, the eminent horticulturist, it was a valuable journal, giving promise of future growth and usefulness, and his dismissal was a calamity from which it did not recover.

In *Gardeners' Chronicle* for Dec. 11 (1886), Abies Lowiana is figured and described. In Bot. Calif. ii. 118, it is included under A. concolor. Prof. Sargent suggests that A. grandis may be but one variable species, including the typical or coast form, the Californian form (A. Lowiana), and the Utah and Colorado form (A. concolor).

WE ARE SORRY to learn that, by a fire in a Chicago bindery, Dr. L. M. Underwood has lost all the remaining copies of the second edition of his "Our Native Ferns." As all the bound copies have been sold, the book is now out of print. We hope that the demand for this excellent work will encourage the author to prepare a third edition.

DR. ALFRED R. WALLACE, who shares the honor with Charles Darwin of originating the theory of natural selection, recently delivered four lectures at the Peabody Institute at Baltimore, on the theory of development and the origin and uses of color in animals and plants, part of the fourth lecture being devoted especially to plants.

IN A PAPER read at the recent Potato Tercentenary Conference, published in *Gardeners' Chronicle*, Dr. J. G. Baker states that the five distinct species of Solanum which are tuber-bearing, are all natives of America. Two of them (S. tuberosum and S. Jamesii) are from our Rocky Mountain region, the first extending into S. America, two (S. cardiophyllum and S. oxycarpum) are Mexican, the remaining one (S. Commersoni) South American.

THE FIRST annual report of the forest commission of New York for 1885, published a short time since, contains, besides other valuable matter, an appendix giving a list of works on forestry to be found in ten of the chief libraries of the country, covering thirty-six pages, and nearly a hundred and fifty additional titles of magazine articles.

DR. BESSEY calls attention to the fact that the roughness of certain uredospores can only be seen when mounted dry. His attention was called to the fact by a student's difficulty in seeing the prickly wall of the uredospores of Puccinia coronata when mounted in water. When mounted dry the prickles appeared with great distinctness.

TWO LARGE American walnuts (Juglans nigra) are growing near London, according to a correspondent of the *Gardeners' Chronicle*, which measure 129 inches each in circumference, at four feet from the ground, and remain nearly the same size for fully fifteen feet upward, the total height of the trees being between 90 and 100 feet. This exceeds the size of this species mentioned in Michaux's Sylva.

THE MADAGASCAR lattice-leaf, Ouvirandra fenestralis, grows and flowers at Kew, with leaves nearly a foot long. A plant in the conservatory of Cornell University has leaves about half as long, but it is found difficult to keep them sufficiently free from unicellular algæ and fine sediment for healthy growth. The plant, besides being rare and beautiful, is morphologically interesting on account of its perforated leaves.

MR. C. E. BROOME, F. L. S., an associate of the Rev. M. J. Berkeley in cryptogamic studies, and a careful observer of English fungi, died November last, aged 74 years. The record of his scientific work in the publication of new species, conjointly with Mr. Berkeley, began in 1848, in the *Annals of Natural History*, and continued in that journal and *Grevillea* till near the time of his death. Although a man of admirable parts, his retiring disposition kept him a stranger to all but immediate neighbors and associates.

MR. F. H. KNOWLTON has distributed, as a reprint from the Proc. Biol. Soc. of Washington (D. C.), Vol. III, additions to the flora of Washington and vicinity, as supplementary to Ward's "Guide to the Flora of Washington and vicinity." It is divided into six parts, as follows: 1. List of vascular plants added, numbering 35 species, besides 4 hybrid oaks; 2. Revision of the Musci and Hepaticæ, by Rev. E. Lehnert; 3. List of lichens, by the same author; 4. Changes in nomenclature; 5. New localities for rare species; 6. Species excluded, 4 in number.

A VERY INTERESTING PAPER by Prof. C. S. Sargent, in the *American Journal of Science* for December (1886), gives some account of the journey of André Michaux to the high mountains of Carolina, in December, 1788. This journey was to collect living plants of Magnolia cordata, a species which no botanist of the present century has discovered in a wild state. From Prof. Sargent's investigations it seems certain that Michaux's M. cordata, as known in gardens, is a rare and local variety of M. acuminata, and as such Prof. Sargent describes it. Tracing Michaux's journey in search of this form, the rare Shortia galacifolia was rediscovered, undoubtedly referred to by Michaux as "*Arbuste*," with "*f. denticulées*." In a note appended to Prof. Sargent's paper, Dr. Gray announces the rediscovery of Shortia at another station in the vicinity, where there were "rods covered with it." It looks as if this rarest of plants is at last found in sufficient abundance to insure its continuance, as well as to enable botanists to obtain specimens of it at a reasonable expense.

VOL. XII. NO. 2.—BOTANICAL GAZETTE.—FEB., 1887.

A Revision of the North American Species of Fissidens.*—II.

CHARLES R. BARNES.

12. F. polypodioides HEDWIG: Musc. Frond. 3. 63. t. 27.

Hypnum polypodioides SWARTZ: Prod. 140.

Fissidens polypodioides HEDWIG: Musc. Frond. 3. 63. t. 27.—Sp. Musc. 154.—BRIDEL: Musc. Recent. II. 1. 141.—Sp. Musc. 1. 168.—Mant. Musc. 189.—Bry. Univ. 2. 69 —BEAUVOIR: Prod. 57.—SCHWÆGRICHEN: Suppl. I. 2. 8.—MUELLER: Syn. Musc. 1. 52.—SULLIVANT: Mosses U. S. 25.—Proc. Amer. Acad. 5. 273.—Icon. Musc. 42. t. 27.—LESQ. & JAMES: Man. 88.—MITTEN: Jour. Linn. Soc. 21. 559.

COLL.: DRUMMOND: Musci Amer. II. no. 38.—SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 87.—2 ed. no. 110.

Dicranum polypodioides SWARTZ: Fl. Ind. Occ. 3. 1772.

Skitophyllum polypodioides DE LA PYLAIE: Desv. Jour. Bot. 6. 153. t. 38. f. 10.[1]

Plants large, 2–5 cm., gregarious, yellowish-green: stems simple, rigid, rooting at base only, which is nearly bare: leaves numerous, scarcely imbricate, lance-oblong to linear-oblong, obtuse, entire or sub-denticulate near apex; border none; costa strong, barely reaching the apex; vaginant lamina $\frac{1}{2}$–$\frac{2}{3}$ length; inferior lamina not narrowed, not at all or slightly decurrent, cells large, 16–24 μ, roundish, pellucid: flowers dioicous; the male in the lower axils; the female in the upper axils; archegonia numerous, without paraphyses: fruit sub-terminal; seta short, 1 cm. long, flexuous, reddish; capsule brown, obconic, much contracted under the large mouth when dry; teeth broad and long; operculum and thick sub-oblique beak equaling one half the length of capsule; annulus large, revoluble.

HAB.: Moist rocks: Louisiana (*Drummond*); Georgia (*Lesquereux*), sterile; West Florida (*Chapman*); Cuba (*Wright*).

13. F. subbasilaris HEDWIG: Sp. Musc. 155; t. 39. ff. 6–9.

MICHAUX: Fl. Bor. Am. 2. 299.—BRIDEL: Sp. Musc. 1. 169.—Mant. Musc. 189.—Bry. Univ. 2. 694.—SCHWÆGRICHEN: Suppl. I. 2. 10.—HAMPE: Linnæa 13. 45.—SULLIVANT: Mosses U. S. 25.—Icon. Musc. 41, t. 26.—MUELLER: Syn. Musc. 1. 50.—LESQ. & JAMES. Man. 88.—MITTEN: Jour. Linn. Soc. 21. 560.

COLL.: DRUMMOND: Musci Amer. I. no. 111.—II. no. 42.—SULLIVANT: Musci All. no. 184.—SULLIVANT and LESQUEREUX: Musci Bor. Am. 1 ed. no. 84.—2 ed. no. 107.—AUSTIN: Musci App. no. 105.

Skitophyllum subbasilare DE LA PYLAIE: Desv. Jour. Bot. 6. 168. t. 38. f. 11.

Plants small, 1–2 cm. high, densely and widely cespitose, green above, brown and tomentose below: stems simple or branched, erect: leaves 12–15 pairs, crisped when dry, oblong, obtuse with a single pointed cell at the apex, minutely crenate below, minutely and irregularly serrate above; border none; costa vanishing below the apex; vagi-

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*Read before the A. A. A. S., Buffalo meeting, August, 1886.

[1]Frequent mistakes are made in citing these plates. They are correctly numbered, but by a typographical error incorrectly referred to by De la Pylaie. There is also confusion in the paging of this monograph.

nant lamina ⅗–⅘ length; inferior lamina not tapering, ceasing before or at the base; cells small, 10–14 μ, roundish, densely chlorophyllose and very obscure: flowers dioicous?; female only known, arising near the base of the stem, rooting: fruit subbasal; seta short, equaling or somewhat exceeding the stems; capsule pale, cylindric-oval, erect, or slightly curved; conic operculum with its beak equaling half the capsule; calyptra slender, cucullate; spores 18–22 μ.

HAB.: On trees and rocks: Canada and states east of Mississippi river; St. Louis, Mo. (*Drummond*).

14. **F. taxifolius** HEDWIG: Sp. Musc. 135. t. 39.

BRAITHWAITE: Br. Moss-Fl. 1. 77. t. 12 A.—RICHARDSON: Append. 27.—SULLIVANT: Mosses U. S. 25.—JAMES: Trans. Am. Phil. Soc. 13. 109.—LESQ. & JAMES: Man. 87.—MITTEN: Jour. Linn. Soc. 21. 558.

COLL.: SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 83.—2 ed. no. 106.—AUSTIN: Musci App. no. 107.

Plants of moderate size, 1–3 cm. high, gregarious, dark green: stems fasciculate-branched at base, branches ascending or decumbent, radiculose: leaves numerous, closely approximate, sometimes slightly imbricate, crisped and incurved when dry, largest above the middle and decreasing toward the apex of stems, oblong-lanceolate, minutely serrulate, marginal cells often pellucid; border none; costa excurrent, broadening to form a strong mucro; vaginant lamina ½–⅗ length; inferior lamina slightly narrowed to the base, not decurrent; cells hexagonal, 12–16 μ: flowers monoicous: male basal, on short rooting branches, antheridia 2 or 3, without paraphyses; female basal, axillary: fruit basal; seta 1–2 cm. long, flexuous, reddish-yellow; capsule oblong, thick, sub-turgid, cernuous, or when empty pendent and contracted below the mouth, dark brown; operculum with a long slender beak commonly bent near the base; calyptra cucullate; spores 18–22 μ.

HAB.: Shaded clayey ground: Canada and states east of Mississippi river; southern Missouri (*Engelmann*).

15. **F. Floridanus** LESQ. & JAMES: Proc. Amer. Acad. 14. 137.

Manual 83.—MITTEN: Jour. Linn. Soc. 21. 556.

Plants 1-3 cm. high, brown below, bright green above: stems sparingly branched from the base: leaves densely crowded, the upper larger, long cultriform; apex minutely erose-denticulate, otherwise entire; border broad, pale; costa strong, vanishing a little below the apex; vaginant lamina more than ½ length; inferior lamina ceasing abruptly at the base; cells minute, hexagonal: flowers monoicous; the male terminal on somewhat elongated lateral branches; the female axillary near the middle of the stem: fruit on a short branch rooting at base, single (rarely two from the same stem); seta 10–15 mm. long, thick, reddish; capsule oblong-oval, cernuous; operculum large, long-beaked.

HAB.: Florida (*Garber*).

16. F. decipiens De Notaris: Epil. Bry. Ital. 479.

Braithwaite: Br. Moss-Fl. 1. 76. t. 11 D.—Lesq. & James: Manual 87.
F. adiantoides Mitten: Jour. Linn. Soc. 21. 559, *not Hedwig!*
Coll: Drummond: Musci Amer. I. no. 110.—II. no. 41, as var. *marginatus* of the next.—Sullivant: Musci All. no. 178.—Sull. & Lesq.: Musci Bor. Am. 1 ed. no. 85.

Plants of medium size, 1–3 cm. high, dusky green, gregarious: stems simple or branched at base: leaves as in *F. adiantoides* but closely imbricate; border 4 or 5 cells wide, usually very distinct, pellucid; cells small and indistinct, 8–12×8–16 μ: flowers dioicous, on plants in different tufts; the male axillary, gemmiform; female terminal: fruit as in *F. adiantoides*, but seta short, not much exceeding the stems, and spores 16-24 μ, mostly 20 μ.

Hab.: On sandy soil and rocks; common in Canada and the Eastern States: Columbia river (*Drummond*).

17. F. adiantoides Hedwig: Musc. Frond. 3. 61. t. 26.

Braithwaite: Br. Moss-Fl. 1. 78. t. 12 B.—Mitten: Jour. Linn. Soc. 8. 29.—Lesquereux: Mem. Cal. Acad. 1. 8.—Lesq. & James: Man. 88.
Coll: Austin: Musci App. no. 106.
F. majus Mitten: Jour. Linn. Soc. 21. 559.

Plants medium or large, 2–10 cm. high, gregarious: stems erect, branching above or below, branches rooting: leaves numerous, imbricate at base, oblong-lanceolate, abruptly acuminate, minutely and regularly serrulate, becoming irregularly serrate with large and small teeth towards the apex; border none (var. *immarginatus*) or of two or three rows of thick-walled, more or less pellucid cells; vaginant lamina ½ length or more; inferior lamina reaching the base; vertical lamina crisped at tip when dry; cells large, roundish-hexagonal, distinct, 16–20 μ, 24–32 μ in sterile shoots: flowers monoicous, short-stalked near the middle of stems; the male gemmiform, below the female: fruits median, 1- several on the same stem; seta 1–2.5 cm. long, yellowish-red, flexuous; capsule oblong, yellowish or dark red, much narrowed under the orifice when empty; operculum and long more or less oblique beak equaling the capsule; spores 22–24 μ.

Hab.: Shady, moist places; common in Canada and Eastern States; Fort Colville (*Lyall*); California.

18. F. grandifrons Bridel: Sp. Musc. 1. 170.

Bridel: Mant. Musc. 191.—Schwægrichen: Suppl. I. 2. 11.—Bruch & Schimper: Bry. Eu. Fiss. Monog. 11. t. 106.—Sullivant: Mosses of U. S. 25.—Mueller: Syn. Musc. 1. 46.—Schimper: Syn. Musc. 1 ed. 110.—2 ed. 121.—Lesquereux: Mem. Cal. Acad. 1. 8.—Bolander: Cat. 37.—Watson: Bot. Calif. 2. 374.—Mitten: Jour. Linn. Soc. 8. 29.—l. c. 21. 559.—Lesq. & James: Man. 89.
Coll: Sullivant: Musci All. no. 186.—Sull. & Lesq.: Musci Bor. Am. 1 ed. no. 88.—2 ed. no. 111.—Austin: Musci App. Suppl. no. 483.
Skitophyllum congestum De la Pylaie: Desv. Jour. Bot. 6. 164. t. 39. f. 16.
[*Fissidens subgrandifrons* Mueller: Bot. Zeit. 22. 359.
Fissidens insignis Schimper (*in herb.* Hampe): Bot. Zeit. l. c.
Fissidens strictus Schimper.—*Fide* Mitten: Jour. Linn. Soc. 21. 559.]

Plants of variable size, but usually very large, 3-15 cm. high, dark green, gregarious or cespitulose: stems pale, fasciculately branched at base, branches simple or again branched, rigid: leaves numerous, all equal, thick, rigid, linear-lanceolate, entire; border none; costa thick, pellucid, vanishing just within the apex; vaginant lamina more than ½ length; inferior lamina not narrowed; cells in several layers, small, 12-16 μ: flowers axillary; archegonia numerous: fruit lateral, from the upper axils; seta long; capsule erect or oblique, oblong, dark red-brown; teeth inserted far within the edge, deeply cleft, very broad at the irregular and sparsely perforate base, closely articulate, the divisions subulate, rough; operculum conic rostrate, beak short, often oblique; spores somewhat oval, 20-28×28-32 μ.

HAB.: On submerged or wet rocks: New York, Chittenango Falls (*Barron*), Syracuse (*Rust, Cook*), Caledonia creek (*Clinton*), Niagara Falls; Owen Sound, Canada (*Macoun, Roy*); Ohio (*Sullivant*); Illinois (*Wolf, Brendel*); south eastern Missouri (*Wolf*); Ruby Valley, Nevada (*Watson*); California (*Bigelow, Bolander, Roy*).

19. F. Julianus SCHIMPER: Flora 21. 271.

MUELLER: Syn. Musc. 1. 44.—MITTEN: Jour. Linn. Soc. 21. 560.
Fontinalis Juliana SAVI: Fl. Pis. 2. 114.[1]—DE CANDOLLE: Fl. Franç. 6. 236.—POLLICH Fl. Veron. 3. 385.—DUBY: Bot. Gall. 554.
Skitophyllum fontanum DE LA PYLAIE: Desv. Jour. Bot. 6. 158. t. 34. 2.
Octodiceras Julianum BRIDEL: Bry. Univ. 2. 678.—BRUCH & SCHIMPER: Bry. Eu. Oct. Monog. 4. t. 108.
Conomitrium Julianum MONTAGNE: Ann. Sci. Nat. II. 8. 246. t. 4.—MUELLER: Syn. Musc. 2. 524.—SCHIMPER: Bry. Eu. Corol. 22.—Syn. Musc. 1 ed. 111.—2 ed. 122.—SULLIVANT: Mosses U. S. 25.—PECK: 19th Rept. 46.—LESQ. & JAMES: Man. 89.
COLL.: SULL. & LESQ.: Musci Bor. Am. 1 ed. no. 89.—2 ed. no. 112.—AUSTIN: Musc App. no. 187.
Fissidens Dillenii HAMPE: Linnæa 13. 45.

Plants large, slender, 5-15 cm. long, floating, the older parts blackish-green: stems filiform, branching by innovations along their whole length: leaves numerous, remote, linear-lanceolate, entire; border none; costa vanishing at some distance from the apex; vaginant lamina ½ length; inferior lamina not reaching the base; cells irregular, hexagonal, inclining to quadrate below, 16-20×20-32 μ: flowers monoicous, terminating very short axillary branches; the male sometimes clustered, antheridia 2-3; the female rarely on elongated branches, archegonia 3-5, vertical lamina of perichætial leaves ceasing just below apex of vaginant lamina: fruit cladogenous, often numerous; seta shorter than the capsule, fragile at base, pale; capsule elliptical, pale, red at mouth; teeth short, premorse, irregularly cleft and perforate above the middle, yellowish, pellucid; operculum conic-rostrate, together with its blunt beak equaling the capsule; calyptra conic, nearly black, cleft or erose at base, covering only the beak; spores 20-24 μ.

[1] This reference I have not been able to verify. The page is quoted by De Candolle as 414.

HAB.: On wood and stones in streams and swamps: Rhode Island (*Bennett*); Hampden, Conn. (*Eaton*); Shawangunk Mts., N. Y., Northern N. J. (*Austin*); Smoke's creek, N. Y. (*Clinton*); Columbus, O. (*Sullivant*); Santee Canal, S. C. (*Ravenel*); Savannah river (*Beyrich*); Roseville, Fla. (*Austin*); Rocky Mts. and California (*Hall*).

20. F. Hallianus MITTEN: Jour. Linn. Soc. 21. 560.

Conomitrium Hallianum SULL. & LESQ.: Austin's Musci App. no. 108.—SULLIVANT: Icon. Musc. Suppl. 43. t. 28.—LESQ. & JAMES: Man. 90.

Plants small, slender, 1–3 cm. long, in small, dirty-green tufts: stems filiform, fasciculately branched at base: leaves remote, numerous, narrowly linear-lanceolate; inferior lamina descending almost or quite to the base; cells 16–24 μ; otherwise as in the preceding: flowers monoicous, terminal on rather elongated, leafy branches: fruit cladogenous: seta once and a half or twice as long as the capsule, pale; capsule oblong-elliptical, pale; teeth undivided, lance-subulate, reddish; distantly articulate, papillose, inserted below the edge; operculum conic-rostrate, together with its acute beak shorter than the capsule; calyptra cucullate, covering entire operculum; spores 18–24 μ.

HAB.: On wood and stones in swamps and rivulets, places wet by spray, and old wells: Athens, Ills. (*Hall*); Little Falls and Ogdensburgh, N. J., and Herkimer county, N. Y. (*Austin*); Caloosa, Fla. (*J. Donnell Smith*).

REMARKS.

F. bryoides.—The teeth in this species and its congeners are somewhat spirally roughened above. The stems bearing their first fruit do not bear any male flowers: at the second fruiting the male flowers are abundant in the axils of the older leaves.

F. bryoides, var. **cæspitans**.—I have seen no American specimens of this variety.[1] The rufous purple rhizoids and pale color are its most striking characters. These differences, together with the robust habit, are just such as we should expect on transferring the species to wet places, and do not seem to me sufficient basis for the new species proposed by Mitten.

F. Closteri.—"The plants are always surrounded by brown patches of protonema, the color of which and general appearance is characteristic."—Austin, *fide* E. A. Rau *in lit.*[2]

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[1] Mr. Allen writes: "We collected it (with very immature fruit) on the stream which comes down from Boott's spur, * * * just south of the stream from Tuckerman's Ravine." The specimens sent to James can not now be found in his herbarium, nor can Prof. O. D. Allen find his own.

[2] ERRATUM.—Page 5, line 4: for "on the ground" read *on rocks along rivulets*.—E. A. RAU.

F. incurvus.—Braithwaite cites "Starke MSS." as authority for this name. But Schwægrichen first *published* it in 1811. From his plate, which has in this part no explanatory text, Röhling took up the name in Deutschl. Fl. 3. 76 (1813). The papillæ of the teeth in F. incurvus and its allies are not arranged spirally as in the bryoides group, but are irregularly distributed.

This species has two distinct forms which differ chiefly in the capsule. The typical form has an arcuate capsule, while the f. *erectus* has the capsule erect. The latter is especially abundant in the James herb. from all parts of the middle Atlantic States. The variety *minutulus*, in its typical form, is readily distinguished by its small size and narrow, wavy-edged leaves. It passes insensibly however on the one hand into the variety *exiguus*, and on the other into true *incurvus*. The inflorescence in the whole group is variable and can not be depended upon for specific distinctions.[1] In specimens of *minutulus* from Oakland, Md., I have found the old plants innovating from the upper axils. These innovations are the male and female stems, and arise side by side from the same point with their rhizoids interlaced. In other specimens the male was found attached to the female exactly as in typical *incurvus*. In some of these specimens the leaves are margined, in others they are immarginate, and in others still some leaves are margined, and some not, apparently as it happened.

F. Garberi.—I have examined many flowers of this species, but have found none with antheridia. I therefore alter the description of the flowers to conform to Austin's investigations and my own.

F. Donnellii.—This plant has been collected but once, without capsules, and ought probably to be referred to *F. subcrenatus* of Schimper, a Mexican species, from which its known characters differ only by the less number (by one pair) and greater narrowness of the leaves. The larger cells and the distinct serration of the leaves are obvious distinctions from F. Garberi, to which it is closely allied.

F. obtusifolius.[2]—"Specimens from Texas appear to be pseudo-monoicous, *i. e.*, a branch with a terminal male flower is at first attached to the female stem, and afterward becomes independent, rooting at base."—*Mss. note in herb. Sullivant.*

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[1]Cf. Braithwaite: Br. Moss-Fl. i. 66.

[2]To habitat on page 7 add: Colorado (*Brandegee*) *fide* Rau.

F. rufulus.—The upper leaves are usually much abraded; of some, the thick borders and costa alone remain.

F. Floridanus.—This species has been severely criticized by Austin,[1] and no specimens of it are extant in this country.

F. decipiens and **F. adiantoides.**—I can not agree with Mitten[2] in changing the application of Hedwig's name. The characters which distinguish *adiantoides* from *decipiens* are stature, size of leaf-cells, character of leaf-border, monoicism and habitat. Of these Hedwig mentions but one, and that one about which it was easy to be mistaken by reason of the scarcity of male flowers. If indeed he had both specimens he merely confused them (as many subsequent writers did), as is shown by his citing Dillenian and Linnæan figures and descriptions of the palustral species under his description, "*fœmineus itidem alaris proprii individui.*" As the only Hedwigian character is somewhat in doubt, it seems unwise and unnecessary to introduce confusion by transferring Hedwig's name from a plant with which it has been associated for a century to a plant which it is possible, but not proved, that he meant.

F. grandifrons.—The description of the fruit is supplied from Himalayan specimens collected by Falconer.

DOUBTFUL OR EXCLUDED SPECIES.

F. impar Mitten: Jour. Linn. Soc. 21. 554.—*F. bryoides* Drummond: Musci Am. No. 113 in part.

"Similar to small F. bryoides, but with more oblong leaves, having shorter and wider points, the inferior edge of the vertical lamina not continued to the base, mostly only half way; limb very narrow or almost obsolete on the vertical lamina; capsule oval or oblong; male flowers bud-like, very minute.

"Canada, Prof. Macoun."

I have examined this plant in Drummond's collection, in which it is recognizable. I have not been able to find it, however, in collections kindly loaned by Prof. Macoun. It seems to me to be only depauperate F. bryoides.

F. inconstans Schimper.—This form seems to be a mere sport of F. incurvus, dependent on the decaying or not of the older stems. To the latter species it is reduced.

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[1]Bull. Torr. Bot. Club, vii. 6.

[2]Jour. Linn. Soc. xxi. 559.

F. synoicus Sullivant: Mosses U. S. p. 103.—Referred by Lesquereux and James to F. inconstans, must be reduced to F. incurvus. The variability of the inflorescence seems to be only a sport as in F. inconstans. It is nearest the var. minutulus.

F. Hallii Austin: Bot. Gaz. 2. 97.—Lesq. and James: Man. 85.—Mitten: Jour. Linn. Soc. 21. 558.

"Size and facies of F. incurvus, from which it is distinguished by the crenulate leaves without a border, the (always?) longer-beaked operculum, the calyptra not cleft and descending scarcely to the base of the beak, etc.—Capsule erect, pedicel moderately long, inflorescence dioicous, plants of both sexes growing together.—Texas, *Hall*."

The above characters are, in the *incurvus* group, wholly insufficient. The scanty diagnosis does not permit it to be referred with certainty to any species. It is probably F. incurvus, var. exiguus. In case it proves, on further collection, to be a good species, it should be called *F. Austini*, as the present name is too near F. Hallianus.

F. Texanus Lesquereux: Lesq. & James Man. 86.—Mitten: Jour. Linn. Soc. 21. 556.

"Plants dark green, turning to black: leaves 5–7 pairs, curved at the apex, broadly lanceolate-acuminate, with a thick dark smooth margin ascending to the apex or to near the slightly serrulate point: costa stout, percurrent or excurrent into a short mucro; dorsal lamina broad, descending to the base: male and female plants similar: capsule long-pedicellate, oval, inclined, rarely erect, greenish brown, smooth: lid conical, short-beaked, subincurved.—Herb. Sulliv. 1850. Texas (*Wright*)."

Neither MSS. nor specimens can now be found in the Sullivant herbarium, and the meager description indicates too close affinity with F. incurvus, and it can hardly be doubted that it is referable to this polymorphous species. The remark of Lesq. & James that "it differs from F. Hallii merely in the entire margined leaves" also indicates that it is not a true species.

F. crassipes Wilson.—No American specimens are known.

Flora near Santa Barbara, Cal.

MRS. R. F. BINGHAM.

The vicinity of Santa Barbara, California, is one of the most favored for botanizing, for although we seldom have rain from May to November, there is no time in the year when a search will not be rewarded by something of interest.

An enthusiastic collector can, in a very short time, pick up a goodly number of plants, along the roadside, in the mountain cañons, on the hills and mountains, on the banks of streams, in the dry beds of streams (after the rains are over), in swamps, on the cliffs, and in the sand near the sea, in still water, and in the ocean.

Not only are flowering plants abundant, but many cryptogams can be obtained. Several beautiful ferns are natives here. During the rainy season many species of mosses can be collected, and a few can be found in favorable locations all the year.

Fresh-water algæ can be found in our streams, and this part of the coast is noted for the abundance and beauty of marine algæ, upon which are many forms of diatoms. Those who are interested in lichens and fungi need have no trouble in finding them.

As the result of several years botanizing here (the greater part of which was done in the years 1877, 1878 and 1882), I have collected about 500 species of phanerogams, twenty species of Musci, over 100 of marine algæ, several parasitic fungi, besides ferns, equisetums, Selaginella, Chara, Azolla, Marsilia, and some other cryptogams.

If a person wishes to know the flora of even a limited area, it must be visited often during the year, and for more than one year. The flora changes with the season; while there are many perennials that are always in bloom, there are many plants that bloom and disappear, or cease blooming, and others take their places, so that several species of plants may occupy the same ground during the same year.

Plants that are abundant one year do not always appear the next year, or in succeeding years. This fact may be one reason why botanists visiting a certain locality, may find plants that some previous or succeeding visitor has failed to find.

Each plant seems to know its own season for appearing.

I have often noticed that when the rains were late, many species which can be found when we have early rains do not appear at all, and some later plants do not appear when we have only early rains.

During the present year we had both early and late rains in large quantity, and it has been very favorable for botanizing. Not since 1874 has the flora been so abundant and so perfect. I have found several species in large quantity that I had not seen, except occasional specimens, since 1878. In some places that I had looked over pretty thoroughly in previous years, I have found plants that I had never seen before. I have added over thirty species to my collection that I had not before obtained.

Many plants have been introduced here both from semi-tropical and temperate latitudes, and several have escaped from cultivation.

Many of our native plants are beautiful and have been cultivated in gardens in this country and Europe. Many less attractive plants are nevertheless very interesting. My attention has been especially called to some plants of the order Naiadaceæ, which are found in the sea, growing upon small rocks near low tide marks. When the tides run very low these plants are uncovered, but at the time of blooming the tides are not very low in the daylight, and they can not be seen, yet the water is not deep enough to enable one to collect by means of boats. The only way to obtain it is to search carefully when it is washed ashore.

The leaves are bright green, long, very slender, and one nerved. The blossoms are diœcious, arranged in two vertical rows on the face of a spadix, which is enclosed in the dilated base of a leaf-like spathe. Within the margin, on each side, is a series of short dilated foliaceous appendages. These appendages cover the blossoms, and in the staminate plant are reflexed at maturity; in fruit the base of the nutlets is covered by the appendages.

Imperfect specimens of this plant were collected here by Dr. Torrey, and it was described under the name of Phyllospadix Torreyi, but the staminate blossoms were unknown until 1881, when I succeeded in finding both forms of the plant, and from those specimens the generic characters of the plant were established. The plant is washed ashore throughout the year, frequently in large quantities; it blooms in July and August, and the pistillate plant is sometimes abundant, the staminate blossoms are rare, and require careful search to obtain.

Although I have obtained a good many specimens, I do not know of any being found here by any one else, and I do not think it has been found in bloom elsewhere on the coast, although botanists have searched for it in many localities.

There is another species, Phyllospadix Scouleri, that was collected in imperfect specimens at Vancouver, and at the mouth of Russian river, but had never been found south of there, or indeed anywhere for several years, until this year, my husband, who is my associate in all my collecting, and without whose untiring assistance I could accomplish but little in field work, has found a specimen with pistillate blossoms. The leaves of this plant are broader than those of P. Torreyi, ribbon-like and three-nerved; the peduncles are short and with a single spathe.

Our Zostera is somewhat different from that of the Atlantic coast, the leaves nearly one-half inch wide and ten to thirteen nerved; the fruit is also larger than the eastern form. California is a land of large products, which may in some measure explain this fact; but our plant is considered a new variety by Rev. Thomas Morong, who describes it under the name Zostera marina, var. latifolia.

Strasburger's Laboratory.

DOUGLAS H. CAMPBELL.

The laboratory is not at all pretentious, and is fitted up in the plainest possible manner. In company with the zoological and palæontological laboratories, it occupies an old building known as the "Poppelsdorfer-Schloss," originally the dwelling of some dignitary or other, and not specially adapted to its present purpose. It is a large square building, enclosing a central circular court, around which a gallery, level with the second story, is built, by means of which access is had to the various rooms.

The building is finely situated at the head of a magnificent double avenue of horse-chestnuts, some half-mile in length, which forms the favorite promenade of the citizens of Bonn. Three sides of the building are included in the botanical garden, which is a very good one.

In the garden there is a very good collection of hardy plants, and besides some half-dozen green-houses and conservatories containing a large and varied collection of tender plants. Among these is a large palm-house containing some very fine examples, and a smaller circular building, in which beautiful specimens of the Victoria regia and other water-lilies were blooming when I first arrived. These have all been removed, however, to make room for other plants.

One of the smaller houses is devoted principally to orchids; the contents of the others are of a more miscellaneous character. Thus it can be seen that there is abundant material for work.

The laboratory itself consists of a series of small rooms, two of which Professor Strasburger uses as his own laboratory and study, and a large one which is occupied by the classes engaged in general work. This latter is at present closed, as the work of the more elementary classes is carried on for the most part during the summer semester.

The laboratory appliances are for the most part of a very simple description, except in the matter of reagents, of which there seems to be an endless variety; but of physiological apparatus there is very little—at least, visible.

Professor Strasburger is an extremely satisfactory teacher. There are so few of us in the laboratory at present that he has time to follow our work closely, and is always ready with helpful suggestions.

One has but to look at him to see that he is a man engrossed heart and soul in his work. He is a man of about forty-three years of age, though looking somewhat older; of medium height, very thin, and with peculiarly strongly marked aquiline features. His whole appearance is indicative of overwork.

As a lecturer he is clear and concise, but the course of lectures that I have been hearing has been chiefly, so far, on a not very interesting subject to me—methods of bacteria culture—and so I can hardly claim to have heard him at his best.

His assistant, Dr. Johow, is a much younger man, and, to judge from what I saw of his work, an able one. He spent about a year in the West Indies with Schimper, who is probably now on his way here from Brazil. I believe he is expected here about the first of January, and will give some lectures this semester.

Of course, my principal object in coming here was to get hold of some of Strasburger's methods, and as he is very obliging, and ready to give help, my hopes have been fully realized. It is one thing to read directions about making a preparation, and another to have all the steps explained minutely by one who is thoroughly versed in the subject. If anything is wrong, it is so much easier to be told where the trouble is than to have to make it out for one's self!

Some time ago I had an opportunity of examining some of Strasburger's own preparations of nuclear-division. They were from the embryo-sacs of Fritillaria and Galanthus and were stained with sopranin. It would be impossible to imagine anything more definite and clearly colored. I had not supposed it possible to fix and stain anything so perfectly. af

From what I have said, you can easily see that I feel fully repaid for coming here.

Chippeway Plant Names.

L. H. BAILEY, JR.

During a recent visit to the extreme northern portion of Minnesota, under the auspices of the Geological and Natural History Survey of that State, I had occasion to acquire some of the plant names of the Chippeways. These names were obtained from two men—Pasheton'egweb and Mimash'gawab—who could speak tolerable English. In accordance with custom in writing Indian names, I have employed *e* for the first sound of *a*. In the middle of a syllable this sound of *e* is much shortened ; *i* usually has the sound of *e; g* and *k* are interchangeable, the sound which they represent being nearly a medium between them, and often partaking also of the sound of *n*. *Ngk* often represents very nearly the sound represented by *g* or *k*. *Ans*, a pure French-like nasal with the sound of *s* retained, is a diminutive ; *min'nis*, island, *min'nisans*, little island ; *sag'ime*, mosquito, *sag'imans*, little mosquito ("sand fly").

Anibi'shan, Plantago major. This word appears to be used also to designate leaf or foliage in general.

Shin'kwag (pl. *shinkwa'kwag*), Pine. Appears to be applied to both Pinus resinosa and P. Strobus.

Wi'gob, Tilia Americana. We find *b* here has much the sound of *p*.

Wi'kwas, Betula papyracea.

Mitig'omish, Quercus macrocarpa.

Bima'tig, Vine.

Wi'kwas bima'tig, Celastrus scandens, literally "birch vine," from its frequent occurrence on the birch.

Manito' bima'tig, Ampelopsis quinquefolia, "spirit vine," from medicinal properties of its roots.

Ki'shig, Thuja occidentalis.

Mi'nan, Vaccinium berries. This word appears to be used also for berry in general. As near as I could learn, it is the plural form of the word, the singular being *wim'in*.

Wabo'so-minan, "rabbit berry," Aralia nudicaule.

Migi'si wimin, "eagle berry," Physalis grandiflora.

Asa'sa-wimin, Prunus Virginiana.

Shasha'go-minan, Cornus Canadensis.

Ote'imin (pl. *ote'iminin*), Strawberry. Evidently applied to fruit of both Fragaria Virginiana and F. vesca.

Manito'katag, "spirit root," Cicuta maculata.

Wan'pekoon, Epilobium spicatum.

Gitchik' amiwashg, Scirpus lacustris and the large Eleocharis palustris, growing in borders of lakes.

Anikawashg'ans, "little joints," Equisetum limosum, growing in lakes.

Assak'anashg, Phragmites communis.

Abakwai', Typha latifolia.

Ansis', well defined masses of Potamogetons growing in water.

Ansisi', various water weeds along the margins of lakes and rivers.

Wabizi' binawatig, Sagittaria variabilis, var. gracilis.

Wabishka biqua'kwat, "white ball," Nymphæa tuberosa.

Bigna'kwatans, "little ball," leaves of Nuphar advena and N. Kalmianum. It would seem that this name should be applied to the flowers, but repeated questioning only supported this application.

Ogito'bag, flower of Nuphar Kalmianum, and perhaps also of N. advena.

Wiken', Acorus Calamus.

Name'bin, Asarum Canadense.

Mash'gig, "mushkeg" of the settlers, a sphagnous swamp.

Mashgikwam'otash, "swamp bag or pouch," Sarracenia purpurea.

Bashginakwa'nibagon, Lycopodium complanatum, L. clavatum, and probably other lycopods.

Washashkwa'tan, Mushroom.

Kine'bigobag, Fern. *Kene'big* is snake. I could not determine the significance of the remainder of the word.

Winnisi'bag, Chimaphila umbellata.

Oshabo'minag, fruit of Ribes hirtellum.

Oshabo'minagansh, bush of Ribes hirtellum.

Mine'sag, fruit of Cratægus.

Osikwa'gomish, fruit of Amelanchier.

Osikwa'gominag, bush of same.

Tchatchamo'sikan, Achillea millefolium.

Miskwim'inag, fruit of Rubus strigosus.

Miskwim'inakash, bush of same.

Ashkashkata'minakwai, Clintonia borealis.

Bashgisikana'gominan, berries of Sambucus racemosa. Pashetonegweb told me of edible and darker colored berries of the same name, evidently the fruit of S. Canadensis, but I did not see the plant there. *Bashgisikan* is gun; *minan*, berries. The intermediate syllables I can not account for. The name refers to the practice of making pop guns from elder stems.

Babashgisikana'tig, bush of elder.

Kakagiwan'tag, Taxus Canadensis.

Pukan', Corylus rostrata.

Miskwa'bimag, Cornus stolonifera.

Osa'kitigomag, Echinospermum sp.

Ni'ga-wimmin, "goose berry," Lonicera oblongifolia.

Shi'gak-minan, "skunk berry," fruit of Ribes floridum. Mimashgawab informed me that there is a red berry of the same name, evidently the fruit of R. prostratum, which occurs there.

Mishshitch'i-minan, fruit of Ribes rubrum.

I could not find names for Lysimachia stricta, Actæa alba, Chenopodium album and hybridum, or the Ashes.

BRIEFER ARTICLES.

New form of Baptisia calycosa.—I wish to call attention to a plant in the last distribution of that excellent collector, Mr. A. H. Curtiss, of Jacksonville, Florida. It is his No. 699*, and is sent out under the name of *Baptisia calycosa* Canby. The specimens which I have seen are, however, quite different in appearance from those originally collected by Miss Reynolds and Miss Floyd in the vicinity of St. Augustine. As in most species of the genus, these were very smooth or even glaucous, the only pubescence being a sparse and often deciduous fringing of the stipules, leaves and calyx, with long white hairs. In Mr. Curtiss's specimens the stems, branches and under side of the leaves (and also their margins and midrib above) are densely covered with a spreading or retrorse villosity which is still more strongly marked at each node of the stems. Apparently they retain their color in drying to some extent, while the type specimens always appear quite black. Mr. Curtiss's locality is at DeFuniak Springs, Wilson county, N. W. Florida, and as this must be about 300 miles from St. Augustine, it is possible that intermediate forms may occur; if these do not turn up a varietal name will be necessary, and the plant in view may be designated as Baptisia calycosa, var. villosa.—Wm. M. Canby.

Fixing and Staining Nuclei.—The following methods have been found to give excellent results in the study of nuclei. The observations were chiefly made with the mother-cells of the spermatozoids of various ferns, but the nuclei of vegetative cells also gave very instructive preparations. In order to fix the nuclei, the prothallia were placed in aqueous solutions of chromic or picric acid or corrosive sublimate. The chromic acid solution should be a 1 per cent. solution; the others concentrated. In these solutions they should remain from one to two hours, though in the corrosive sublimate solution less time is required. The chromic and picric acid preparations must be washed in several waters before staining. It has been found a good plan to leave them over night in abundant fresh water before the final washing.

The sublimate preparations may be transferred to absolute alcohol, in which they should remain several hours.

The specimens are now ready for staining. The best results were obtained with hæmatoxylin and gold chloride. The secret of good hæmatoxylin staining is to use a very dilute solution—three or four drops of the prepared solution in a watch-glass full of distilled water—and to allow the specimens to remain in this for at least twenty-four hours. Strasburger is especially emphatic upon these points.

After taking the specimens from the hæmatoxylin solution, they must be passed successively through 50 per cent., 70 per cent. and absolute alcohol before mounting. Half an hour is usually sufficient for each of the alcohols. For immediate examination they may be mounted in glycerine, but for permanent preparations first in origanum oil, and then transferred to Canada balsam (dissolved in chloroform).

The gold chloride method is simpler, and I have found it to answer admirably for specimens fixed in picric or chromic acid; but with those fixed with corrosive sublimate or alcohol it has not answered so well.

A few drops of 1 per cent. gold chloride in water are placed in a watch-glass almost half filled with distilled water, and the specimens are allowed to remain from one-half to one hour, the solution being kept in the dark. Strasburger recommends a trace of HCl, but with the picric and chromic acid preparations, although thoroughly washed, I found this unnecessary. The specimens are then thoroughly washed, being at the same time exposed to the light and finally mounted in glycerine. With alcoholic material hæmatoxylin was found to give the best results.

The above notes embody nothing especially new, but may be useful as a memorandum of work actually done.—DOUGLAS H. CAMPBELL, *Bonn*.

A Useful Artificial Light.—The following apparatus, recommended by Strasburger, has been found very useful in dark weather, and of course can be used at night: A glass globe about six inches in diameter is filled with a very dilute solution of ammoniated copper oxide, and suspended between a large Argand burner (gas or oil) and the microscope. The light should be about twenty inches from the microscope, and the globe sufficiently supported so as not to oscillate. The light obtained is bright but not dazzling, and of a soft green color that is extremely agreeable to the eyes. A screen of some kind should be used to protect the eyes from the light and heat of the lamp or gas-flame used. The apparatus is referred to in the "Botanische Practicum" as the *Schuster Kugel*.—D. H. CAMPBELL, *Bonn*.

The influence of heredity upon vigor.—The results of two series of experiments with the tomato plant, carried on during the past three seasons, furnish a forcible illustration of the influence of the health of the parents upon progeny in plants.

In the fall of 1883 a single plant was noticed in a row of tomatoes that appeared more feeble, and had more of its fruits decayed than any other. A few seeds were gathered from some of the sound fruits of this feeble plant, and at the same time, a few from sound fruits on a neighboring plant that appeared healthy and vigorous. The following spring the two samples of seeds were sown, and the young plants transplanted to adjoining rows in the garden. It was a surprise to find that in habit the plants of each row closely resembled the parents, *i. e.*, the progeny of the feeble plant was also feeble, even more so than was the parent, while that of the vigorous plant appeared entirely healthy. The difference in the two rows was so marked that, but for the unquestionable identity of the fruit, one would scarcely have thought it possible that they could be of the same variety. The same selections of seed were continued through 1885 and 1886, with like results. The past season the progeny of the feeble plant of 1883 scarcely exceeded one-fourth the size of that of the vigorous one. The plants lay prostrate on the ground, with discolored and shriveled foliage, and with the fruits fully one-half decayed before frost came. This decay is a soft rot, quite different from the black rot that so often affects tomatoes. The fruit becomes soft and collapses without changing color, the skin finally bursts, permitting the contents to flow out, when the skin dries without detaching itself from the plant.

In the second series of experiments plants were grown through three successive generations from seed taken from quite immature fruits. In one instance seeds were gathered in every case from fruits that had not commenced to change color toward ripeness; in the other they were taken from entirely ripe fruits. It is of interest to observe that the effect of the immature seed upon the vigor of the progeny was precisely similar to that of the seeds from the enfeebled plant above noted. The plants grew more and more feeble, until they failed to attain more than a fourth the size of those grown from ripe fruit.

Several varieties of tomatoes now cultivated show evidences in their manner of growth of having been originated by the selection of too immature seed. This course may have been taken to secure earliness. Practical deductions, however, may be left for the cultivator; present interest centers more especially in the fact, illustrated by the experiments, that the hereditary law of the transmission of vigor holds as strongly in the vegetable as in the animal kingdom.—EMMETT S. GOFF.

Petroleum Spirit as a Plant Preservative.—If petroleum spirit (boiling from 25°–45°C.) has not been employed for preserving plants intended for the study of chemical constituents, I should like to propose it.

Plants for macro-chemical work are usually preserved by drying. Dried plants have lost volatile substances, particularly volatile oils. Chemical changes, too, have been produced by plants remaining in contact with air. Since the first step in the chemical analysis of the plant is to treat it with petroleum spirit, and as cold maceration requires a good deal of time for complete extraction, time is actually saved by thus keeping the plant.

I am not proposing petroleum spirit as a preservative entirely on my own experience. An experienced chemist to whom I spoke thought it would be excellent. After beginning the analysis of different plants, he had several times been interrupted and obliged to keep them in petroleum spirit for a year at least. If kept in the dark he invariably found them in good condition.

Dried plants are not fit for microscopic study, even if their chemical constituents are unaltered. Their cells are contracted and they break so readily that sections are not conveniently made. Therefore plants must be kept in a liquid. Ordinary alcohol removes too many constituents and renders the plants too brittle. In a measure the same is true of absolute alcohol. Moreover absolute alcohol absorbs water so rapidly that it is troublesome, and it is too expensive. Since Dr. H. W. Jayne, of Frankfort, Philadelphia, has undertaken the manufacture of petroleum spirit it is easily obtained and does not cost a great deal. Ordinarily it removes only a little chlorophyll and volatile and fixed oils. If these constituents are to be especially studied, the previous macro chemical examination would show in what they were insoluble and the plants preserved in these. My experience has been that petroleum spirit does not contract the plant or render it brittle, as does alcohol. Since petroleum spirit does not remove water, I should think this would be true in most cases.

The rapidity of evaporation of petroleum spirit is objectionable because of waste and the danger of fire. But rapidity of evaporation is not always disadvantageous. One can thus easily free the object from petroleum spirit if it is desired to mount in something else.—LILLIE J. MARTIN.

[Histologists will notice that Miss Martin does not claim that petroleum spirit is a suitable preservative for tissues for histological examination. Cell-walls are admirably preserved by it, but the structure of the cell contents is not well shown. The liquid is so volatile as to make the handling of sections almost impossible. Nor does the petroleum spirit harden specimens suitably for section cutting. We call attention to these points lest some one may be disappointed by hoping to preserve histological material by this liquid.—EDS.]

EDITORIAL.

IN THE December number of the *American Naturalist* (p. 1075), occurs the following, portions of which we italicize: "The species of *tree moss, Ursea barbata*, grows to a considerable length on the south shore of Lake Superior. * * * The *moss* trails from the limbs *a la the parasitic* Spanish moss of the South." This item of "scientific news" occurs in the department under that name edited by Wm. Hosea Ballou. Just why there should be such a department in addition to the others edited by specialists, and embracing almost all branches of natural history, we can not see. The editor of this department can not be a specialist, and is therefore constantly liable to bring discredit upon the *Naturalist's* good name, by the insertion of items like the above, which savors of the style of the daily newspaper. Had this note come under the eyes of the editor of the department of botany, Dr. Bessey, it would of course have appeared in a correct form. We respectfully suggest to the editors of the *Naturalist* that they have the department of "scientific news" edited by the various specialists on their staff, and not left to the tender mercies of any special news gatherer.

IT MAY not be too late, at least for its own sake, for the GAZETTE to express its opinion on the "Hatch bill," which is pending before Congress. The bill provides for the establishment of agricultural experiment stations in connection with the agricultural colleges established under the act of 1862 in the various states and territories, or hereafter established under that act. The trustees of these colleges have entire charge of such stations, and are required to appoint a director and necessary assistants:

"It shall be the object and duty of said experiment stations to conduct original researches or verify experiments on the physiology of plants and animals, the diseases to which they are severally subject, with the remedies for the same; the chemical composition of useful plants at their different stages of growth; the comparative advantages of rotative cropping as pursued under a varying series of crops; the capacity of new plants or trees for acclimation within the isothermal limits represented by the climate of the several stations and their vicinity; the analysis of soils and water; the chemical composition of manures, natural or artificial, with experiments designed to test their comparative effects on crops of different kinds; the adaptation and value of grasses and forage plants; the composition and digestibility of the different kinds of food for domestic animals; the scientific and economic questions involved in the production of butter and cheese; and such other researches or experiments bearing directly on the agricultural industry of the United States as may in each case be deemed advisable, having due regard to the varying conditions and needs of the respective states and territories."

In order to secure uniformity of methods and results these stations are to receive advice and assistance from the Commissioner of Agriculture (though not under his control in any way), and are to report their work annually, in addition to issuing quarterly bulletins of progress. For carrying out the provisions of this act, $15,000 annually is appropriated to each station.

No more useful legislation has ever been proposed in the United States, and the benefits accruing to the agricultural industry and botanical science, from the establishment of such stations, would be incalculable. The provision for original research and the prompt publication of results is a most commendable feature, and the bill is worthy of the heartiest support. Immense pressure has been brought to bear upon Congress, and the friends of the bill confidently expect its passage. In this hope the GAZETTE earnestly joins.

NOTES AND NEWS.

DR. GOEBEL, of Rostock, will succeed the late Dr. Wigand at Marburg.

DR. S. A. T. TUELBERG, a Scandinavian botanist, died December 15, 34 years of age.

MR. A. H. CURTISS is editor of the *Florida Farmer and Fruit Grower*, published at Jacksonville, Fla.

RUDOLF VON UECHTRITZ, chiefly known for his studies of the Silesian flora, died November 21 last, at 48 years of age.

DR. A. F. W. SCHIMPER, formerly connected with the Johns Hopkins University, has just returned to Bonn from a journey in Brazil.

MR. WILLIAM FAWCETT, of the Botanical Department, British Museum, has been appointed Director of the Jamaica Botanical Gardens.

DON FRANCISCO LOSCOS Y BERNAL, a Spanish botanist who did much to make known the flora of his region, died November, 1886, at the age of 63.

A STUDY of the microbe of rabbit septicæmia by Dr. T. Smith has been distributed by the author from the *Journal of Comparative Medicine and Surgery.*

THE ENUMERATION of North American Hypocreaceæ by Ellis and Everhart comes to a close in the January *Journal of Mycology* with the 161st number.

MR. J. H. HART, superintendent of the Government Cinchona plantation (Jamaica), has been appointed superintendent of the Trinidad Botanic Garden.

DR. TSCHIRCH recommends the addition of lead or barium compounds to the alcohol used in preserving plants as an efficient method of retaining the original colors.

FATHER SCORTECHINI, a well known Indian botanist, recently died at Calcutta. His death was induced by severe work in the botanical exploration of Perak.

DURING the last ten years between 1100 and 1200 new plants from Madagascar have been described in the *Journal of the Linnean Society* and *Journal of Botany*. Twenty nine of these are new genera.

THE EDITORS of *Notarisia* desire to compile a directory of all writers and investigators who give attention to algæ. Such will please send their addresses to Messrs. De Toni and Levi, 3422 S. Samuele, Venice, Italy.

AT THE CHRISTMAS meeting of the Indiana Academy of Sciences, at Indianapolis, Dr. H. W. Wiley presented a valuable paper on the "Causes of the Variation of Sucrose in Sorghum," of which we shall publish an abstract shortly.

AS THE APPROPRIATION bill before Congress now reads, the work of plant pathology of the Agricultural Department will receive about $5,000 for carrying on the next year's work, exclusive of salaries. But it may yet be cut down.

A SHORT ACCOUNT of the life and work of Dr. Georg Winter, editor of *Hedwigia*, from the pen of Prof. W. A. Kellerman, is given in the *Journal of Mycology* for January. A full list of his publications, forty-three in number, is appended.

TRUFFLES of edible size have finally been found in the United States. They come from Louisiana, and have been identified by Mr. J. B. Ellis as Tuber niveum (*Terfezia leonis* Tul.). It is reported quite common near Natchitoches, and is eaten by the residents.

HUGO DE VRIES suggests, in *Nature*, a method of preserving such colorless plants as Monotropa in alcohol without their assuming a brown color. "To 100 parts of common strong alcohol add 2 parts of the ordinary concentrated solution of hydrochloric acid of the shops."

ON COMPARING the reprint of Röll's *Zur Systematik der Torfmoose* with the original in *Flora* we find that the paging has been so completely altered as to make it impracticable to state at length the changes. It is greatly to be regretted that such confusing changes should be introduced into important papers.

A. J. BROWN declares that the membrane commonly known as "mother of vinegar" is formed by Bacterium xylinum, n. sp., and not by Bacterium aceti, to which it has been ascribed. The membrane gives all the reactions of cellulose, which the bacterium forms from the dextrose and other sugars present.

THAT BOTANY is a suitable, and even very desirable study for young men is the conclusion reached by Dr. J. F. A. Adams in an article in the *Swiss Cross*, the new journal of natural history for the Agassiz Association, published in connection with *Science*. He has the botany of the plant collector chiefly in mind.

A NEW JOURNAL, *Agricultural Science*, has started with the year, which will doubtless contain more or less matter of interest to botanists. It is edited by Charles S. Plumb, of Geneva, N. Y., and is a monthly of twenty-four pages, rated at two dollars per annum. It presents an excellent appearance, and has articles in the first number by well-known scientists.

PROF. BAYLEY BALFOUR, in *Nature* for Dec. 9 (1886), confirms George Kleb's easy demonstration "that algæ make the water in which they live alkaline when they are fixing carbon in light. A watery solution of phenolphtalein is added, and in proportion as the fixation of carbon proceeds the water gradually assumes a deep red tinge, which gradually disappears when light is excluded."

DR. E. KLEIN, in *Nature* (December 23), calls the Cambridge cholera fungus (of Messrs. Roy, Brown and Sherrington) to account, and says it is a common mold which has developed during preserving of the material, and has grown from the free surface into the tissues, and has no connection with Asiatic cholera. His criticisms indicate a surprising lack of care in the work of the gentlemen referred to.

THE RESULTS attained by Mr. Roland Thaxter in the cultivation of Rœstelia from spores of Gymnosporangium, which have already been partly described in this journal by Dr. Farlow, are given in detail in Proceedings of the American Academy, recently issued. In addition to what has already been said, it is noted that G. macropus, the common cedar-apple, is joined with R. pyrata, an American form of R. penicillata.

WE REGRET to record the death of Marshall P. Wilder, Dec. 17, in his eighty-ninth year, for many years president of the Am. Pomological Society, and so well known to all plant cultivators. The *Gardener's Chronicle* (Jan. 1), in an appreciative notice of his services, gives a characteristic extract from his last letter to them, dated March last, in which he mentions himself as "still living, and continuing to stir up the soil to see what it will produce."

IN THE *Journal of Botany* (January), Drs. De Toni and Voglino call attention to the vexation of homonymous genera. No remedy is suggested for existing confusion, but caution suggested in subsequent naming. For instance, Antennaria is a genus of Compositæ and Hyphomyceteæ, Chauvinia is a member of Chlorophyceæ and Gramineæ, Cryptodiscus is a Discomycete and an Umbellifer, Leptotrichum is a Hyphomycete and a moss, and so on.

AT A RECENT meeting of the Cambridge (England) Philosophical Society, Mr. Walter Gardiner gave an account of the gland-bearing organs found in Hodgsonia. Studying the gland-bearing genera of Cucurbitaceæ and Passifloraceæ, he concludes that the function of the extra floral nectaries of these two families is to attract certain insects (probably ants), which are of service in protecting the plant from the attacks of other and harmful insects, such as caterpillars.

THE LIBRARY of Kew has just come into possession of the rarest and most valuable Japanese botanical work, the Honzo Dsufu, by Iwasatti Tsanemasa. It contains colored figures of 1500 species, and is in 96 volumes, the first 6 of which only have ever been printed, the rest existing in hand-made copies, and only two or three copies are known to be complete. This magnificent work was presented to Kew by Mr. Tokutaro Ito, now a student of botany in the University of Cambridge.

DR. AITCHISON, of the Afghan Delimitation Commission, has made a collection of about 800 species (10,000 specimens) of the plants of that region. The collection has not been fully worked out yet, but it is estimated to contain about 100 new species. A curious Umbellifer (Ferula oopoda) is described, "in which the bases of the cauline leaves are developed into large circular bowls, through a succession of which, gradually smaller upwards, the stem passes. The largest of these bowls are a foot in diameter, and about two quarts in capacity." Dr. Aitchison thinks these bowls do not serve as reservoirs of water.

AT A RECENT meeting of the Linnean Society, Mr. C. T. Druery described a new instance of apospory in Polystichum angulare, var. pulcherrimum. A paper on apospory was also read by Prof. F. O. Bower, in the course of which he showed how in Polystichum at least four different modes of the origin of the oophyte may be distinguished, two being in connection with the sorus, while two are at points apart from the sorus, and may occur even on fronds which bear no sori at all. In considering the whole phenomenon of apospory Prof. Bower came to the conclusion that it is to be regarded rather as a sport than a reversion bearing deep morphological conclusions with it.

THE BIENNIAL REPORT of the University of Nebraska shows that a remarkable growth has taken place in its scientific departments under the leadership of Dr. Bessey. For botany, with which we are most concerned, there are five rooms required, now provided with an outfit of many compound and simple microscopes, a library especially valuable in serial works, over twenty-three thousand specimens in the herbarium, and other useful and illustrative material. The standard of scholarship has been considerably raised during these two years.

DR. G. HABERLANDT, investigating the structure of stinging hairs of various families, finds their essential structure very similar. Usually there is a large terminal cell, more or less sunk in a multicellular base by which it is attached. A short distance below the point the walls of the terminal cell are very brittle, made so either by the deposit of mineral substances or by lignification. The substance which produces the irritation is not yet known. Formic acid, to which the urtication has been ascribed, he thinks will not produce the effects in the small quantity in which it is present.

THE first number of a new journal devoted to animal and vegetable parasites has been received. It is entitled *Centralblatt für Bacteriologie und Parasitenkunde*, and is edited by Dr. Uhlworm, of Cassel, Germany, assisted by Drs. Leuckart and Loeffler, and a very long list of promised contributors. Dr. Sternberg, of Johns Hopkins University, will represent the editor in this country. It is a bi-weekly of the size and appearance of the *Botanisches Centralblatt*, and promises to be in its field an equally useful journal. It will at least be indispensable for bacteriologists. The price per year is 28 marks ($7).

A SIMPLE METHOD of detecting ptomaines at the time of their formation has been devised by Alexander Poehl, according to Biedermann's *Centralblatt*. A needle culture is made in nutritive gelatine [kept in the dark presumably], to which has been added .05 per cent. of ferric chloride, and the same of ferricyanide. In twelve hours the organisms will have grown sufficiently to bring about a reduction, if any ptomaine is formed, giving rise to Prussian blue, which will at once be evident by its color. The presence of air prevents the change taking place at or near the surface of the gelatine. For organisms which require an alkaline medium, the culture must be acidulated with hydrochloric acid after the lapse of sufficient time for the growth of the bacteria, in order to bring out the blue color in the presence of a ptomaine. An interesting result of the studies already made is that the forms which liquefy the gelatine are found to induce no reduction.

IN *Nature* for December 16 (1886), D. Morris gives two interesting instances of the dispersion of Jamaican plants by birds. Uncinia Jamaicensis has light fruits bristling with hooks very favorable for grasping the migratory birds. Small birds have been known to become so entangled by them that they were unable to extricate themselves. As a result this plant is dispersed plentifully in the track of migratory birds. Pimento vulgaris, which gives rise to the great allspice industry of Jamaica, is distributed by frugiverous birds, by whom the fruit is greedily eaten. In fact, it is said that this industry is entirely dependent upon the action of frugivorous birds. Ground is prepared for a new pimento plantation, and in a year an abundance of young pimento plants will be found growing from ripe berries scattered there by birds. It is thought that the seeds undergo some fermentation in passing through the alimentary canal, which fits them better for vegetation than those gathered immediately from the tree.

THE RELATION of nutrition to sexual variation, advocated by Meehan, Hoffmann and others, appears to have been observed long ago. F. W. Burbridge calls attention, in the *Gardeners' Chronicle*, to a statement in Threkeld's "Synopsis Stirpium Hibernicarum," published in Dublin in 1727, which says: "The male hemp has the seed, the female only flowers, yet both are procreated from the same seed. The more attentive husbandmen observe that in a fat soil you have more plenty of male hemp—in a lean soil more of the female; or where sown too thick, and so wants nutritious juice, it is female." Transposing the words "male" and "female' to accord with present usage, and the account agrees with recent investigations.

FUNGUS DISEASES of the grape-vine is the topic of the second bulletin of the Botanical Division of the Department of Agriculture, prepared by F. L. Scribner. It contains 136 pages, illustrated with seven excellent plates, partly colored, and with cuts in the text. The diseases described are the downy mildew (Peronospora viticola), powdery mildew (Uncinula spiralis), black rot (Physalospora Bidwellii), anthracnose (Sphaceloma ampelinum), leaf blight (Cercospora viticola) and leaf spot (Phyllosticta Labruscæ). These are carefully discussed, both botanically and practically. An article by Col. Pearson, of New Jersey, is appended, together with a translation of several articles on French and Italian remedies. A copious index closes a paper which does credit to the Department, and will be of service to both the botanist and vineyardist.

THE *Journal of Botany* for January contains a biographical sketch (with portrait) of the late Dr. H. F. Hance, prepared by F. B. Forbes. Dr. Hance was born August 4, 1827, in London, and died at Amoy (where he was acting consul) June 22, 1886. His name is closely identified with Chinese botany, and his contributions, of late years, in the *Journal of Botany*, have made his name familiar to all botanists. Sir Joseph Hooker gives th following estimate of his scientific work: "With regard to Dr. Hance's botanical attainments and the value of his labors, I can speak in very high terms. For upwards of 40 years he devoted all his spare time to investigating the vegetation of China, displaying rare ability in mastering the technicalities of structural and descriptive botany, at times enriching the scientific journals in England with accounts of new plants of great interest in a botanical and economic point of view. In all that he attempted he aimed at critical accuracy in identification and diagnosis, and this he attained in an eminent degree, so that there is no possibility of failure in recognizing from his descriptions the plants he had under examination. Had Dr. Hance lived he would doubtless have given in a connected form an account of the vegetable riches of China, such as it would have been far beyond the grasp of any other naturalist to have produced, and this, too, with a classical diction that is extremely rare in the writings of scientific men. As it is, he has left no successor in China."

COULTER and ROSE on UMBELLIFERÆ.

VOL. XII. NO. 3.—BOTANICAL GAZETTE.—MARCH, 1887.

Delphinium, an attempt to distinguish the North American Species.

ASA GRAY.

This *essay* at an arrangement of our species of Delphinium is submitted to the botanists of the United States in the hope of eliciting, during the ensuing spring and summer, some observations on the living plants and such collections of specimens with their roots, fruit, and seed as may either confirm or invalidate the characters which I have endeavored to turn to account.

I make no reference to the naturalized species, of the section *Consolida;* nor to the two scarlet-flowered species of California, D. nudicaule and D. cardinale (§ *Phœnicodelphis*), except to say that it would be well to verify the fact noted by that most experienced seed-raiser, Mr. William Thompson, that while D. nudicaule germinates (after the manner of D. tricorne) with prolonged connate cotyledon-petioles and hypogæous plumule, the nearly allied D. cardinale does not.

In our species of the *Delphiniastrum* section, I think good use may be made of the seeds and of the root, although most of our species have the same type of seed.

1. Seed-coat close, smooth: root fasciculate-tuberous. D. TRICORNE.

2. Seed-coat cellular, more or less loose and rugulose: stem scapiform from thickish branching roots.

Leaves well dissected: raceme many-flowered. D. SCAPOSUM.

Leaves merely 3-cleft: raceme few-flowered. D. ULIGINOSUM.

3. Seed-coat loose, cellular, becoming transversely rugose-squamellate: fascicled roots long: stem leafy. D. AZUREUM.

4. Seeds with loose cellular coat either arilliform or when dry merely scarious-margined or winged at the angles, not at all squamelliferous: more or less leafy-stemmed.

* Fasciculate roots elongating, not at all tuberiferous.

+ Stem strict, tall or robust, many-leaved: raceme many-flowered: pedicels seldom longer than the flower or fruit, ascending or erect: follicles erect or nearly so, short-oblong.

— as in Megarhiza ar.

Alleghany species, slender-stemmed: small flowers canescent-puberulent. D. EXALTATUM.

Californian, stout: sordid flowers villous. D. CALIFORNICUM.

Rocky Mountains to Oregon, etc.: flowers glabrous, canescent puberulent, or barely pubescent outside. D. SCOPULORUM.

+ + Stem lax, several–few-leaved: pedicels of loose raceme spreading or ascending, mostly long: follicles elongated cylindraceous, often diverging at maturity: flowers pretty large.

Stems 2 to 6 feet high: leaves mostly ample, the lobes acute: follicles recurving in age. D. TROLLIIFOLIUM.

Stems a span to a foot high: lobes of the small leaves obtuse, mostly linear. D. BICOLOR.

+ + + Stem strictly erect, with few or sparse leaves, a foot or two high, bearing a virgate or narrow raceme, with ascending pedicels, at least the upper not longer than the spur: follicles oblong, not over half an inch in length, not recurving.

Very glabrous, a foot or two high, robust: leaves thickish: sepals half an inch long, little surpassing the petals. D. ANDERSONI.

Puberulent or glabrous, 1 to 3 feet high: leaves not thick; divisions or lobes few and linear: roots comparatively long and slender.

Raceme a span to a foot long: sepals oval, over half inch long, much surpassing the petals, fully as long as the spur. D. PARRYI.

Raceme and flowers smaller: sepals oblong, 3 or 4 lines long, hardly surpassing the petals, shorter than the spur. D. PARISHII.

* * Fasciculate roots short and thickening, but not tuberiform: herbage puberulent or below hirsute: stem strict, a foot or two high: leaves not large: raceme spiciform or narrow: pedicels short, except some lower ones, ascending or erect: follicles oval or short oblong, erect, puberulent.

Raceme virgate, usually elongated and many-flowered: sepals oval, 4 or 5 lines long, hardly longer than petals or spur. D. HESPERRIUM.

Raceme of few to several large flowers: sepals orbicular-obovate or oval, 5 to 9 lines long, much surpassing the petals: follicles turgid. D. VARIEGATUM.

* * * Fasciculate-tuberous or grumous roots, *i. e.* a cluster of globular or oblong testiculate or sometimes palmate tubercles, bearing only fibrous rootlets.

+ Raceme spiciform and virgate, many-flowered, with erect or appressed pedicels shorter than the spur: stems strict.

Tall, somewhat velvety-pubescent: calyx externally pubescent. D. SIMPLEX.

Lower, glabrous or inflorescence puberulent: leaves thickish. D. DISTICHUM.

+ + Raceme loose, few–many-flowered: pedicels spreading or ascending, comparatively long, never appressed,

Long and lax, lower often 2 inches long: leaf lobes all narrow: follicles oblong-cylindraceous, half to three-fourths inch long, at maturity almost always widely recurving: flowers large and not numerous. D. MENZIESII.

An inch or less long, rarely longer: follicles oblong, hardly over half inch long or shorter, mostly erect: herbage glabrous or nearly so.

Spur not longer than sepals, thickish: lower leaves with broad or broadish divisions. D. DECORUM.

Spur longer than sepals, slender.

Low, or slender and few-flowered: leaf-lobes all or mostly linear: sepals 3 or 4 lines long: root-tubercles disposed to be fusiform. D. PAUCIFLORUM.

Strict, 2 feet high, with rather many-flowered raceme: leaf-lobes lanceolate: petals all bright blue. D. NUTTALLII.

Such a key is far from satisfactory.

D. tricorne Michx. does not extend further west than Minnesota and Arkansas.

D. scaposum Greene belongs to S. Utah and Arizona, in the latter territory accompanying D. azureum. More fruit of it is desirable.

D. uliginosum Curran seems to be a near relative of the preceding. It is imperfectly known, only at one station, in Lake Co., California.

D. azureum Michx., with its var. **vimineum,** extends from Saskatchewan and from N. Carolina to Arizona and Mexico. The seeds should well distinguish it.

D. exaltatum Ait. is our most eastern species and can not be confounded.

D. Californicum Torr. & Gray seems also quite peculiar, and is restricted to the Californian coast district.

D. scopulorum Gray I take to be a collective species, of the Rocky Mountains and northwestward, to the type of which I am constrained to annex the following varieties:

Var. **stachydeum.** A form with narrow leaf-lobes and strict stem (3 to 7 feet high), upper part of this with the long and dense spiciform raceme and outside of flower cinereous-puberulent.—Interior of Oregon, *Cusick.* New Mexico and Arizona, *Pringle.*

Var. **glaucum.** Like the other broader-leaved forms, sometimes glaucous, even the pedicels glabrous or only obscurely glandular-puberulent, and follicles glabrous.—*D. glaucum* Watson. Sierra Nevada, California, to Washington Territory, and even to the Yukon River. Connects with

Var. **subalpinum.** A foot to a yard or more high, with shorter raceme of larger and deeper-colored flowers, the inflorescence and even upper part of stem viscidly pubescent or villous, and follicles glabrous.—This is *D. elatum* Gray in Am. Jour. Sci., *D. occidentale* Watson, and is the analogue of *D. alpinum* of Europe. It occurs through the higher mountains of Colorado to those of E. Oregon.

D. trolliifolium Gray occurs on the Columbia River, below the Dalles, and in N. W. California, and is evidently a species of woodland or shade.

D. bicolor Nutt., a low species of the higher Rocky Mountains, and of those of E. Oregon, etc., with the inflorescence and flowers somewhat of D. Menziesii, proves to have deep and long (instead of tuberiferous) roots. It is *D. Menziesii* var. *Utahense* Watson, Bot. King. Exp.

D. Andersonii is *D. Menziesii* Watson l. c., as to Nevada plant, and mainly *D. decorum* var. *Nevadense* of the Botany of California. It belongs to the mountains of W. Nevada and the adjacent Sierra Nevada. More specimens in fruit are desirable.

D. Parryi is founded on specimens collected in San Bernardino Co., California, by Parry in 1850, Parry and Lemmon in 1876, and by Parish; also apparently the same collected near Santa Barbara by Brewer.

D. Parishii is a rather low and rigid-stemmed species, much smaller-flowered than the preceding, collected at Agua Caliente, on the southeastern borders of California, by Parish, and in adjacent Lower California by Orcutt.

D. hesperium is a common Californian species, which has passed for *D. simplex* and for Californian *D. azureum*. It appears to abound from Mariposa Co. and from Monterey northward, and it reaches W. Oregon. The roots of this and the next species are intermediate in character between the merely fasciculate and the tuberiform types, but rather of the former.

D. variegatum Torr. & Gray is very well marked in character, and is one of the most showy species. Bentham, in Pl. Hartw. 295, took it for *D. decorum*, but wrongly. We know it only in California, from Monterey to the Upper Sacramento Valley.

The remaining species have genuine grumous or tuberiform roots, although, as to

D. simplex Dougl., this is only an inference; for the roots of Douglas' plant, and of Spalding's from the same district (W. Idaho), which accord in character, are wanting in the specimens. But the plant comes near to the following, which has commonly been taken for it. Further knowledge of this species is much desired.

D. distichum Geyer in Hook. Lond. Jour. Bot. vi. 67. *D. azureum* Torr. in Bot. Wilkes' Exped. Common on the low prairies of E. Oregon and Washington Territory, and extending to Montana.

D. Menziesii DC. Chiefly near the coast; Brit. Columbia to Oregon and northern part of California. There are puzzling specimens, but it appears to be the only grumose-rooted species with pretty large and slender peduncled flowers, succeeded by long and narrow divergently recurved follicles. Yet sometimes these seem to remain erect.

D. decorum Fisch. & Meyer. This is a low and lax species of the western part of California, extending eastward to the Sierra Nevada, of very variable foliage, but comparatively broad-leaved. Indeed the rounded lower leaves are sometimes barely 3-lobed, and the divisions commonly round-obovate or cuneiform. The typical form (the plant raised in the St. Petersburgh garden, from seeds gathered at the Ross Colony—of which an original has been obligingly sent me for identification) has flowers as large as those of *D. Menziesii.* Other specimens agree with this; but not rarely, both in the northern and southern districts, it is much smaller-flowered, and passes freely into

Var. **patens,** the *D. patens* Benth. Pl. Hartw. This is a common form, with narrow leaf-lobes, and a narrower raceme of rather small flowers, the pedicels in fruit ascending. It would be taken for a quite distinct species, except for the intermediate forms.

D. pauciflorum Nutt. The type of this species occurs in the Rocky Mountains, from Wyoming and adjacent parts of Colorado to Idaho, and a slender form reaches the eastern borders of Washington Territory, and also California, where

Var. **depauperatum,** taken to be *D. depauperatum* Nutt. in Torr. & Gray, having broader leaf-lobes, may really be only an attenuate form of *D. decorum* var. *patens.* Additional materials and well formed fruit are wanted.

D. Nuttallii. So named because in our herbarium it is "D. simplex" of Nuttall. It is a moderately tall species, with grumose root, apparently quite distinct in character, occurring in low grounds along and near the Columbia River, above the Dalles, where it has been of late abundantly collected by Howell, Henderson, Suksdorf, etc. Nuttall's specimen is ticketed "Columbia Plains."

On the causes of the variations in the contents of sucrose in Sorghum saccharatum.

HARVEY W. WILEY.

For some years I have been investigating the Sorghum saccharatum in respect of its adaptability to the production of sugar.

During this time many difficulties have been encountered and these troubles have all been overcome with one exception. The chief obstacles to successful sugar making have been, *first*, unfavorable climatic conditions; *second*, imperfect methods of extracting the sugar; *third*, improper treatment of the extracted juice; *fourth*, variations and rapid changes in the sucrose of the juice. All of these problems have been successfully solved save the last. It is proper to say, however, that certain methods of cultivation and certain methods of selecting seeds tend to produce maximum contents of sucrose in the cane and these methods are not yet fully developed. A proper conception of the variations to which the sucrose in sorghum is obnoxious can not be had unless we study briefly the method of its formation, how it is stored and the physiological functions in which it takes part.

Vegetable physiologists have taught us that a carbohydrate can be formed by a certain retrogressive change in protoplasm, by which the cell envelope, in other words cellulose, is produced. The carbohydrates which appear in the embryo of a plant are developed at the expense of the stores of material in the seed. After the appearance of the chlorophyll cells in the plant the production of carbohydrates takes place with their aid, CO_2 being absorbed from the air and free oxygen being eliminated.

It would be easy to explain the production of carbohydrates by supposing that the chlorophyll cell exerted a reducing influence[1] on the CO_2 which, with the assimilation of water, produced, for instance, starch by the formula $6CO_2+5H_2O=C_6H_{10}O_5+O_{12}$. In the vast majority of plants it is found, in corroboration of this supposition, that the volume of the oxygen set free is sensibly the same as the carbonic dioxide absorbed. The carbohydrate which is generally formed in the chlorophyll cells is starch. This starch is removed from the leaf, and it is supposed that the carbohydrates which are formed in all parts of the plant are derived from this original substance.

In point of fact, however, the production of organic matter in a plant does not probably take place in the simple manner above described. It is more likely that the presence of a nitrogenous body is necessary and this proteid itself is the active principle of the production of new organic matter, by a certain decomposition it suffers, with the help of carbonic dioxide and water. Nor is it by any means certain that

[1]It has lately been stated that this reduction is due to the action of electricity on the leaf—producing hydrogen—and this hydrogen is the active principle in the reduction of he carbonic dioxide. This statement appears to be purely theoretical.

starch is the only organic matter formed by the chlorophyll cells; in fact, it is known that oil is often the product of this constructive and destructive metabolism.

But it seems reasonable to suppose that the different sugars are as likely to be formed in the leaf of the plant as starch.[2] When we remember how easily starch is detected in most minute quantities and how easily sugar is missed even when present in much larger quantities, we do not wonder that vegetable physiologists have supposed that starch is the first carbohydrate formed in the leaf and that all the others are derived therefrom. The explanation which is made of the translation of the starch from the point of its formation to the localities where it is stored is as follows:

Take, for instance, the formation of starch in the germ of cereals. We are taught that the starch first formed in the leaves is changed into sugar and in this soluble state carried through the plant until it reaches the seed. This sugar, reaching the point where the seed is forming, is changed to starch again by the amyloplast.

Let us subject this theory of the translation of starch to a brief examination. There are two only known methods by which starch can be converted into sugar, *viz.: first*, by the action of certain acids, and *second*, by the action of certain ferments. The conversion of starch into sugar by acids even at a high temperature and with the stronger acids is very slow. It is simply incredible that such a conversion can take place at the ordinary temperature in the leaf of a plant and by reason of the action of the extremely dilute weak vegetable acids which the leaf contains. In the same way it must be conceded that the opportunity for the action of a ferment in the leaf is extremely limited.[3] Such action requires time and much more favorable conditions than can be found in the living leaf. In any case if sugar be formed from starch in either of the ways indicated it could not be sucrose.

In fact the reducing sugar which is found in plants is seldom starch sugar, *i. e.* maltose or dextrose. This appears to be a fact which the vegetable physiologists have entirely ignored. The sugars of plants which reduce an alkaline copper solution are either derived from sucrose by inversion

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[2]Meyer (*Botanische Zeitung*, 44, Nos. 5, 6, 7, 8) has lately shown that the leaf of the plant is incapable of forming starch out of sucrose, lævulose, etc., and calls especial attention to the fact that starch may not be the original substance formed.

[3]The ferment which acts on the starch has been studied by Brasse and Schimper (Bied. *Centralblatt*, vol. 14, p. 169, vol. 15, pp. 310 and 473). It is called *amylase*.

or more probably are of independent formation. If they were derived from starch they would show dextro- if from sucrose, lævo-gyration. In point of fact they often show neither, as I long ago pointed out when in view of this optical inactivity I proposed for them the name of anoptose. When they do show rotation, however, it is left-handed.

It seems to me that there is one fact that the physiologists forget, *viz.*, that starch is not always insoluble. In my examinations of sorghum juices I have never failed to find soluble starch when I looked for it. The existence of bodies when first formed in the soluble state, which when once made solid become insoluble, is not unknown. Certain forms of silica are illustrations of this. It seems much more reasonable to suppose that in the case of the sorghum for instance the starch which appears in the seed is partly transferred directly from the soluble nascent state to the seat of its final deposition. This, indeed, is hardly a theory in the light of the fact mentioned above: that the sap of the plant always contains soluble starch.

Led by the commonly accepted theory that the starch in the grain of cereals, etc., was formed from sugar, a few years ago some experiments were made to increase the sucrose in sorghum by cutting away the seed heads as they appeared and thus preventing the formation of starch. Two or three analyses were made and the results showed a large increase in the sucrose in those plants in which the formation of starch had been prevented.

In 1885 I conducted some experiments on a large scale. About two acres of a sorghum field were selected. In each alternate row of the growing cane the seed heads were removed as they appeared. Numerous analyses were made of the canes from both kinds of rows. The result showed most conclusively that no marked increase of sucrose was noticed by reason of the prevention of the deposition of starch. It is far more simple to suppose that the sucrose which we find in sorghum is produced directly by the decomposition of protoplasm in presence of carbonic acid, provoked by the katalytic action of the chlorophyll cell. At any rate there is no sort of evidence that it is ever made from starch and no physiologist has ever invented any hypothetical saccharoplast to account for such a transformation.

This subject of the origin of sucrose is of great interest but I have not yet finished my experimental studies of it and so will not pursue it further at present.

The question now arises is the sucrose of sorghum a plastic material, reserve material, or waste? In respect of plastic material it is sufficient to call attention to the fact that the development of sucrose does not begin in the plant until it is far on the road to maturity. To this it may be objected that its accumulation does not begin until this period, and that what is formed earlier in its history is a really plastic material used in the development of other tissues. Had I time I might show, I think, conclusively, that the presence of the sucrose as a plastic material is not probable. Is it a reserve material? The sucrose which is deposited in the seeds of plants, in tubers like the sugar beet, and in sugar-cane, doubtless is a true reserve material and by its decomposition helps the growth of the succeeding plant. But the sucrose in sorghum seems to have no such function. It can in no way aid the incipient growth of the next plant, for that plant grows from a seed. As far as any use in the economy of the plant is concerned, it appears to be absolutely worthless. It is true that in the case of "suckering," the sucrose in the cane may suffer loss, but "suckering" is not always a natural growth; it is adventitious and is always detrimental to the proper maturity of a plant.

It seems, therefore, that the sucrose in sorghum is purely a waste material—as much so as an alkaloid or a resin.

In the cases where sucrose is a true reserve material, as in seeds, in tubers, and in sugar-cane, we find there is no tendency for it to disappear until the needs of the new plant require it. The sucrose remains, for instance, unchanged in the sugar beet until the new growth begins. The same is true in a higher degree of the sucrose in seeds. The fact, therefore, that in sorghum all traces of sucrose may disappear in a few days shows that its office is radically different.

As a result of my investigations I will say that the development of sucrose in sorghum is an accidental function, or rather an adventitious function. It goes on usually *pari passu* with the formation of the starch in the grain and the content of sucrose in the plant, and its quantity is at a maximum at the time the starch formation is completed. In the sugar-cane the sucrose appears to be not only reserve, but also plastic material. In the upper part of the cane the content of sucrose is much less than in the lower, showing that in the region of most active growth the sucrose may suffer decomposition and help in the formation of proteid. (I wish to add here that the only way in which the plant can use sucrose for the formation of other bodies or for working it into living tissues is by thus getting it into protoplasm.) On the other hand the content of sucrose in sorghum is sensibly the same in all parts of the cane, being just as great at the top near the place of most rapid starch storage, as it is near the base. It is not strange, therefore, if it be true that the production of sucrose is only the expression of the exuberant vitality of the leaf of the sorghum, that the greatest variations should be met with the content of sucrose. These variations are not confined to different varieties or to different fields but are found in the same variety in different canes growing in the same hill, and which, therefore, have been subjected to precisely the same conditions of culture and weather.

In ten successive analyses of sugar beets made two years ago, I found no greater variation than one per cent. in sucrose. The same was true of ten successive analyses of sugar-canes I made last month, November, 1886. On the other hand, any ten successive analyses of sorghum canes, made last October, will show a variation of six per cent.

I have not the time here to cite all the instances I have noticed which illustrate the principles set forth above. They number hundreds. Without a record of these analyses, however, the fact clearly appears that the chief cause of variation is found in the accidental or adventitious nature of the formation of the sucrose—in other words, its independence of the life history of the plant. When, however, the sucrose has once been formed, as in a mature cane, it is subject to sudden variations. Sudden changes in the weather, severe frosts, followed by warm weather, or simply standing dead ripe, often cause a rapid disappearance of the sucrose. It is first converted into invert sugar and this quickly disappears by fermentation.

When the canes have been cut also, if they be expressed at a temperature of a warm September day, the sucrose is rapidly inverted. This inversion is not due to the action of the acids which the sap contains, but is produced by a special ferment, probably *invertin*, or some similar substance.[4]

These variations in the content of sucrose, are, as I intimated at the beginning, the chief obstacles now in the way of the successful introduction of a sorghum sugar industry into this country. The last one is easily avoided by promptly working the cane as soon as it is cut. The first one can

[4]Ducloux, Compt. rend, 103, p. 881, has shown that sunlight is capable of inverting a solution of sucrose.

only be overcome by the scientific agronomist, aided by the best practical botany and chemistry.

Since sending the above paper I have received the *Revue Scientifique*, of February 5, 1887, containing a notice of the observations of Girard on the production of carbohydrates in plants. This author definitely confirms my statements in respect of the independent formation of sucrose in leaves. The reviewer says:

> "Les expériences de M. A. Girard mettent hors de doute que les limbes fabriquent alors des saccharose et des sucres réducteurs."

M. Girard shows the possibility of leaves developing starch from sucrose, but there appears to be no evidence that the reverse of this operation takes place.

Notes on Umbelliferæ of E. United States. II.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE II.)

ANGELICA L.—Fruit strongly flattened dorsally, broadly winged at the commissure: carpel with 5 strong primary ribs, each with a group of strengthening cells,[1] the 2 lateral extended into broad wings, distinct from those of the other carpel, forming a double-winged margin to the fruit: oil-ducts one to several in the intervals or indefinite, 2 to 10 on the commissural side (figs. 14–18).—Stout perennials, with ternately or pinnately compound leaves, large terminal umbels, scanty or no involucre, small many-leaved involucels, and white or greenish flowers.—Incl. *Archangelica* Hoffm., excl. *A. Gmelini* DC.—Archangelica is referred to Angelica by Maximowicz, Bull. Acad., Petersb., 19. 273. The only characters serving to separate Archangelica from Angelica break down. The number of oil-ducts in the intervals, while usually one in Angelica, in Angelica Curtissii may be two, or even three, as well in the dorsal intervals as in the lateral; while in Archangelica hirsuta the oil-ducts may be reduced to one or two in the intervals. The generic relation of neither of these species can be determined by any character drawn from the oil-ducts, and plac-

[1] In January GAZETTE, p. 14, third sentence from bottom, in contrasting the characters of Angelica and Conioselinum, the last clause ("especially conspicuous under the lateral ribs") might be understood to refer to Conioselinum. It refers to Angelica.

ing Angelica Curtissii and Archangelica hirsuta together the other Archangelicas must follow. Also, the adherence of the seed to the pericarp is hardly a usable character, as in Archangelica hirsuta it becomes loose very tardily, and in most (even mature) specimens appears as completely adherent as in Angelica Curtissii. Sometimes the same is true in A. dentata also. Archangelica Gmelini we do not consider a member of Angeliceæ at all.

* Seed adherent to pericarp: oil-ducts one to several in the intervals: uppermost leaves mostly reduced to large inflated petioles.

1. **A. Curtissii** Buckley, Am. Jour. Sci. 1. 45. 173. Smooth: leaves twice ternate or the divisions quinate; leaflets thin, ovate-lanceolate (1 to 3 in. broad), sharply and irregularly toothed: fruit smooth ($1\frac{1}{2}$ to 3 lines broad); oil-ducts mostly one in the intervals (sometimes 2 or 3), 2 to 6 on the commissural side (figs. 14, 15).—Along the Alleghanies from Pennsylvania to N. Carolina. Fl. August.

2. **A. hirsuta** Muhl. Cat. 2 ed. 30. Pubescent above: leaves twice pinnately or ternately divided; leaflets thickish, lanceolate to oblong (5 to 10 lines broad), serrate: fruit pubescent (2 lines broad); oil-ducts 3 to 6 in the intervals (sometimes 1 or 2), 6 to 10 on the commissural side (fig. 16).—*Archangelica hirsuta* Torr. & Gray, Fl. 1. 622; Chapman, 164; Gray, Manual, 193. *Angelica triquinata* Nutt. Genera, 1. 186.—Dry ground, New York to Minnesota, and southward to Tennessee and Florida. Fl. July.

** Seed loose in pericarp: oil-ducts indefinite, somewhat evenly distributed, under the ribs as well as in the intervals: upper petioles not so prominent.

3. **A. dentata.** Slender, smooth: leaves ternate, with long slender petioles and few leaflets, which are small, lanceolate, coarsely toothed: umbels slightly pubescent: fruit smooth or pubescent; oil-ducts about 20, with 8 on the commissural side (fig. 17).—*Archangelica dentata* Chapman, Torr. & Gray, Fl. 1. 622; Flora, 164.—Dry pine barrens, Florida. Fl. July to September.

4. **A. atropurpurea** L. Spec. 251. Very stout, smooth, with dark purple stem: leaves 2 to 3-ternately divided; segments of 5 to 7 leaflets, which are lanceolate to ovate (1 to $1\frac{1}{2}$ in. broad), sharply cut mucronate-serrate: umbels smooth: fruit smooth; ribs larger and with much more conspicuous

groups of strengthening cells; oil-ducts 25 to 30, with 8 to 10 on the commissural side (fig. 18).—*Archangelica atropurpurea* Hoffm. Umbel. 161; Gray, Manual, 193.—Low river-banks, from New England to Pennsylvania. Minnesota, and northward. Fl. June.

CŒLOPLEURUM Ledeb.—Fruit globular-ovoid, round in section, or slightly flattened laterally: carpel with 5 very prominent thick corky primary ribs, about equal and none of them winged, each with a large group of strengthening cells: oil-ducts 1 in each interval, 1 (rarely 2) under each rib, and 2–4 on the commissural side: seed loose in the pericarp, plane or slightly concave on the inner face (figs. 19, 20).—Stout perennial, with 1–3-ternately divided leaves, few-leaved involucre and involucels, and greenish-white flowers. Fl. July.—The genus is well marked by its fruit characters. It clearly differs from the whole group of Angeliceæ in the absence of lateral wings, and in the fruit not being at all dorsally flattened. The flattening, if any, is slightly lateral, as in Ligusticum. From Ligusticum it differs in its very large ribs and single oil-duct in each interval; from Selinum in that it has oil-ducts beneath the ribs as well as in the intervals. It was referred by Bongard to Pleurospermum, but differs in having oil-ducts beneath the ribs, and in the face of the seed being mostly plane or very slightly concave.

1. **C. Gmelini** Ledeb. Fl. Ross. 2. 361. Stem 1–3 ft. high: leaflets ovate, acute, cut-serrate.—*Archangelica Gmelini* DC: Gray, Manual, 193. *A. peregrina* Nutt.—New England and northward, also in the Rocky Mountain region.

ÆTHUSA L.—Fruit ovate-globose, slightly flattened dorsally: carpel with 5 thick sharp primary ribs and no strengthening cells except in very tips of the ridges: oil-ducts one in each interval and two on the commissural side (figs. 21, 22).—Poisonous annuals, with 2 to 3-ternately compound leaves, divisions pinnate, ultimate segments small and many cleft, no involucre, long narrow involucels, and white flowers in July.

1. **Æ. Cynapium** L. A fetid, poisonous European herb, in cultivated grounds, from New England and Pennsylvania to Minnesota.

CONIUM L.—Fruit ovate, flattened laterally: carpel with 5 prominent wavy primary ribs, each with a large bundle of strengthening cells: oil-ducts none, but a layer of secreting cells next the seed: seed deeply and narrowly concave on the inner face (figs. 23, 24).—Poisonous biennials, with spotted stems, large decompound leaves with lanceolate pinnatified leaflets, narrow-leaved involucres and involucels, and white flowers in July.

1. **C. maculatum** L. A large branching European herb, in waste places throughout the Northern States.

POLYTÆNIA DC.—Fruit obovate to oval, much flattened dorsally: carpel with 5 primary ribs, the dorsal and intermediate small or obscure in the depressed back, the lateral forming broad thick corky wings closely contiguous to those of the other carpel and forming the margin of the fruit: oil-ducts 12 to 18 about the seed (4 to 6 on commissural side) and many scattered through the thick corky pericarp, which also contains 5 small bundles of strengthening cells: seed-section variable, oval or much flattened (figs. 25, 26).—Perennial, mostly glabrous herbs, with twice pinnate leaves (upper opposite and 3-cleft), segments cuneate and incised, no involucre, narrow involucels, and bright yellow flowers in May.

1. **P. Nuttallii** DC. Mem. Umbel. 53. t. 13. Plant 2 to 3 feet high: pedicels and involucels pubescent.—Michigan to Louisiana and westward.

EXPLANATION OF PLATE II.—Fig. 14, Fruit of Angelica Curtissii, × 7. Fig. 15, Section of carpel of same, × 20. Fig. 16, Section of carpel of A. hirsuta, × 20. Fig. 17, Section of carpel of A. dentata, × 20. Fig. 18, Section of carpel of A. atropurpurea, × 20. Fig. 19, Fruit of Cœlopleurum Gmelini, × 7. Fig. 20, Section of carpel of same, × 20. Fig. 21, Fruit of Æthusa Cynapium, × 10. Fig. 22, Section of carpel of same, × 20. Fig. 23, Fruit of Conium maculatum, × 7. Fig. 24, Section of carpel of same × 20. Fig. 25, Fruit of Polytænia Nuttallii, × 3½. Fig. 26, Section of carpel of same, × 20.

BRIEFER ARTICLES.

Carex notes.—*Carex glaucodea* Tuckm., which W. Boott, Esq., has recently referred to C. grisea, has an even, strongly curved style, completely separating it from the latter, and also from C. flaccosperma, which has an even, straight style. "Bulbous thickened" does not accurately describe the style of C. grisea, as it is often merely thickened above the base as in C. oligocarpa. But this character is sufficiently marked to disconnect it from the others mentioned. Judged by external characters only, these three species sometimes closely approach each other, but their styles are permanently different.—E. C. HOWE, *Lansingburg, N. Y.*

Ash in basket work.—In the BOTANICAL GAZETTE, vol. xi, pp. 326-328, is an article on Hierochloa borealis, in which the author describes the use of this grass in basket work. Furthermore he says: "The wood used, which forms the main part of these articles, is white ash, Fraxinus Americana, and red maple, Acer rubrum, called in Maine white maple. These woods they prepare at home, splitting the ash into strips of the requisite thinness and width by means of a machine."

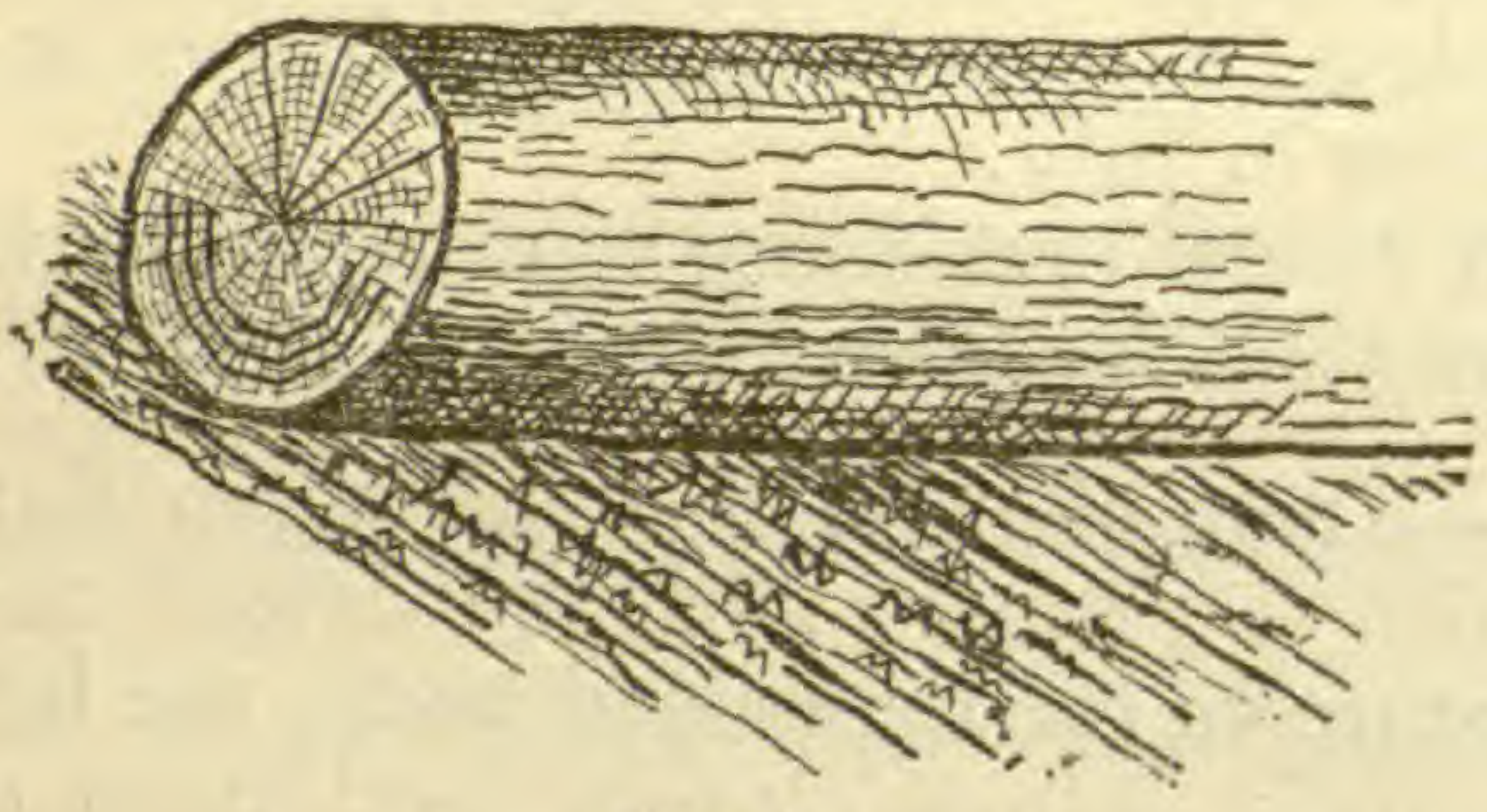

Fig. 1.

In conversation with an old basket maker, in the eastern part of Yates Township, Orleans County, N. Y., I gleaned the following facts relative to a more primitive method of splitting ash than that by machines. This basket maker first splits the ash log into wedge-shaped pieces as represented in the upper half of figure 1. These pieces are again divided into parts along the cross-lines, as seen in the lower half of figure 1. The pieces now obtained are called "bars. In order to separate the bar into strips suitable for his work, the basket maker places the bar on a block and strikes hard blows upon it with a heavy hammer. The blows fall perpendicular to the layers of growth. This causes the layers of wood to slightly separate, much in the same way as a lad in making a whistle, by pounding for a time, loosens the willow bark. In order to still farther separate the layers, the basket maker causes the end of the bar to project about four or six inches from the pounding block, and strikes more hard blows upon the projecting end. This causes the end of the bar to separate in layers, as figure 2 shows. The strips of layers of growth, or "grains" in the basket makers' terminology, can then be readily pulled apart. These strips vary in thickness and are either trimmed by various guages or are themselves split by one of two methods. Thus, the edge of the strip having been split by a knife for a distance of six inches, one of the halves is placed on the floor and the basket maker holds it down with his foot, at the same time pulling on the other split portion. Thus it is divided. Or the basket maker grasps the strip with both hands, near one end, and bends it rapidly between them; then he slips his hands up the strip and repeats the bending, etc., until he has reached the end of the strip. This procedure separates the fibres so that the strip is easily made into two. This basket

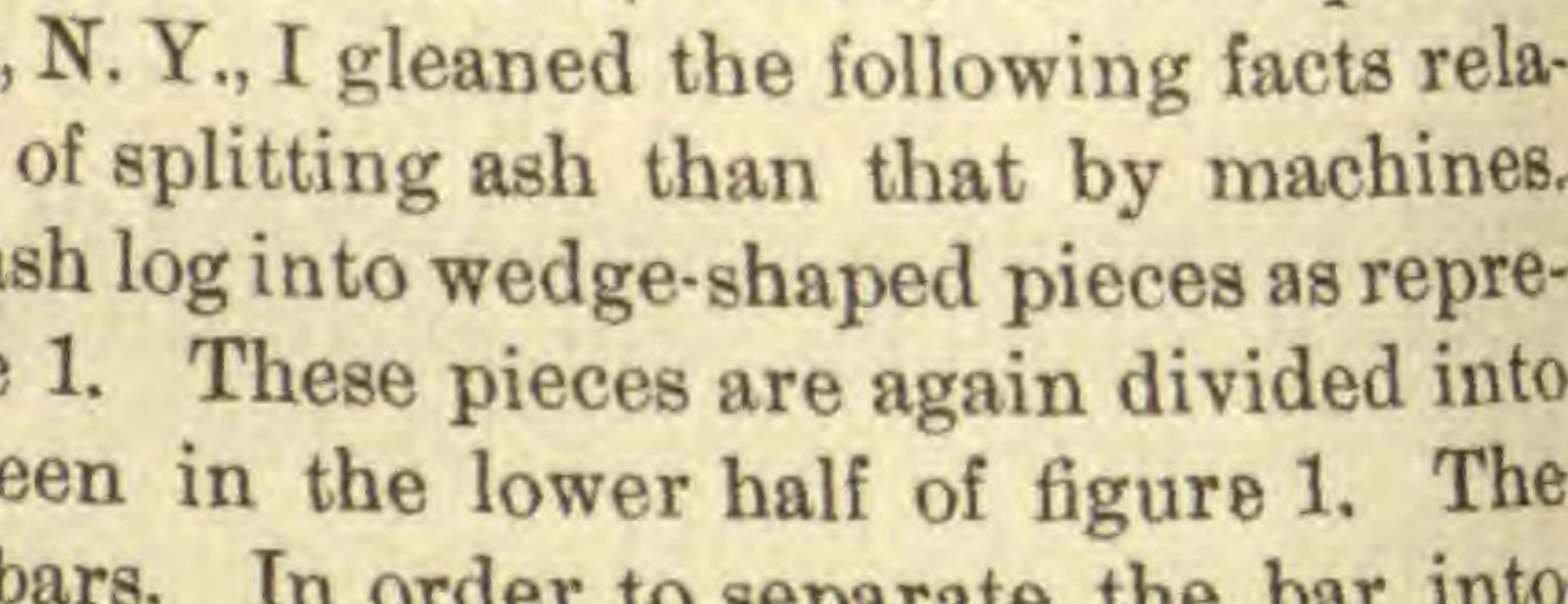

Fig. 2.

maker prefers black ash which has been exposed to the wind and sun. The best ash for his purpose is obtained from a wood-lot which is open and dry. Next to this he prefers isolated trees near a forest. He does not use black ash of the "black ash swamps," for, he says, "the grains are too thin and the wood is not as tough."

The structure of the ash determines its mode of splitting under heavy blows. It divides at the lines of demarcation of the annual layers. Here are to be seen, upon microscopic examination, large dotted ducts, whose open mouths are quite evident to the naked eye, in cross section.

The earliest mention of the ash and other trees in this section of Western New York, that I know of, may be found in a handbill issued by Joseph Ellicott, November 26th, 1800, (and quoted in Turner's History of the Holland Purchase), viz: "Those who prefer land timbered with black and white oak, hickory, poplar, chestnut, wild cherry, butternut and dogwood, or the more luxuriant, timbered with basswood, sugar tree, white ash, wild cherry, cucumber tree—a species of magnolia—and black walnut, may be suited."

I am indebted to a botanical friend, Miss L. A. Weld, for the drawings.—CHARLES E. FAIRMAN.

Astringent qualities of Heuchera and Mitella.—It is well known that astringency is a common property in the Saxifrage family, and in the west, *Heuchera hispida* Pursh., *H. cylindrica* Dougl., and *H. parvifolia* Nutt., are well known by the hunters, prospectors and others who lead a wandering life. These plants are all very astringent and are successfully employed in cases of diarrhœa of all degrees of severity. This complaint is very troublesome and all the more so on account of its liability to occur at any time. This is particularly the case in alkali regions where the water one has to drink is so bad as to bring on this sickness in a few hours. Of course no drug stores are at hand, but by a little search one can usually find one or another of the species mentioned, H. parvifolia being the commonest species in Northern Montana. Any one troubled with the complaint mentioned can, by chewing a small portion of the root and swallowing the juice, quickly relieve himself. Or where the dried root is used, some people carrying a supply wherever they go, a decoction is often made, but is very disagreeable to take. The great trouble with alum root is that if one takes only a little too much sudden constipation comes on and has been known to last for days, often causing dangerous symptoms.

We have tried several native roots at different times while far away from human habitations and have found that the root of *Mitella pentandra* Hook. is far superior to alum root. It is milder and slower in its action and besides being mildly astringent possesses a bitter principle which acts as an appetizer, as we have demonstrated to our perfect satisfaction on several occasions. The last time we employed it was in the case of a young man who had been troubled with diarrhœa for three weeks. During the last week of the period the complaint was coupled with severe indigestion and total loss of appetite. Having nothing at hand to give him we broke off the root from a botanical specimen of Mitella pentandra and divided it into two parts of about ten grains each. He chewed and swallowed one piece on the spot (about 9 A. M.) and ate the remainder at 11 A. M. Before noon he actually complained of great hunger and spoke with evident relish, to our amazement, of what he expected to have for dinner. We saw him again at 2 P. M., and he felt much better, telling us how he had enjoyed his dinner. The next morning we saw him again, and he was well in every respect, having a good appetite and digestion, his bowels being free and regular in their action. Now this man had been sick, and looked sick, for three weeks, yet that little bit of root made him well in less than twenty-four hours. We would not say that such decided results would take place in every instance, but, as mentioned before, we have used the root of this plant on several occasions with beneficial results. By accident we discovered the good quality of the plant in question. It is our custom to taste every root we find new to us, and that is the way we found out. Thinking this might be new to the public, and that the knowledge of it might be of practical value to others, we submit these remarks to the readers of the GAZETTE. —F. W. ANDERSON, *Great Falls, Montana.*

Celery Leaf Blight (*Cercospora Apii* Fres.)—This disease annually destroys about one half of the celery planted in this section; last year (1886) the loss occasioned by the parasite was not so great as in former years, owing, no doubt, to the dry weather which prevailed in this section. Frequent showers and heavy dews followed by hot sunshine favors the growth of the fungus. The fungus usually appears in this section about the first of July, and at the approach of cool weather, which usually comes on in September, the fungus gradually disappears. When fresh the conidia germinate readily (in three hours) by sending out a delicate, colorless thread from each cell. So long as the celery leaves are kept dry but few of the conidia germinate, but if the leaves are frequently moistened the fungus quickly destroys them. Celery protected from the direct rays of the sun, either by natural means, as planting under trees, or by screens made for the purpose, is rarely attacked by the parasite.

On September 26, 1886, several healthy celery plants that were growing in the open air were lifted and planted in the green-house. About one week later sowings of the conidia of C. Apii were made upon the leaves of several plants. Fifteen days later the leaves where the sowings had been made showed the pale green pustules which always appear just before the hyphæ and conidia become visible. Owing to the cool weather which came on about the time the pustules made their appearance, the fungus made no further progress, except several spots which showed the brownish hyphæ, but no conidia. The plants upon which no sowings were made remained healthy. If the experiment had been made earlier in the season the development of the fungus would have been more rapid. A form of C. Apii is quite common on Pastinaca, but is quite distinct from C. Apii on cultivated celery. In the *Journal of Mycology* (vol. I, p. 37), the form on Pastinaca is included under *C. Apii* Fres. Mr. Ellis thinks, however, that the form on Pastinaca might be called *C. Pastinacæ* with propriety, as distinct from *C. Apii* Fres.—B. T. GALLOWAY, *Columbia, Mo.*

An American Papaver.—Last summer Mr. John Spence, a florist of Santa Barbara, collected many plants in the high mountain regions of Santa Barbara County, which he submitted to me for examination. Among other novelties were the beautiful orange-colored blossoms of a Papaver. In the absence of root or foliage, it was not easy to tell whether it was P. Rhœas of Europe or something new; but, judging from the location in which it was obtained, I suspected it might be something new, and sent it to Dr. Gray. On a visit to the same locality later in the season, Mr. Spence obtained ripe seed, and succeeded in raising perfect plants, specimens of which he has sent to Dr. Gray, who decides that it is a new species. Being the first American representative of the genus, Dr. Gray very appropriately christened it *Papaver Californica.* Mr. Spence says the plant is found in quantity where the ground had been burned over the previous season, and that the large masses of brilliant orange flowers could not fail to attract attention. The same plant was found last year, by other individuals, in two different localities in the Santa Ynez mountains, and under the same conditions, on ground that had been burned over the previous year; but we have no report of its having been collected before last year.—MRS. R. F. BINGHAM.

Vermicularia phlogina Fairman (n. sp.)—Perithecia very delicate, minute, superficial, sparingly clothed with bristles of varying length, subhyaline above, darker below, continuously or sparingly septate, 60-100 μ long and 5-7 μ thick, tips (especially the longer ones) obtuse: sporules oblong, fusoid, hyaline, slightly curved, endochrome at length imperfectly divided in the middle, 15-20$\times$2½-3 μ.—Differs from *V. Coptina* Pk. in its smaller, paler perithecia and different bristles.

On leaves of Phlox divaricata. Ridgeway, Orleans County, New York, July, 1886.

This Vermicularia occurs on the phlox leaves, (generally after flowering of the host), often mixed with a Cladosporium (*C. epiphyllum* Nees?) sometimes pure, and at times suspected leaves have only the Cladosporium present.—CHARLES E. FAIRMAN, *Lyndonville, New York.*

EDITORIAL.

ONE THING is especially true of American botany—it is vigorous and progressive. The evidences of accelerating growth may reasonably support hopes of a future development as profound, even if not as massive, as Germany now possesses. We are of a mind with our German correspondent (whose views on this and other points carry all the more weight by being taken from a letter not written for publication), that time will bring us college faculties in botany, with all implied improvements and accompaniments, where we now have isolated teachers. It is, indeed, quite possible to establish a few laboratories and lecture rooms in emulation of the best the world knows, if men of erudition and indomitable energy are willing to devote themselves to the work, and can secure the backing of sufficiently large and wealthy institutions, yet to see the science acknowledged as an essential part of a general education, which is now true in a limited sense only, there must exist the conviction in the public mind that it is of greater importance than other studies which it displaces. Public attention is much more directed toward the useful at the present time than what is simply interesting. It will be good policy, therefore, for botanists to pay regard to those subjects which affect the thought and welfare of the people. In passing this way the dangerous ground of superficiality must be sedulously avoided, for our plea is not for popularity at the expense of science, but for the advancement of science by the aid of the good will of the people. Let the botany, presented by botanists, take hold of problems of human welfare and philosophy in a masterly way, and the public will not fail to show appreciation by lending its support to the advancement of the science as a whole.

OPEN LETTERS.

Anatomical Botany.

I am half inclined to take exceptions to an editorial in the GAZETTE for November, 1886, *a propos* of physiologists *versus* systematists. It seems to me that you rather ignored another group of workers, for want of a better name, anatomists. There is an immense amount of structural work, in fact, all morphological work, embryology, etc., which, to my mind, can not properly be brought under the head of physiology, and which certainly does not belong to the domain of systematic botany. Now it seems to me that just here is a great field open for our American botanists, in which very little expensive apparatus, aside from the microscope, is required. It is not all of it easy work, but certainly there is enough to be done to satisfy the most ardent of those same young enthusiasts of whom you speak, who set out to reorganize the whole science.

Bonn.

DOUGLAS H. CAMPBELL.

Ouvirandra fenestralis.

In the January number of the BOTANICAL GAZETTE the fact is mentioned that it is very difficult to keep Ouvirandra fenestralis free from algæ. This seems to be the only real difficulty in cultivating this most interesting plant, and it may be of interest to your readers that it has been overcome in the Botanic Garden at Breslau (Germany) by putting some specimens of Planorbis corneus into the tank where that plant was growing. This snail cleans Ouvirandra thoroughly without injuring it. I do not know whether Planorbis corneus occurs in America, but any other species will probably do quite as well. English cultivators recommend keeping Ouvirandra in the shade to prevent the luxuriant growth of algæ on it. (cf. Regel's *Gartenflora*, 1886, pp 308 and 6?7).

Botanic Garden, Oxford, England. DR. S. SCHÖNLAND.

Rendering herbarium specimens pliable.

A year or more ago I received a package of plants from a botanical correspondent which, though otherwise very fine, were extremely brittle, and therefore liable to be injured by handling. It happily occurred to me to try whether perhaps glycerine would render the specimens more pliable and so to a portion of my poisoning mixture (the ordinary one of 1 oz. corrosive sublimate to a quart of methylic alcohol) I added glycerine in the proportion of 4 ozs. to the quart. On treating the plants with this solution they were very much improved and could be handled without danger of undue breakage. Since then I have used no other mixture, only I have gradually improved it until now my poisoning solution is made up as follows: Alcohol, 26 fl. oz.; corrosive sublimate, 1 oz.; mix and dissolve, then add 6 fl. oz. glycerine. Plants poisoned by this solution are not only well preserved, but are also much less liable to be damaged by frequent handling. F. T. ASCHMAN.

Sharon, Pa.

German and American Botanists.

One is very soon impressed with the different standing of science in Germany and America, when he is here. I wish all our workers, and especially the young men, might come and learn something of the thoroughness, the patience and enthusiasm of the Germans. It would have a wonderful effect upon our future scientific development. The amount of original work done here is enormous. No professor of natural science is content with the mere teaching of his specialty, but strives to add something to the knowledge which he already has. Indeed, no man can long hold his place who does not do original work. The result is keen interest and competition, and a splendid scientific literature. I will not say our American scientists are at fault, because they do not do likewise, for they are overloaded with routine work, and have no time outside of college duties. They are not yet specialists, because few of our American institutions are yet broad enough to support a botanical or chemical *faculty*. But all this will come also in America in due time.

Göttingen, Germany. WINTHROP E. STONE.

NOTES AND NEWS.

THE *American Naturalist* will hereafter be published by J. B. Lippincott & Co., of Philadelphia.

PROFESSOR JOHN M. COULTER was elected president of the Indiana Academy of Science for 1887.

IN THE GAZETTE for December, 1886, page 330, in "Explanation of Plate XI," Carex gracillima should read Carex debilis.

A PAPER on North American Geraniaceæ has been presented to the Boston Society of Natural History by Dr. Wm. Trelease.

THROUGH THE kindness of a member of the corporation, the botanical laboratory of Brown University is now equipped with six of Beck's "Star" microscopes.

IN THE GAZETTE for November, 1886, there is a mistake in Professor Scribner's plate on the Black Rot. In figure 8 the μ should be *mm*. The mistake was made in copying the figure.

AN INTERESTING fungus, *Boletus decipiens* B. & C., has been found in Niagara County, N. Y., by Dr. Charles E. Fairman. Hitherto it has only been collected in the southern states.

MR. PHILIP L. COBB, of Cleveland, O., writes that Viola hastata and a white flowered variety of Cnicus arvensis occur east of that city, and that Lactuca Scariola is common in and about the city.

M. ALPH. DECANDOLLE has just distributed a paper, from the *Archives des Sciences Physiques et Naturelles*, on the botanical origin of certain cultivated plants and the probable causes of the extinction of certain species.

EXPERIMENTS made by G. H. Whitcher (*Agricultural Science*, vol. I p. 30) appear to show that the aerial roots of corn (maize), which are produced most abundantly at the time of flowering, give off ammonia during their growth.

THE *Journal of Botany* (February) contains the description (with plate) of a fine new hepatic from Killarney, by Richard Spruce. It is called Lejeunea Holtii. A list of Jamaica mosses and Hepatics is also given by Henry Boswell.

SOCIETATUM LITTERÆ is the title of a small monthly in which Friedländer & Sohn, of Berlin, propose to give a bibliographic list of papers in natural history published by the societies of the world. It is 2 marks 50 pfg. a year, or about 60 cents.

THE *Bulletin of the Torrey Botanical Club* for February contains "Notes on Diatoms," by C. Henry Kain; "Note on the Inflorescence of Camellia Japonica," by E. E. Sterns, and "A Method of Drying Plants with Little Loss of Color," by Charles E. Smith.

IT IS VERY much desired to obtain copies of the January number of 1886 (Vol. XI, No. 1.) Any botanist having a duplicate copy would confer a great favor by sending it to the BOTANICAL GAZETTE, Crawfordsville, Ind. The regular price for single copies will be paid.

THE GAZETTE has received much commendation for its very full index of Vol. XI, issued with the December number of that year. It is proposed to make all the information contained in the GAZETTE as available as possible and exhaustive indexing will hereafter be one of its features.

AT a recent meeting of the Philadelphia Academy, Miss Helen C. De S. Abbott announced the discovery of hæmatoxylin in the bark of Saraca Indica. It is another genus of the same order to which Hæmatoxylin Campechianum belongs, the only plant heretofore known to yield hæmatoxylin.

LORENZO G. YATES, of Santa Barbara, California, has published a list of Hawaiian ferns, with notes of locality, etc. Of the 129 species, ten are found in North America, five of which are Californian. Mr. Yates has also in preparation a similar list of the ferns of Ceylon, as well as a list of all known ferns, with synonymy, habitat, etc.

PROF. F. L. SARGENT gives in the *American Monthly Mic. Journal* for February an interesting paper "On the Schwendener Theory of the Constitution of Lichens." In this connection we must congratulate this journal upon its improved appearance. The abandonment of the two-column page is a decided change for the better.

MR. HENRY WILLEY, of New Bedford, Mass., is offering for sale his large collection of lichens and also his library. It is undoubtedly the most complete in this country after that of the late Professor Tuckerman. It would give any student of lichens in this country an unsurpassed opportunity for good work. The collection is valued at $2,000.

MOST OF THE ornamental indigenous plants of the United States are kept for sale in small or large lots by Edward Gillett, of Southwick, Mass., also the seeds of many kinds. His annual catalogue for 1887 makes the tenth issue, and it is pleasant to note that the commercial demand shows an increased appreciation of native wild flowers and ferns.

THE "BOTANICAL SOCIETY of Western Pennsylvania" was organized in Pittsburgh, Pa., on October 21st, 1886, with twenty-five charter members from that city and vicinity. Prof. B. H. Patterson was elected president, and Dr. A. Pettit, secretary of the new society. Monthly meetings are held, preparatory to active field work during the coming season.

THE COLUMBUS (Ohio) Horticultural Society has published a very interesting volume of proceedings for 1886. With such botanists as Professors Townshend, Lazenby and Devol at work the botanical activity of the state is reported as increasing. The only criticism to be made upon this report is its sad lack of continuous pagination. The secretary's address is W. S. Devol, Columbus, O.

A SYNOPSIS of Tillandsiæ has been begun by J. G. Baker in the February *Journal of Botany*. The suborder is in great confusion and Dr. Baker's work will be most acceptable to botanists. It contains six genera, separated into two groups by the coalescence of petals into a tube or not. In the present paper the genus Sodiroa (with three species, one of them new) is considered and two species (out of eleven) of the genus Caraguata.

THE JOURNAL of the Elisha Mitchell Scientific Society of North Carolina for the year 1885–6 shows a commendable activity in the scientific circles of that state. This publication, of about one hundred and fifty pages, contains a great variety of papers, two of which are of great botanical interest, viz.: "A Sketch of the Life and Scientific Work of L. D. von Schweinitz," with portrait, seventeen pages, containing also complete bibliography; and the "Wilmington Flora," sixty pages, by Dr. T. F. Wood and Gerald McCarthy. The latter is a full catalogue of 1,202 species and varieties, representing 527 genera and 129 orders of phanerogams. The secretary's address is F. P. Venable, Chapel Hill, N. C.

THE LAST NUMBER (December) of *Drugs and Medicines* has just come to hand. It treats chiefly of Lobelia inflata. The drawings of the microscopic structure of various parts are unusually bad—in fact, not up to the average of college student's work. The illustrations of microscopic structure have never been on a par with the other illustrations. The editors of this excellent quarterly might profitably seek to improve the work in this direction.

DR. H. W. WILEY, of the Agricultural Department, has just distributed as Bulletin 14, the record of the recent experiments at Fort Scott, Kan., in the manufacture of sugar from sorghum and sugar canes. The results are very interesting from a scientific point of view, and suggest many problems for future investigation, but the "practical" result is best stated in Dr. Wiley's own words:

"It must be confessed that the chief object of this last series of experiments, viz.: to place the industry where private capital would see its way clear to its extension, has not been attained."

THE ACCOUNT of larval entomophthora, E. Phytonomi on Phytonomus punctatus, given in the January number for 1886, is supplemented by Mr. Arthur in his recent report to the New York Agricultural Experiment Station. It is found that the germination of the spores on the surface of water differs widely from germination under water. Instead of forming mycelium they put out short hyphæ of definite length, on each of which is born a single minute spore, as shown in the accompanying figure (x 200). Such spores are well adapted by their minuteness for long distance transportation through the air.

THE INDIANA Academy of Science is a young but very vigorous organization. After a meeting to organize, the first annual meeting was held at Indianapolis during the holidays. Over 100 persons, of various scientific taste and attainment, joined, and among them the botanists were well represented. Among the papers presented, those of botanical interest were "Origin of the Indiana Flora," John M. Coulter; "Mildews of Indiana," J. N. Rose; "Chlorophyll Bands of Spirogyra," Stanley Coulter; "Additions to the Indiana Flora," Geo. C. Hubbard. In addition to these, Prof. Chas. R. Barnes gave directions for the collection of mosses. Prof. Stanley Coulter's paper brought out certain peculiarities in the action of the young bands of Spirogyra under shock and will shortly be prepared for the readers of the GAZETTE.

DR. E. LOEW has published in the *Jahrbuch* of the Berlin Botanic Gardens the results of his extensive experiments upon the reciprocal relations of showy flowers and insects. The work was intended to supplement that of Hermann Müller. Müller's investigations were conducted with the native flora of Germany. Loew, however, substituted an artificial assemblage of flowers from various parts of the world, and tried to ascertain how far the insects would make the selections indicated by Müller. In general Müller's conclusions were corroborated, but the bee tribe often made different selections when foreign plants were brought into competition with indigenous ones. Of oriental flowers they preferred the deeper-colored ones, while the lighter-colored Compositæ among American plants were preferred.

COULTER and ROSE on UMBELLIFERÆ.

VOL. XII. NO. 4.—BOTANICAL GAZETTE.—APRIL, 1887.

Notes on Umbelliferæ of E. United States. III.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE III.)

The range of Erigenia bulbosa, as given on page 15, *ante*, should be somewhat extended, so as to include Eastern Pennsylvania, along the Lower Susquehanna (*Porter*), and Tennessee (*Gattinger*). It is very much desired that botanists will not only assist us in thus perfecting the range of our species of Umbelliferæ, but also in providing good fruiting specimens. The failure of many of our best collections in fruiting specimens is somewhat remarkable, and we give this early notice, that all collectors, western as well as eastern, may take pains during the coming season to collect fruiting specimens of all the Umbelliferæ of their region. We already have to acknowledge the courtesy which has extended to us all needed assistance from the Harvard Herbarium and from the herbaria of I. C. Martindale, Thomas C. Porter, M. S. Bebb, Wm. M. Canby, Walter Deane, and S. M. Tracy.

LIGUSTICUM L.—Fruit ovate to oblong, not flattened either way: carpel with 5 equal strong primary ribs (sometimes winged), each with a group of strengthening cells: oil-ducts 2–4 in the intervals, 6 on the commissural side: seed-section somewhat dorsally flattened: stylopodium conical (figs. 27–30).—Smooth perennials, with aromatic roots and fruit, 2–3 ternately compound leaves, and white flowers.

1. **L. Scoticum** L. Spec. 250. Stem simple, 1–2 ft. high: leaves twice ternate; leaflets ovate, coarsely toothed; fruit narrowly oblong, 4–5 lines long; oil-ducts small, 2–3 in the intervals; seed-section nearly semicircular (figs. 27, 28).—Salt marshes, New England. Fl. August.

2. **L. actæifolium** Michx. Fl. i. 166. Stem branched above, 2–6 ft. high: leaves thrice ternate; leaflets broadly oblong, coarsely serrate: fruit ovate, 2–3 lines long; oil-ducts large, 3–4 in the intervals; seed-section pentagonal (figs. 29, 30).—Rich ground, S. Pennsylvania to Kentucky and southward. Fl. July and August.

TIEDEMANNIA DC.—Fruit ovate to obovate, flattened dorsally: carpels with 5 primary equidistant ribs; dorsal and intermediate filiform; lateral extended into broad wings, closely contiguous to those of the other carpel, forming a winged margin to the fruit, nerved dorsally at the inner margin, giving the appearance of five filiform ribs on the back of each carpel; strengthening cells under each rib and nerve: oil-ducts solitary in the intervals, 2–6 on the commissural side: seed-section oblong to broadly oval: stylopodium short, thick, conical (figs. 31–36).—Smooth erect aquatic herbs, with leaves reduced to petioles or of few narrow leaflets, involucre and involucels present, and white flowers. Eastern species. Including *Archemora* DC.—Bentham and Hooker have included both Tiedemannia and Archemora under Peucedanum. They are very distinct in habit from our own Peucedanums, which are low dry ground western forms, with much dissected leaves and mostly yellow flowers. The fruit characters still further confirm this difference of habit, the carpels being much more flattened dorsally in Peucedanum, giving a narrow seed-section, the lateral wings nerved ventrally (on commissural side) instead of dorsally, thus giving the appearance of but 3 filiform ribs on the back of each carpel, the stylopodium depressed or wanting instead of conical, and no involucre. These characters seem sufficient not only to separate Tiedemannia and Archemora from Peucedanum, but to unite them into a single genus. No fruit character can be made to separate them, and the only distinction would have to be drawn from the leaves, and this breaks down in the intermediate Archemora ternata. So many salient characters unite Tiedemannia and Archemora, and so few can be made to separate them, that it seems best to consider them a single genus, and one well distinguished from Peucedanum, at least in North America. Archemora Fendleri of the south-west is probably not a member of the genus.

1. **T. teretifolia** DC. Mem. Umbel. 51, t. 12. Stem hollow, 2–6 feet high: leaves reduced to cylindrical hollow pointed nodose petioles: oil-ducts filling the intervals, 2–4 on commissural side (figs. 31, 32).—Virginia to Florida and Louisiana. Fl. August to September.

2. **T. ternata.** Stem slender, 2 feet high: leaves ternate, with linear entire leaflets, the lower long petioled, or sometimes reduced to a flat-tipped petiole: oil-ducts smaller, 4 on commissural side (figs. 33, 34). *Archemora ternata* Nutt. —North Carolina to Florida. Fl. November.

3. **T. rigida.** Stem 2–5 feet high: leaves simply pinnate, with 3–9 linear to lanceolate entire or remotely toothed leaflets:

oil-ducts small or sometimes large, 4–6 on commissural side (figs. 35, 36) *Archemora rigida* DC.—New York to Minnesota and south to the Gulf. Fl. August.

PEUCEDANUM L.—Fruit roundish to oblong, much flattened dorsally: carpels with 5 primary ribs; dorsal and intermediate filiform and approximate; lateral extended into broad wings, closely contiguous to those of the other carpel so as to form a winged margin to the fruit, strongly nerved ventrally (on commissural side) at the inner margin; strengthening cells under each rib and nerve: oil-ducts 1–3 in the intervals, 2–6 on the commissural side: seed-section much flattened (figs. 37, 38).—Dry ground acaulescent (or short caulescent) herbs, with fusiform roots, dissected leaves, no involucre, mostly yellow (sometimes white) flowers, and stylopodium depressed or wanting. Western species.—The strong nerve on the commissural face of the lateral wings seems to be a constant and distinctive character, taking the place of the dorsally placed nerve on the lateral wings of Tiedemannia.

1. **P. nudicaule** Nutt. Torr. & Gray, Fl. i. 627. Low, nearly acaulescent, pubescent: leaves much dissected: flowers white: fruit nearly round, 2–3 lines broad; oil-ducts small, solitary in the intervals, 2–4 on the commissural side.—Minnesota to Iowa and westward. Fl. in earliest spring.

PASTINACA L.—Fruit oval, very much flattened dorsally: carpels with 5 primary ribs; dorsal and intermediate filiform; lateral extended into broad wings contiguous to those of the other carpel, strongly nerved towards the outer margin; strengthening cells continuous about the seed cavity and under the nerves: oil-ducts small, solitary in the intervals, 2–4 on the commissural side: seed-section very much flattened: stylopodium depressed (figs. 39, 40).—Tall stout biennial, with pinnately compound leaves, mostly no involucre, and yellow flowers.

1. **P. sativa** L. Stem grooved: leaflets ovate to oblong, cut-toothed.—Introduced everywhere. Fl. July–September.

Bentham and Hooker include Pastinaca under Peucedanum, although the fruit characters are quite distinct and almost identical with those of Heracleum. In fact, were it not for the remarkable petals of Heracleum and its conical stylopodium Pastinaca could not be distinguished from it. In comparison with Pencedanum the fruit of Pastinaca is much more dorsally flattened, the lateral wings are strongly nerved towards the outer margin, instead of at the inner margin on the commissural side, and a remarkable layer of strengthening cells completely invests the seed cavity, instead of occurring in small isolated groups beneath each rib, all of which characters are shared with Heracleum. As of minor importance the habit of Pastinaca is not that of Peucedanum, but rather that of Heracleum. Pastinaca is thus characterized by the fruit and habit of Heracleum and the floral character of Peucedanum, and had better stand as an intermediate genus. The length of the oil-ducts, a character sometimes used, is far from constant. In Peucedanum they are generally as long as the fruit; in Pastinaca sometimes as long and sometimes shorter; in Heracleum generally about half as long, though sometimes nearly as long.

HERACLEUM L.—Fruit oval, somewhat narrowed at base: like *Pastinaca*, but with thick conical stylopodium (figs. 41, 42).—Tall stout perennial, with ternately compound leaves, deciduous involucre, white flowers, and obcordate petals, the outer ones commonly larger and 2-cleft.

1. **H. lanatum** Michx. Fl. i. 166. Woolly, stem grooved: leaflets broad, irregularly cut-toothed.—Wet ground, throughout the northern states, and as far south as North Carolina and Kentucky; also westward. Fl. June.

EXPLANATION OF PLATE III.—Figures 27, 29, 37, 39, 41, are × 4; figures 31, 33, 35, are × 6½; all cross sections are × 20.

A Botanical Tramp through North Carolina.

GERALD M'CARTHY.

After spending some five or six days in botanizing in the Tar river country, I shipped my presses, etc., by wagon, to Newberne, about forty-five miles farther south, and followed on foot, with portfolio and box, prepared to collect along the way. The road over which my route lay extended for the greater part of the forty-five miles through a series of gum and cypress swamps. These swamps had been flooded by recent heavy rains, and were now aggregated into one vast quagmire. Long stretches of the road were covered, often to a depth of three feet, by the coffee-black water of the swamps, and in places was crossed by deep streams, which connected the basins of the different swamps. Bridges are everywhere absent, the only means provided the foot-passenger for getting across such places being what is called the "foot-log." The foot-log causeway is a characteristic institution of subaqueous Carolina. It consists of logs, usually of bald cypress, strung across the stream, and supported at the ends by piles driven a few feet into the soft ooze beneath. The upper surface is chipped off, so as to furnish a level and slippery pathway of some twelve to sixteen inches breadth. Frequently, after getting half way across some wide lagoon or stygian stream, the wayfarer is confronted by a yawning chasm, where the connecting logs have been swept away by the rising flood. It may be, too, that the twilight is fast deepening into the Egyptian darkness of the cypress swamp. Then the belated traveler must wade if he can, swim if he must.

The most abundant trees of all this wet region are the valuable black gum and bald cypress. The latter often rises to a height of over one hundred feet, and attains a girth of twenty-five feet or more above the swollen base. Where the trunks are not overcrowded, each one is surrounded by a palisade of cypress knees. The use of these curious excrescences can perhaps be explained by some of our biologists. Some one has suggested that they are intended to protect the sapling tree from injury by floating ice, a service, indeed, they are well fitted to perform, only it must be remembered that ice and the current to give it momentum are both usually absent from cypress pools. It may be, however, that the swamp water, which has a strongly acid reaction, acting upon the soft, spongy texture of the wood, has something to do with the production of these apparently useless appurtenances, as well as the swollen base of the trunk itself.[1]

The cane, Arundinaria macrosperma, mingled with Scirpus lacustris, Typha latifolia, and Smilax laurifolia, forms an impenetrable jungle along each side of the road, which it would soon invade were it not for the corduroying process.

Separating the basins of the different swamps are ridges of higher ground, usually with clayey soil. These ridges are often treeless, and are then covered by rank-growing sedges and aquatics. Among the sedges I noticed the following: Cyperus strigosus, C. retrofractus, C. Haspan, C. rivularis, C. flavescens, C. flavicomus, and C. Grayii, Dulichium spathaceum, Fuirena squarrosa, Eleocharis tubercu-

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[1] The ordinary function assigned to "cypress kness" is that they permit the access of air to the roots. Also see BOTANICAL GAZETTE, viii. 286.—EDS.

losa, Eriophorum Virginicum, Fimbristylis spadicea, Rhynchospora inexpansa, R. alba, R. oligantha, R. microcarpa, R. pallida, R. gracilenta, R. Torreyana and R. glomerata. R. corniculata is rather scarce, but increases southward. Dichromena leucocephala, D. latifolia, Scleria triglomerata, S. oligantha, S. Elliottii, S. gracilis and S. laxa abound. Of carices the most common are C. flavescens, C. vulpinoidea and C. lupulina. This genus is by no means so well represented as one would expect.

But the flora of these lonely swamps is, like the swamps themselves, rather monotonous. The collector will often get as complete a set of species in a single day as he can secure by a whole week's labor, even though he force his way, as the writer did,

> "Through tangled juniper, beds of reeds,
> Through many a fen where the serpent feeds,
> And man never trod before."

There are very few grasses to be met with in the swamps, and these are of little interest. Panicum Crus-Galli, Agrostis vulgaris, Panicum dichotomum and Paspalum Floridanum are about all.

The shrubs and trees which sometimes cover the high ridges include Gordonia Lasianthus, Stuartia Virginica, Magnolia glauca, Cyrilla racemiflora, Oxydendron arboreum, Quercus aquatica, Q. Castanea, Alnus serrulata, Cupressus thyoides, Juniperus Virginiana, Acer rubrum, and one or two species of willow.

The Autumnal changes in Maple Leaves.

W. K. MARTIN AND S. B. THOMAS.

The results we would record in this paper were obtained from investigations conducted in the botanical laboratory of Wabash College. The work was done during the time of the autumnal changes, so that abundant and fresh material was constantly at hand. The object was chiefly to note the changes in the cell contents as the death of the leaf approached, and to localize, so far as possible, the changes in color.

The structure of the normal green maple leaf is shown in figure 1, consisting of the ordinary epidermal layer above and below, a single cell in depth, a single layer of rather elongated palisade cells, and usually about three layers of spongy parenchyma, more closely packed than usual. The chlorophyll bodies are small and thickly and evenly distributed throughout the mesophyll cells.

The first indication of the approach of autumnal changes is the withdrawal of the contents of the mesophyll cells. This goes on gradually, but the cells are seldom emptied. The amount of protoplasmic cell contents lost to a plant by the fall of its leaves must be very considerable. The whole mass of the chlorophyll bodies in any cell is much reduced by this process of withdrawal (see figures 2 and 3). At the same time the protoplasm of the cell seems to dispose of much of

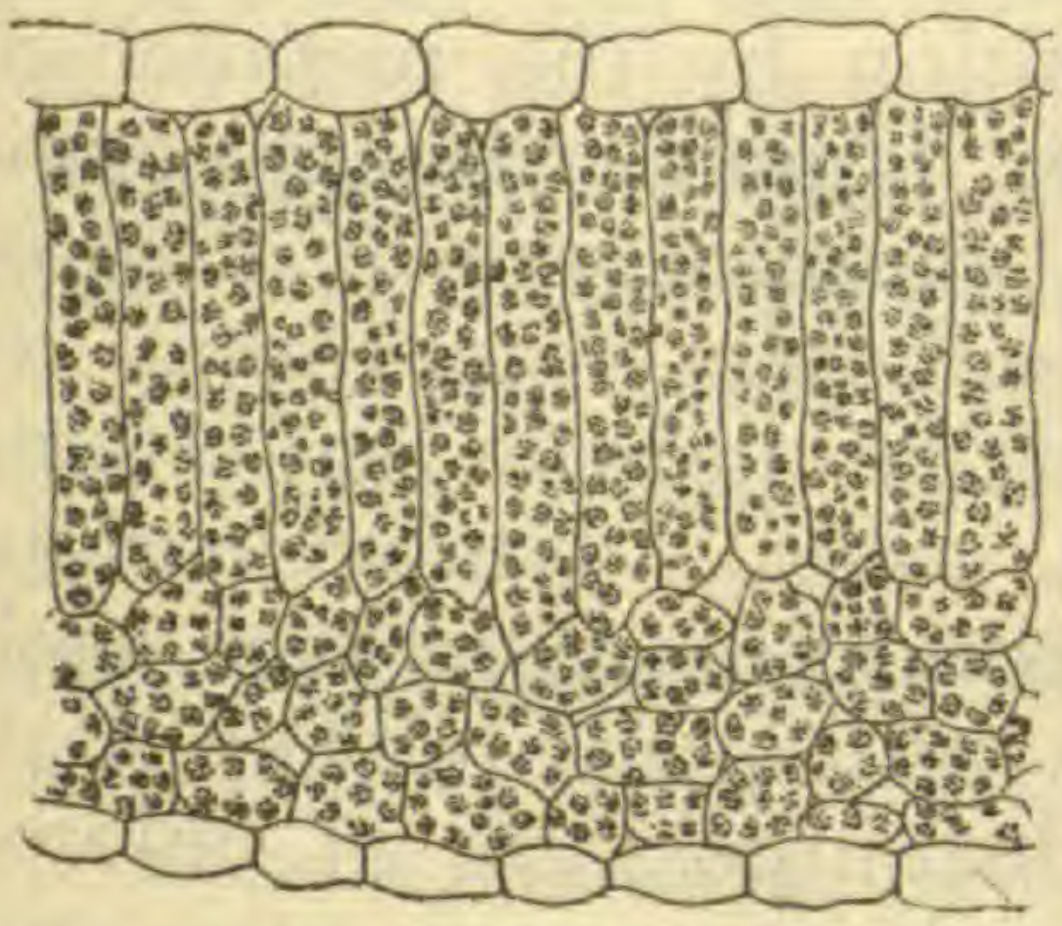

FIG. 1.

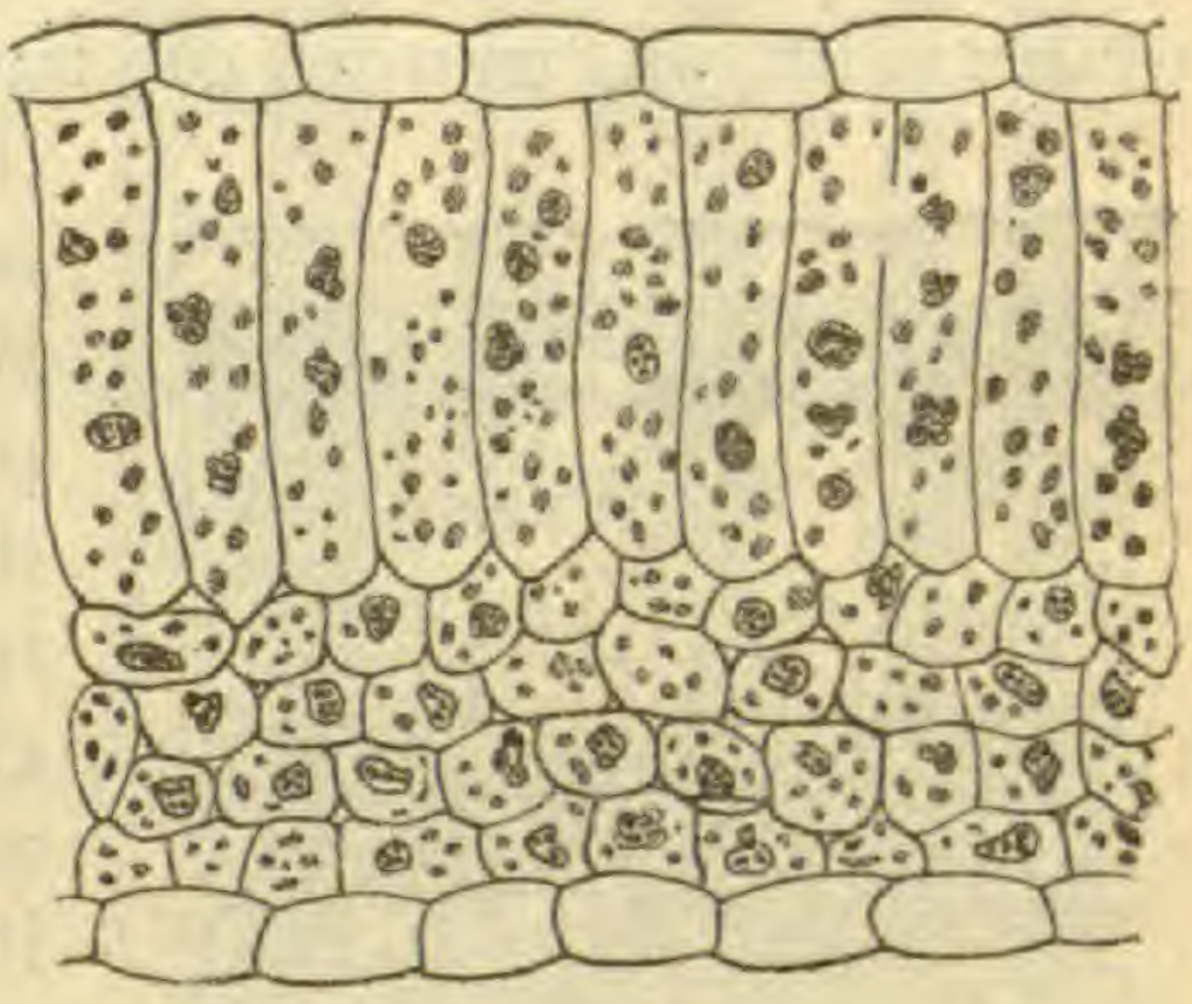

FIG. 2.

its substance in the manufacture of cellulose, chiefly in the palisade cells, in which it is deposited upon the cell walls in successive layers, either uniformly or in restricted patches, or is used occasionally in building a transverse partition across a palisade cell (fig. 4). In every case the lines of stratification are beautifully marked. That this deposit is cellulose was determined by the ordinary tests for that substance. During these changes the chlorophyll bodies are seen both to disintegrate and to blend together in larger masses. In the case of the red leaf these larger masses often become invested by a pellicle which appears to be cellulose.

In the leaf which has become brown (fig. 2), a greater amount of cell contents remain than in the red, the chlorophyll bodies do not mass together so much, and the cell sap is a dirty brown.

In the red leaf (fig. 3) the cell contents are even more reduced, some cells being almost empty, the remaining contents are mostly collected in masses of considerable size and often surrounded by the pellicle referred to, and the cell sap is colored by the characteristic red coloring matter, erythrophyll.

In the yellow leaf the cell contents are much like those of the red leaf, but the cell sap is colorless and the chlorophyll masses are stained yellow by xanthophyll.

What has been said of red and yellow and brown leaves is applicable as well to groups of cells in the case of mottled leaves.

The existence of erythrophyll and xanthophyll in these positions, the former in the cell sap, the latter in the solid cell contents, is of course well known in a general way. But we wish to add an additional fact or two in the explanation of these phenomena. Chlorophyll, manufactured constantly under the influence of light, is as constantly undergoing decomposition by the metabolism of the cell. Under ordinary conditions the manufacture of chlorophyll is sufficient to cover up its decomposition and the leaf retains its green color. Under certain changed conditions, however, such as intense light or diminished vitality, the decomposition of chlorophyll exceeds its manufacture, and xanthophyll (probably one of the products of its decomposition[1]) appears. In other words, xanthophyll is being formed all the time, but only becomes apparent when the manufacture of chlorophyll is checked. The condition of intense sunlight gives us the occasional summer yellowness, while to lowered vitality must be attributed the failure of chlorophyll manufacture in the autumn. This lower vitality is brought about by diminution of light, lowering of temperature, and probably causes in the plant itself. The common notion that frost is the cause of autumnal coloration is true only so far as it is one of the causes which tends to diminish the vitality of the plant and so the manufacture of chlorophyll. Autumnal coloration may take place before any frost. Xanthophyll then stains the chlorophyll masses yellow, which were before stained green by chlorophyll.

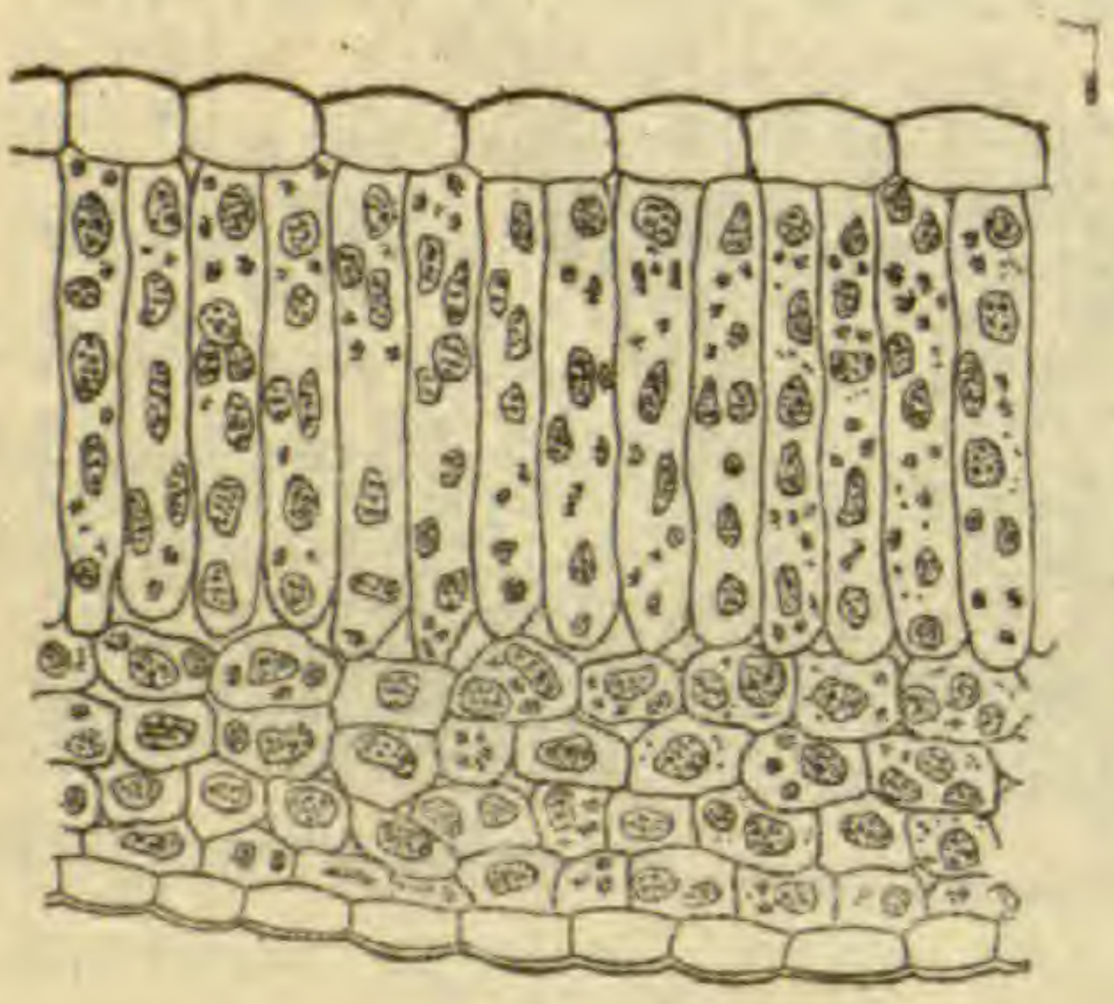

FIG. 3.

The red coloration is brought about in a very different way, as erythrophyll is manufactured in the leaf and stains

[1] Vines' Physiology of Plants, p. 241.

the cell sap, leaving the chlorophyll masses untouched. This red coloring matter can not be discovered in any of the crude materials brought into the plant, or in any other part than the leaves, except sometimes in the phloem regions of the petioles. When the leaf falls and the cell sap evaporates, and the chlorophyll bodies die, the erythrophyll lays hold of the cell wall and solid contents and stains them. In this way dried leaves retain their red color As erythrophyll is soluble in water, however, contact with moisture will soon cause the most of it to disappear. In the case of many cells containing erythrophyll we found the chlorophyll masses retaining their green color. In fact, the green was so slow in disappearing that it was only in the most advanced stages that it had given place to the yellow of xanthophyll. In some cases, where chlorophyll masses were in contact with external cell walls, they had become yellow, while in the same cell those masses completely surrounded with erythrophyll remained green. The explanation of this seems to lie in the fact that in the red rays the decomposition of chlorophyll goes on less actively than in the rays of low refrangibility.[2] The erythrophyll thus acts as a check upon the decomposition of chlorophyll, and so on the appearance of xanthophyll. It thus seems that all the leaves would become yellow but for the presence of erythrophyll. The brown coloration seems to be a modification of the red, the erythrophyll color of the cell sap being replaced by a dirty brown. Whether this is a resultant from the action of erythrophyll upon certain cell contents, or an entirely different coloring matter, was not ascertained.

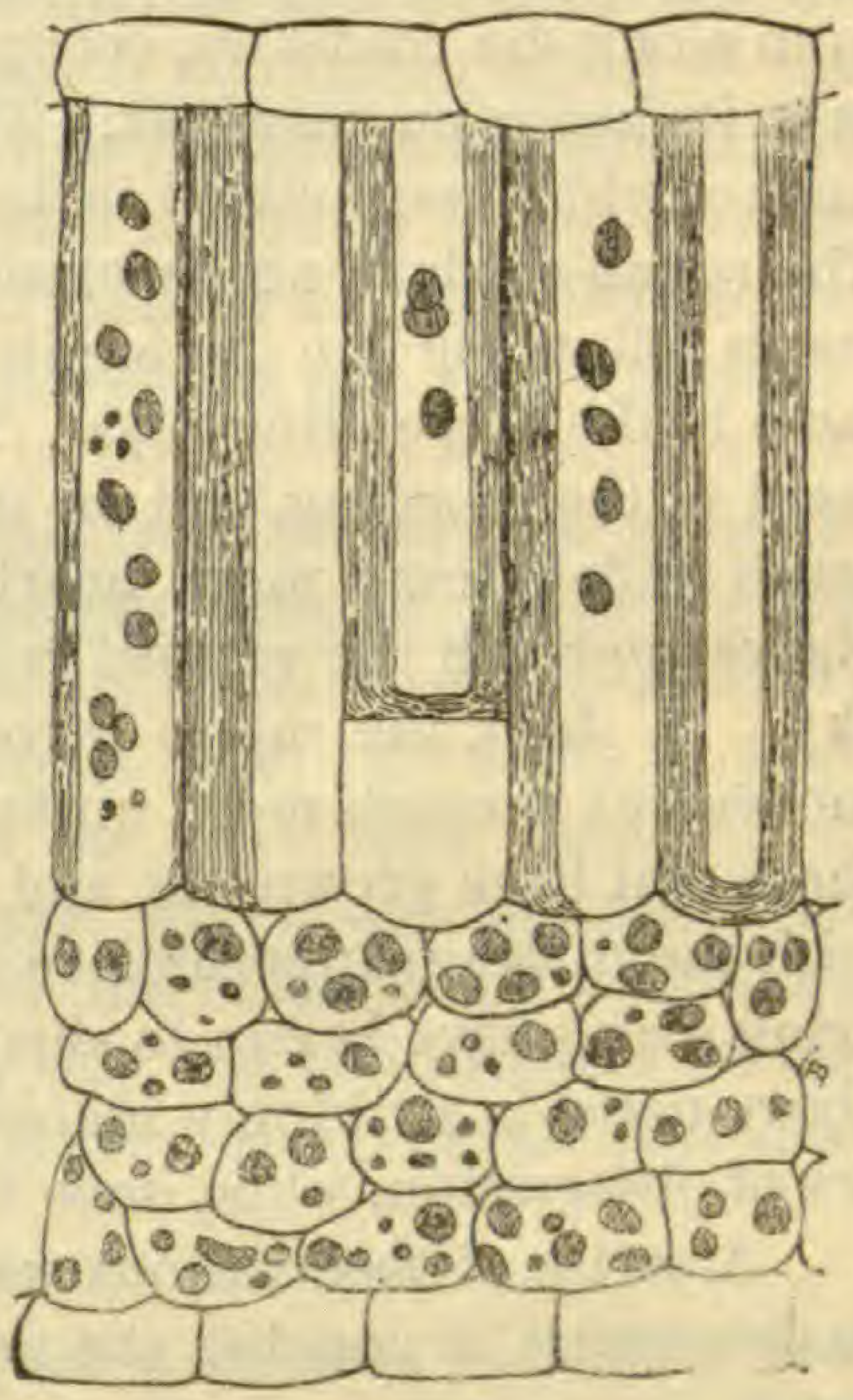

FIG. 4.

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[2] Vines' Physiology of Plants, p. 266.

BRIEFER ARTICLES.

A Plant Heliostat.—The *Malva borealis* Wall. is a very common weed in cultivated ground throughout Southern California. It is an annual that quickly springs up in rich, tilled soil that is at all neglected. This "Malva," as it is appropriately called, is an almost constant stimulus to better culture, and stands ready to possess the soil, for a time at least, so soon as the harrow, gang-plow or hoe ceases to make frequent visits. The large areas in walnut groves, orange orchards, open fields for grain growing, and even along the roadsides, occupied by this weed, made any observations as to its habits an easy task. The most interesting characteristic of this mallow, which was noticed, is the heliotropic power possessed by the foliage. The round-cordate, neatly crenate and more or less five to seven-lobed leaves follow the sun during its daily course, and present their upper surfaces to the descending rays. The position of the blades is facing eastward in the morning, and as the day advances the laminæ turn to the south and become more nearly horizontal. During the afternoon the blades approach the vertical position, and at sunset they face the western sky. In short, the malva leaves are living heliostats. This heliotropic movement is much more uniform in the leaves of young plants than in those that have grown old and woody. Over an area entirely covered with the malva plants that are about six inches high, and before any flowering stems have begun to shoot upward, the peculiarity of the leaves above noted is strikingly manifest to any person, however blunt his powers of observation, when once his attention is called to the matter.

A series of observations was made upon the movement of the leaves to determine, if possible, the portion of the blade that is most active in the turning, and also to discover the method of the return from the evening position to that assumed in the morning. By pushing small wooden stakes into the soil, and thus marking the position of a leaf at any given time, together with the use of strings tied upon the leaves, the changes could be determined. Frequent observations were required at all times of the day and far into the night. It was found that the point of torsion was located just below the blade in a short portion of the upper end of the petiole. At this place, averaging a line in length in the most active leaves, the petiole is of different color and texture from the remaining lower portion of the long petiole. The fibro-vascular bundles here converge from their several strands into one central tough thread, and the surrounding soft tissue is similar to that of a pulvinus in nyctotropic and sensitive plants. The exterior of this portion of the petiole is of a reddish brown color. The blade effects its daily turning at this place, and when night comes on it returns to its morning position by retracing the path taken during the day. In no case was there any indication of any attempt to make an entire revolution. The backward movement begins as soon as the sun is set; in fact the following of the sun is not so pronounced after 3 o'clock (and earlier on dark days) as up to that hour. It seems as if the sun drew the leaf around by its own attraction, and the blade moves back to its point of rest when the force is withdrawn. There was no evident daily motion observed in the remaining portion of the long petioles. It is true that they varied their position from time to time, but with no regularity. Petioles on the eastern side of a plant remain more nearly horizontal than those located elsewhere. Those upon the north and south sides are more upright, with a tendency to point eastward. The western leaves are nearly upright, so that the blades may be able to catch the direct rays of the morning sun. At night there is an evident falling of the petioles as if to assume a position of rest, while the blades become nearly horizontal at the same time. By 9, or at most 10 o'clock in the evening the plant reached its position of repose, and an hour or more before the sun's morning rays can strike the plant the blades are all in position. Three distinct views of a malva patch may be obtained at any time when the sun is shining. If the view is, so to speak, from the sun, that is, in the direction of the rays of light, only the upper surfaces of the leaves are seen; if toward the direction of the sun, the under surfaces are in view. The difference between the shades of green of these two views is very marked. A third view is at right angles to the sun's rays, from which point the leaves are only seen by their edges, which are inclined from the perpendicular, the angle depending upon the height of the sun at the time of observation. Upon a dark, stormy day the heliotropism of the leaves is in a large degree suspended.—BYRON D. HALSTED, *Botanical Laboratory, Ames, Iowa.*

Leaf Prints.—Several years ago I devised a method of taking leaf prints of marked beauty, and a specimen of the work recently sent to Dr. Gray elicited the reply: "'Tis a new way; better send account of it to BOTANICAL GAZETTE," etc. I do so, prompted by the belief that the method may be of actual usefulness to the botanist as well as a refining recreation for those who love nature "on general principles." There will be needed for the work: 1. A small ink roller, such as printers use for inking type. 2. A quantity of green printer's ink. 3. A pane of stout window glass (the larger the better) fastened securely to an evenly planed board twice the size of the glass. A small quantity of the ink is put on the glass and spread with a knife, after which it is distributed evenly by going over in all directions with the ink roller. When this has been carefully done, the leaf to be copied is laid on a piece of waste paper and inked by applying the roller once or twice with moderate pressure. This leaves a film of ink on the veins and network of the leaf, and by placing it on a piece of blank paper and applying considerable pressure for a few moments the work is done, and when the leaf is lifted from the paper the impress remains with all its delicate tracery, faithful in color and outline to the original.

To get the best results, however, several points must be carefully noted. Get a quarter or half pound of *dark* green ink, which is put up in collapsible tubes costing from 50 cents to $2 a pound, according to quality. As sold it is invariably too thick for this purpose, and should be thinned by adding several drops of Balsam Copaiba to as much ink as may be taken on a salt spoon. Much depends on the proper consistency of the ink. In inking, the leaf is apt to curl on the roller, but it should part readily from it. In case it sticks tightly, *the ink is too thick.* Take care that the ink is evenly distributed on the glass and roller, as it is essential that each part of the leaf receives an equal coating of ink. If the leaf is large, ink it part by part, keeping the roller supplied frequently. A roller three inches long, costing 40 cents, will answer for all small leaves and branches of plants (clean the roller with benzine after using). If the leaf is finely veined the lower surface makes the better print, but if the veins are coarse and large the upper surface may be used. If the specimen is fleshy or brittle, allow it to wilt until it becomes more pliable, or, if necessary, it may be pressed and dried first. In most cases the best copy is obtained after taking one or two impressions, as the leaf takes the ink better after several applications. A good quality of unsized paper that is made slightly damp by putting in a cellar several hours before using is best for general work, but in other cases well sized paper will take a copy that will allow a *foliotype* (may I coin the word?), to bear inspection side by side with a good lithograph. I find a little press very valuable in making the impression, especially if the leaf is at all coriaceous. If it be soft, it should be covered with a few thicknesses of newspaper. If it is irregular in thickness, paper may be laid over the thin parts so that equal pressure is received. This is necessary with all leaves that have thick stems. If the leaf or branch is very irregular or delicate, or in the absence of a press of any kind, the specimen may be covered with several layers of paper and held in place with one hand while the pressure is applied with the thumb or palm of the other hand as required.

These particulars are as complete as practicable; experiment will lead to many improvements in details. Employ tact and neatness and you will be surprised at the result. For illustrating monographs, and similar papers where the number is too limited to warrant an expensive lithograph, for identifying a rare specimen, or as an adjunct to an herbarium, combining portability, unalterability and beauty withal, the method seems particularly fitted. But aside from this, others may find a delightful and instructive recreation in taking prints of the entire flora of the old farm, the trees of a certain grove, the native annuals of a county, the ferns of a state, or any other special field that seems most inviting. Such copies may be taken in a blank book suited to the pur pose, or better, take them on single sheets of uniform size, as in this way imperfect copies may be thrown out, and when the work is completed they may be named, classified and bound, making a volume of real value and worthy of just pride. I would esteem it a favor as well as a pleasure to hear personally from any who may employ this method in any way the coming season, concerning the progress of their work, with its attendant imperfections and successes.—HORACE M. ENGLE, *Marietta, Pa.*

A method of staining Peziza specimens.—Decolorize the Pezizæ by soaking in a solution of corrosive sublimate (1 to 2000 Aq. Dist.). Wash from precipitated calomel by agitation in distilled water. Macerate in 90 per cent. alcohol for twenty-four hours. For immediate examination, lower for a few seconds in a strong hæmatoxylin solution, wash in distilled water; or, if preferred, use the dilute hæmatoxylin fluid. (See Campbell, *ante*, p. 40.)—CHARLES E. FAIRMAN.

A visit to Washington.—A brief visit to the capital of the country recently gave an opportunity of inspecting some of the botanical work in progress under the auspices of the government, a short account of which may interest others.

The casts of fruits, vegetables and fungi, naturally colored, with other material illustrative of the vegetable kingdom, first attract the attention of the visitor, as he passes through the museum on the second floor of the Agricultural Building on his way to the herbarium. Entering the herbarium one is pleasantly greeted by the head of the Botanical Division, Dr. Vasey. During his fifteen years of service the botanical work of the department has expanded and developed new features, giving rise to two lusty offshoots, the Forestry Division and the Section of Vegetable Pathology.

The large double room of the herbarium is lined with tall cases filled with the 200,000 sheets, or so, of mounted specimens, with tables and low cases in the center for bulky specimens. In this room also are the desks of the assistants. The division is fortunate in having recently secured the services of Mr. Crozier, of Michigan, who is now engaged in preparing a catalogue of the North American desiderata. This will be heartily appreciated by the botanists of the country, enabling them to contribute desirable material, as they have long expressed a willingness to do, when they should be informed of the needs of the herbarium.

On the next floor above are the rooms of the Forestry Division. The work here does not profess to be botanical, but as it deals with trees, many of the problems being treated biologically, and employs several eminent botanists in the field, the botanists of the country will naturally take an interest in the work and its results. Mr. Sudworth, of Michigan, has recently been appointed assistant.

Adjoining rooms are occupied by the Section of Plant Pathology, under the care of Prof. Scribner. We found various diseased and injured parts of plants lying about, awaiting study. This work having but recently been begun the library and collections are small, but they are well selected and thoroughly indexed. The microscopic and other appliances show an appreciation of good tools. This room and the one on the floor above, occupied by the assistant, Mr. Erwin Smith, also of Michigan, have but lately become available for this use, being formerly occupied by the statistician, who now has rooms in the new seed building not far distant. Mr. Smith was working on diseases of potatoes, and other matters, carrying on cultures and making microscopic examinations.

On the upper floor are also the rooms belonging to the Bureau of Animal Industry; the one for the culture of bacteria, presided over by Dr. Theobald Smith may properly be considered to be partially botanical. There were the various appliances for thorough bacteriological work, and yet the rooms and furnishings are by no means as good as the importance of the subject should warrant. It is fortunate that pine tables and battened doors do not detract from the accuracy of scientific results secured in their presence.

In a broad gallery of the National Museum is another botanical quarter. There is a large herbarium here also, including American and foreign plants arranged in a single series, put up in a similar way to those at the Agricultural Department. But the chief interest lies in the work on fossil plants. Several workers are engaged under Prof. Ward in indexing the literature of the subject, which is put in card-catalogue form for the present, but eventually is to be printed. The amount of labor required is enormous, but the results will be of inestimable value to future workers. Series of specimens which are being studied are arranged in drawers. These are carefully selected, and then passed into the hands of assistants, who make drawings of them, working out with much patience every detail of the structure which the rock can be made to furnish. The weight of the specimens and the indistinctness of the impressions make the drawings desirable for comparison and study, while the specimens are always at hand for verifying doubtful points. Proofs of the plates to be used in the volume on the Types of the Laramie Flora, which is now in press, showed fine work, and some interesting features in photogravure.

In a room still higher up we met Mr. Knowlton studying the microscopic structure of fossil wood, the first work in this branch of paleobotany that has been done in a systematic way in this country. It is a surprise to find how perfectly the structure of some silicified woods is preserved, the drawings appearing as if taken from living plants. The preparation of the sections for study is not difficult, but consumes time; however the study is a fascinating one.

Lack of time permitted only a cursory inspection of these several centers of botanical activity, a glance into the plant houses at the Agricultural Department, and a sight of the Botanic Garden from the distance; and it may be that other botanical attractions in the city were entirely overlooked. Enough, however, was seen to make it clear that Washington contains many elements of botanical interest, and that valuable botanical work is being done there, directed by a coterie of genial botanists. Let fellow scientists pay the city a visit whenever convenient to do so, and they will be amply rewarded.—J. C. A.

EDITORIAL.

THE TWO EXTREMES of botanical teaching are frequently referred to. They may be called the ancient and the modern, and neither alone is productive of the best results. The subject is a much discussed one, but is never decided, the chief result being a settling down to some intermediate position which is likely to be the right one. When two methods of teaching have their acknowledged advantages, and when the only disadvantage of either is that it lacks the other, it would seem that the best method would be to combine the two, and thus obtain all the advantage and eliminate all the disadvantage. The ancient method gives a wide range of acquaintance with external forms, a general knowledge of the plant kingdom and its affinities, a living interest in the surrounding flora; but it disregards the underlying morphology of minute structures and chemical processes, the great principles which bring plant life into one organic whole. The modern method, on the contrary, takes a few types, carefully examines their minutest structures and life work, and grounds well in general biological principles; but it loses the relation of things, as well as any knowledge of the display of the plant kingdom in its endless diversity, and worse than all for the naturalist, cultivates no love for a flora at hand and inviting attention. The former is the method of the field, the latter of the laboratory. The wise teacher will adopt both methods and thus avoid the greatest disadvantage of either. The most natural way of combining the two seems to be to begin with the old method, an unrivalled one in awakening enthusiastic interest and kindling the naturalists' fire, and then to lead to the other. What naturalist has not begun with the fever for collecting? And to what more natural impulse in the young can appeal be made? Theoretically, the science of botany may be said to best begin with the study of protoplasm or Protococcus, but the natural order of the human mind in approaching the subject may be different. We venture to make the assertion that no competent teacher of botany is ever satisfied with the results from using one method exclusively, and that no teacher, however strongly he may write or talk concerning modern methods as the only ones, fails to incorporate some of the old with the new. The botanical teaching of the future will consider these not as two opposing methods, but as complementary, both essential to the rounding out of a botanical course.

BEFORE THE botanical activity at our American colleges can be much increased, the Board of Trustees, Regents and Presidents must get rid of the prevalent and most pernicious idea that a college professor's time must be chiefly occupied by teaching. An acquaintance of the writer received lately an invitation to the botanical chair of a well-known Ohio college, in which, after reciting the duties of the chair, the President added: "As at present the professor's whole time will not be occupied, he may be asked to take also some additional work of a congenial nature." Why can not those in authority see that the giving up of the whole time to instruction is the chief cause of the lack of scientific spirit in our colleges as compared with those of Germany? Give any man who has the capacity for original research in him the time necessary for the prosecution of such work and in five years he will attract more students to the institution with which he is connected than he would by fifty years of the most commendable teaching. It is not the fame of DeBary the teacher, but of DeBary the investigator, that draws students to Strasburg. And it is so in every case. The host of German botanists, who might be named, attract American students, not because they are eloquent lecturers or faithful instructors, but because the German University demands that they spend the chief share of their time in conducting original investigation. When American colleges are willing to pay men living salaries, when they demand that *their* professors shall be able to conduct original researches, and when they allow time for the work, then shall we see botany and all the kindred sciences flourish. Such a college would be as a tree planted by the rivers of water!

OPEN LETTERS.

The Honzo Dsufu.

In looking over your note, p. 46, *ante*, on "A Japanese botanical work," I found some typographical errors in the name of its author, which should be Iwasaki Tsunemasa, or rather in your way of writing a personal name Tsunemasa Iwasaki. He lived in Tokyo, and devoted his time and attention to making illustrations of plants in the extensive collection of his own garden, and of those which he met with during his botanical tours and elsewhere. Most of his drawings were made from nature, and with such artistic skill and knowledge of the characters of plants, that one can determine the species with the aid of his plates with readiness and safety. This great work was finished in 1828. The arrangement of the work is after the classical Chinese herbal, the Honzōkōmoku. I think that there are about a dozen complete sets now in existence, either in private or government possession. In the preface of the "Enumeratio Plantarum in Japonia sponte crescentium" by Franchet and Savatier, an account of the work is given at some length on pp. vi and vii.

Botanical Laboratory, Harvard University. K. MEIYABE.

Humblebees and Petunias.

In the October number of the BOTANICAL GAZETTE I noticed a note from Mr. Schneck, stating the manner in which the humblebees extract the honey from the flowers of Physostegia Virginiana, by making a slit in the base of the corolla. Following is a similar case: During last summer I noticed that the humblebees never attempted to enter the tubes of the common garden Petunia, but alighted on the upper side of the corolla, made a slit in its wall near the calyx and inserted their proboscis to extract the honey. The slits were about one-third of an inch long and were made by the bee pressing his mandibles against the corolla, and so forcing apart the tissue, which tears easily in a longitudinal direction. I have not yet noticed whether the flowers so mutilated are after all fertilized by other smaller insects entering the tube. GILBERT VAN INGEN.

Ithaca, N. Y.

CURRENT LITERATURE

Analytical Key to West Coast Botany, containing descriptions of 1,600 species of flowering plants growing west of the Sierra Nevada and Cascade crests, from San Diego to Puget Sound. By Volney Rattan. 12mo. 128 pp. A. L. Bancroft & Co., San Francisco, 1887.

The author is already known by his "Popular California Flora," and this is a continuation of the effort to bring the botany of the west coast within the reach of the schools. This "Analytical Key" is preliminary to a West Coast Botany for beginners, which is promised within three years. Umbelliferæ and Compositæ are omitted, and the more difficult monocotyledonous orders, but the names of the other species are placed within easy reach of beginners. This kind of work is very helpful to botanical science in general, and we expect it to result in a greater array of botanists than ever from the west coast.

Die natürlichen Pflanzenfamilien, by A. Engler and K. Prantl. Part I. Leipzig: Wilhelm Engelmann, 1887.

This is the beginning of a very extensive and important work, and the names of its editors assure botanists that it will be well done. It is intended to give an account of all the natural orders of plants, including their genera and principal species, and is fully and handsomely illustrated. Each order is to be monographed by a specialist, and thus the work will not only be of a high order, but probably completed within a reasonable time. This first part is devoted to palms, by O. Drude, and contains a full account of their distribution (geological as well as geographical), economic value, and structure, both vegetative and reproductive. Botanists will watch the progress of this work with great interest.

Manipulations de Botanique, guide pour les travaux d'histologie végétale, par Paul Girod. 72 pp., 20 plates. Paris, 1887.

This is one of the many books of to-day useful as laboratory guides. The first part briefly describes microscopic appliances and methods of using them. Then follow such subjects as "dicotyledonous stems," "monocotyledonous stems," "dicotyledonous roots," etc., all the way to algæ. Brief directions with each plant taken up, and a plate on the opposite page containing careful drawings of all the sections, clear troubles from the path of the student as completely as any laboratory guide we have ever seen. While by no means complete or explicit enough to serve the whole purpose of a laboratory guide in histological botany, it will be very useful to the advanced student as a book of reference, and in suggesting different lines of work.

Die fossilen Hölzer West Indiens, von J. Felix. Cassel, 1883.

This work, which has but recently been received in this country, is another one of the many valuable contributions of Dr. Felix to the interesting and difficult study of the internal structure of fossil wood. This department of paleobotany, which may be said to have had its origin in the year 1830, when Witham published his first observations, has, during the past few years, attained a remarkable activity in Europe, and particularly in Germany.

Several of the West Indian islands, and particularly the island of Antigua, have long been noted for their deposits of fossil wood, and many specimens had found their way into European museums from this locality. These specimens, through the kindness of the various curators, were placed at the disposal of Dr. Felix, and the results of their study is the present monograph.

Before proceeding to the detailed description of the species he remarks somewhat at length upon the difficulty attending the study of monocotyledonous and dicotyledonous wood as compared with that of coniferous. In the latter there are but three elements to be considered: "Tracheiden, Strang und Strahlen-Parenchyma," while in the former the tissues are numerous and complex, consisting of parenchyma, annular, spiral and scalariform vessels, wood cells, bast-fibres, etc. As the result of his personal examination of over four hundred living species, belonging to various families, the author concludes that a study of the histological structure alone is not in general sufficient for the identification of genera or species, since, as he says, different species of the same genus may differ so extraordinarily in their structure that, should one have them before him only in a fossil state, they would never be referred to the same genus. Again, species of different genera may so much resemble each other that, if known only in a condition of fossilization, they would undoubtedly be referred to the same genus; for example, Sophora Japonica, Robinia hispida and Gleditschia triacanthos; also different genera in the same family may differ from each other in a very marked degree, as do the genera Amorpha, Sophora and Erythrina in the Leguminosæ. But, notwithstanding the difficulties in the way of specific or generic determination, the family can probably in all cases be recognized. The genera of fossil plants founded upon histological data must then be comprehensive. Salicinium, for instance, will include Populus as well as Salix.—F. H. KNOWLTON.

Handbook of Practical Botany. By E. Strasburger, Professor of Botany in the University of Bonn; edited from the German by W. Hillhouse, M. A., F. L. S., Professor of Botany, Mason Science College, etc. 8°. pp. xxiv, 425. London: Swan Sonnenschein, Lowrey & Co. 1887.

This book adds another admirable help to the study of plant anatomy in the laboratory. Teachers everywhere hailed with delight the appearance of the *Botanisches Practicum* of Strasburger, and, shortly after, of its abridgement, *Das Kleine botanische Practicum*. The translation and careful editing of the latter now puts a most excellent manual into the hands of English and American students—for it must be confessed (though with somewhat of shame) that most American college students can not use a German book with any profit. Most of our readers already know the arrangement and excellence of the book from the German edition. "The manual is divided into thirty-two chapters, each of which is intended to provide material for several hours' practical work in the laboratory. The earlier chapters are easy, and the difficulties to be encountered increase almost constantly up to the last chapter." To each chapter the editor has prefixed a list of materials necessary, and regrets that he did not also list the reagents to be used. Both are excellent ideas. The enlarged appendices, containing lists of reagents and notes on their preparation and use, are very valuable. Throughout the work the editor has interpolated phrases and paragraphs which serve to make clearer the author's meaning and supplement the study which he directs. The additional illustrations which are given are the ubiquitous ones from Sachs, DeBary and Prantl, which, though good, do not compare favorably with the fresh and beautifully executed originals of the *Practicum*.

As to translation, the work is perhaps as well done as usual, though it must be said that the English is not "the King's English." It is plain, however, that this is attributable to the influence of the German upon the translator. It is hardly possible for a man to translate from the German directly into good English, unless he be an exceptional scholar. One must either be content to write out the literal translation, lay it aside for several months and then reduce it to readable English, or let some one else correct the manuscript. Such sentences as these are not uncommon: "So much drawing ability as is necessary for this he may indeed possess, or can however readily obtain by practice the necessary facility." "So much water is also poured into the plate till the bell-shade has its lower edge quite immersed in it." Nor do we like some of the terms the editor has adopted; such, for instance, as *fibro-vasal* for vascular or fibro-vascular. Was it an accident that all reference to the fact that this is a translation of "Das *Kleine* botanische Practicum," and not of "Das botanische Practicum," was omitted?

But aside from whatever slight faults the translation has—and what book is free from them?—the fact is that this work is certain to prove highly helpful to botanical students, especially to "those who, without desiring to become professional botanists, wish nevertheless to become acquainted with the elements of scientific structural botany." May their tribe increase! As our American colleges run, this will be an excellent book to put into the hands of a student who has completed the "Handbook of Plant Dissection." Finally the book is admirably manufactured. The limber binding, all but unobtainable in this country, is delightful.

The Principles of Pharmacognosy, an introduction to the study of the crude substances of the vegetable kingdom, by Friedrich A. Flückiger, Ph. S., M. D., Professor in the University of Strasburg, and Alexander Tschirch, Ph. D., Lecturer on Botany and Pharmacognosy in the University of Berlin. Translated from the second and completely revised German edition by Frederick B. Power, Ph. D., Professor of Materia Medica and Pharmacy in the University of Wisconsin. New York: William Wood & Co., 1887. 8vo. pp. xvi, 294, with 186 figures.

In presenting to American students a translation of a standard German work by authors of eminence in their department of applied science, Professor Power, a botanist of no small attainments, as well as an accomplished chemist, has rendered a considerable service to botanists. Aside from its value as a pharmaceutical handbook, this little volume, with its copious and accurate illustrations, is an admirable treatise on elementary vegetable histology, based essentially on Haberlandt's Physiologische Pflanzenanatomie. The work of the translator is well done; the type and wood cuts are excellent. The book should find a place in every botanical laboratory.—W. T.

Contributions to American Botany, XV. By Asa Gray. From Proc. Amer. Acad., xxii. pp. 270–314.

This contribution is largely concerned with a revision of certain polypetalous genera and orders precursory to this part of the Synoptical Flora. In Papaveraceæ three tribes are proposed, *viz.*, Platystemoneæ, Papavereæ, and Hunnemanniæ, and a revision of Eschscholtzia (nine species) is given. A new generic key is proposed for Portulacaceæ, and notes on all the genera with a revision of Claytonia, with twenty-one species, are given. In the consideration of the Malvaceæ the tribe Malveæ has its sub-tribes reduced to two, allowing Sideæ to include all the genera with capitate stigmas. A tentative arrangement is proposed for the perennial species of Sidalcea. The very closely related genera Malvastrum and Sphæralcea are still kept up, but with a new distribution of species. All those species are retained in Malvastrum in which there is no empty terminal portion in the carpel, but the cell conforms to the solitary ovule and seed. This gives a Malvastriform section to Sphæralcea, and in our Rocky Mt. species, for example, Malvastrum coccineum retains its place, while Malvastrum Munroanum becomes Sphæralcea Munroana. *Horsfordia* is a new genus, between Sphæralcea and Abutilon, of two species. H. alata is Sida alata of Watson, and H. Newberryi is Abutilon Newberryi of Bot. Calif. A new order, CHEIRANTHODENDREÆ, is established, containing the genera Cheiranthodendron and Fremontia. Bentham first placed these genera in Malvaceæ, but later transferred them to Sterculiaceæ. Dr. Gray thinks it better to recognize the peculiarities of these genera, of which the leading one is the strongly quincuncial calyx, and not to force them into an order of which a valvate calyx is an essential and substantially an unvaried character. New species of Mr. Pringle's collecting are also described in addition to these under the heading "Miscellanea."

Outlines of Classification and Special Morphology of Plants. By Dr. K. Goebel. Translated by Henry E. F. Garnsey, and revised by I. B. Balfour. Oxford: Clarendon Press, 1887. pp. xii, 515.

The original of this new edition of Sach's "Text-book of Botany," Book II, has been in the possession of botanists since 1882, but this most helpful translation puts it within the reach of all English speaking botanists. There has been considerable delay in its publication, as the reviser's preface is dated 1885, but it is none the less welcome. The chief thought of the book seems to be to "make use of a consistent terminology based upon homology," a thing of great educational value, although there are some who may think it is not the best plan. For example, to call a pollen-grain a microspore may seem to be doing violence to a long established name, but when it is understood that the microspores of Phanerogams are called pollen-grains, there can be no objection to using the latter name as a special group-name, and at the same time retain the idea of homology. Objections of this kind are chiefly raised in the new terminology of Phanerogams, but the clear way in which this is stated, at the same time acknowledging the old names, can not be too highly commended. In fact, the whole treatment of Phanerogams is masterly, and is probably the most valuable contribution in the book, and should be carefully studied by every student of botany. The changes in the grouping of plants are known from the original German text, but it may be well to note them here Four great groups are recognized, viz., THALLOPHYTES, MUSCINEÆ, VASCULAR CRYPTOGAMS, and SEED-PLANTS or PHANEROGAMS. It would seem more uniform to call the three last groups Bryophytes, Pteridophytes and Spermaphytes. Under Thallophytes five equivalent groups are recognized, which involves the greatest change from the original grouping as given by Sachs. *Myxomycetes* and *Diatomaceæ* are set apart as the first two groups, to which no serious objection will be made, unless that it seems somewhat unnatural to separate diatoms and desmids so widely. The third group contains *Schizophyta*, while the fourth and fifth are *Algæ* and *Fungi*. The last two groups seem to show the widest departure from the original presentation of these plants. The teaching that the presence or absence of chlorophyll makes no special difference in the presence of morphological resemblances has been widely taught. However, the present use of these terms has not been absolutely restricted by the former distinction between algæ and fungi, and so morphological resemblance has not been slighted. The group *Algæ* is made to contain three sub-divisions, viz., *Chlorophyceæ*, *Phæophyceæ*, and *Rhodophyceæ*, or green, brown, and red seaweeds. *Fungi* contains six sub-divisions, viz., *Chytrideæ*, *Ustilagineæ*, *Phycomycetes*, *Ascomycetes*, *Uredineæ*, and *Basidiomycetes*. The second great group, MUSCINEÆ, comprises *Hepaticæ* and *Musci*. The third group, VASCULAR CRYPTOGAMS, contains *Filicineæ*, *Equisetineæ*, *Sphenophylleæ* (a fossil group), and *Lycopodineæ*. The grouping of SEED PLANTS is that which has been long familiar to botanists. Not the least valuable part of the book is the appended "Explanation of terms." Altogether, this work is the most valuable recent contribution in the English language to the classification and morphology of plants.

NOTES AND NEWS.

PROF. AND MRS C. S. SARGENT have gone to Mexico, via Key West and Galveston.

DR. ASA GRAY and wife sailed for Europe April 7. The Doctor goes chiefly to visit the Lamarck herbarium.

DR. C. S. SARGENT reports that 70,000 trees and shrubs have been planted at the Arnold Arboretum during the last year.

COOKE'S HANDBOOK of British Fungi, 2d edition, being issued as a supplement to *Grevillea*, has now reached page 192, and species 709 in the genus Agaricus.

DR. GRAY'S new book, to take the place of "How plants grow" and the "Lessons," which have done such yeoman service, is about ready for the press.

A. P. MORGAN gives descriptions and an analytical key to the species, twenty-four in number, of the North American Amanitas of the genus Agaricus, in the March *Journal of Mycology*.

THE *Gardener's Monthly* says that Dr. Rothrock has been compelled to take a year's vacation on account of his health. He will go south, spending the summer among the mountains.

THE WILMINGTON FLORA, by Thomas F. Wood and Gerald McCarthy, already noticed in this journal, has been distributed separately as a reprint from the Journal of the Elisha Mitchell Scientific Society of N. Carolina.

THOMAS HOWELL, of Arthur, Oregon, has just distributed a catalogue of the Phanerogams and Pteridophytes of Oregon, Washington, and Idaho. Mr. Howell is a well-known collector, and his catalogue is thoroughly reliable.

DR. LORENZO G. YATES (Santa Barbara, Cal.) has distributed his list, with notes, of the ferns of Ceylon. The catalogue contains extracts from manuscript notes of Dr. Thwaites, and the published works of Hooker, Baker, and Wall.

THE *Bulletin* of the Washburn College (Topeka, Kan.) laboratory of Natural History is an excellent publication, devoted to the natural history of the state. Its various numbers contain much information concerning the flora of Kansas, especially the cryptogamic flora.

PROF. W. R. DUDLEY, of Cornell University, will start in a few months for a year's study and travel in Europe. Cornell has the admirable regulation that a professor may take one year in seven, with half salary, for going abroad. Professor Dudley has taught in the University ten years, and well merits this opportunity for relaxation.

THE *Pharmaceutical Era* is a monthly periodical, begun with the year, and among other departments has one devoted to botany, under the charge of Charles F. Wheeler. Mr. Wheeler is well known as one of the authors of the Catalogue of Michigan Plants. The new periodical is edited by Dr. A. B. Lyons, is published at Detroit, and costs $1.50 a year.

WE REGRET to announce the death of Dr. Eichler, of the University of Berlin, and Director of the Botanic Garden, where he succeeded Alexander Braun. Through his editorship of the *Flora Brasiliensis*, succeeding von Martius, his researches among Coniferæ and other orders, and his *Blüthendiagramme*, he is one of the most widely known of our botanists.

HORTICULTURAL NOMENCLATURE is the subject of an article by Prof. L. H. Bailey, Jr., in *Agricultural Science* for March, in which he advises the use of English for the part of the name referring to the cultural condition, or, if Latin must be used, to separate the parts of the name denoting the cultural and natural condition of the plant by a comma, or the abbreviation "hort.," but not by "var."

PART III. (Oct.–Dec., 1886) of the Proc. Philad. Acad. contains several articles of botanical interest, as follows: History and biology of pear-blight (conclusion), J. C. Arthur; Notes on the lichens in the herbarium of the Academy, J. W. Eckfeldt; On the interdependence of plants, and Petiolar glands in some Onagraceæ, Thomas Meehan; On hæmatoxylin in the bark of Saraca Indica, Miss H. C. De S. Abbott.

IT WAS a happy and fruitful thought which led B. A. Elliott & Co., of Pittsburg, to attract the attention of the public to the stock in which they deal by issuing the handsome work on "A few flowers worthy of general culture." It is a small quarto, profusely illustrated with artistic engravings, and with an interesting text quite free of shoppy flavor, advocating the use of hardy plants for the lawn and garden, including native sorts.

IN THE *Torrey Bulletin* for March, Arthur Hollick and N. L. Britton give an account of *Cerastium arvense* L. and its North American varieties, accompanied by three plates, one of them colored. Some six varieties are described, two of which are new, and one of these is C. oblongifolium of the Manual. A full synonymy and bibliography are given. In the same number Mr. Thomas Morong describes a new Eryngium from Louisiana.

IN *Science* for March 11, Mr. B. E. Fernow enters his protest against the sweeping judgment of Professor Sargent condemning foreign trees. He calls attention to the facts that forestry and arboriculture are not the same thing, and that New England is not all of the United States. With forest conditions and in other regions of our great domain Mr. Fernow claims that it remains to be seen whether the cultivation of foreign trees will be profitable.

THE HISTORY of the currant is treated by Dr. E. L. Sturtevant in the Proceedings of the N. Y. Hort. Society for 1887. The author traces it among the early horticultural writers, especially the pre-Linnæan herbalists, it being first mentioned by Ruellius in 1536. His conclusion is that "the currant fruit has not changed at all in type under culture, but has furnished variety characteristics in increased size, diminished seed and improved quality."

IN THE *Journal of Botany* for March, B. Daydon Jackson gives an interesting account of the preparation of the new "Index of plant-names," a work of tremendous labor and of equal importance. Some idea of its magnitude may be estimated from the statement that "rather more than 30,000 covers were required for the genera, and the whole of the MS. is accommodated in 178 boxes, housed in two sets of pigeon-holes; the entire MS. is computed to weigh rather more than a ton."

NOTES ON microscopical methods for the use of students in Cornell University, prepared by Prof. S. H. Gage, cover the requirements of general microscopical instruction in a thorough and serviceable manner. The work, illustrated with nearly a dozen lithographic diagrams, is an ample introduction to the use of the microscope and its accompaniments for students in either animal or vegetable histology. It is intended by the author to be used with his notes on histological methods, published a year ago.

THE SUMMER SCHOOL of Harvard University will be held at the Botanic Garden, Cambridge, Mass., beginning Wednesday, July 6th, and ending Saturday, August 6th. The course has been planned with reference to the needs of teachers, and will include laboratory work in the morphology of phanerogams and cryptogams, under the direction of Mr. James E. Humphrey. Professor Goodale will lecture on the morphology and physiology of phanerogams, and Mr. Humphrey on the morphology and classification of cryptogams.

THE *American Naturalist*, though long delayed, makes its appearance doubly welcome by an entirely new dress. It is to be congratulated upon its improved appearance. The botanical articles are "Parasitic bacteria and their relation to Saprophytes," by Theobald Smith, and "History of garden vegetables," by E. L. Sturtevant. In the botanical department we find "Pollen-tubes of Lobelia," "The tree-trunk and its branches," "The article 'Schizomycetes' in the Encyclopædia Britannica," and an account of the various botanical journals.

THE December number of the *Journal of the New York Micros. Society*, received the middle of March, closes the second volume. The journal barely maintains the promise of its beginning. The leading articles of the present number are singularly elementary in tone, as if addressed to amateurs. It is accompanied by a supplemental number devoted to experiments in raising diatoms in the laboratory, by Rev. Samuel Lockwood. This is one of the most valuable articles yet published, and recounts the tests by which it was proven that several species of diatoms could be grown from minute resting spores after the lapse of fourteen to sixteen years.

DR. GRAY'S opinion regarding the capitalization of plant names was recently secured by a correspondent of the *American Florist*, and the following extract from it may be of interest to botanists: "No botanist writing in the English or Latin language would ever write the name of a genus, say Rosa or Begonia, without a capital initial letter. But if any one is writing generally about roses, or begonias, or phloxes, or such names, which you use as English plurals, it is simply a matter of taste and usage whether to use a capital or small initial. There is a strong tendency to the latter, and I see no harm in it. I do not fall into that custom in my books, partly for this reason: When I write Strawberry, Flax and Wheat, I mean the p ant so called; and when I write strawberry, flax or wheat, I refer to the fruit, fibre or grain, and when I write rose I mean the flower, not the plant. This I find convenient and useful; but the common usage seems to me perfectly proper."

THE GOVERNMENT appropriation for the fiscal year ending June 30, 1888, to support the botanical part of the Department of Agriculture, is $15,440. Of this sum $9,400 goes to the Section of Plant Pathology (as the *Section of Mycology* is henceforth to be known), and $6,040 to the remainder of the Division of Botany. The appropriation for the present fiscal year was $8,200, inclusive of the mycological part, and for the preceding year, $3,000. If memory is not at fault, earlier annual appropriations never exceeded the last figure. Those who know about the expenditure of this money, know that good use is made of it, and feel gratified at the evidences of increasing usefulness.

A RECENT WORK on British Fungi by W. D. Hay, called an elementary text-book, proves, upon examination, to be neither elementary nor a text-book in any proper sense, but a semi-popular treatise on edible fungi. Whoever essays to use it, however, should first be master of the subject in order to check the author, whose statements are frequently not above criticism. One is prepared for this upon finding that the author acknowledges no help, and says that he has "never met with any person versed in mycology." The source of the fifty-nine plates, forty-four of which have no connection with the text, is not divulged, but any one familiar with the works of the more prominent mycological writers could guess closely. It seems probable that the publishers, a good firm, have been caught napping.

IN A RECENT meeting (Jan. 20) of the Linnean Society, Mr. J. R. Vaizey read a paper on the morphology of the sporophore in mosses. The "central strand," surrounded by a single layer of cells is composed, as is well known, of an outer cylinder of elongated cells with somewhat thickened walls and a central region of smaller thin-walled cells. The former Mr. Vaizey calls *prophloem*, the latter, being conductive of water, *proxylem*. This proxylem only differs from the xylem of vascular plants "in the absence of spiral thickening and lignification of the cells." "The prophloem differs still less from phloem," though no sieve tissue has been discovered; but this is lacking in some vascular plants. The conclusion drawn is that mosses and vascular plants have descended from a common ancestor, similar to the Anthocerathæ.

AT A MEETING of the Linnean Society of London, January 20, 1887, a paper was read by Francis Darwin and A. Bateson upon "The effects of stimulation on turgescence in vegetable tissues." The important results announced are summarized as follows by the *Journal of Botany*: (1) Turgescent pith placed in water increases in length, at first slowly, then more quickly, and then again the rate of increase becomes slow; (2) the rate of increase in length increases as the temperature of the water rises, reaches an optimum, and suddenly falls as a temperature sufficient to cause flaccidity is reached; (3) the following reagents cause distinct acceleration, *viz.*, alcohol, ether, ammonia and hydrocyanic acid; the first three a very temporary effect, whereas prussic acid has a prolonged action; (4)

the following reagents produce retardation, *viz.*, acetic acid, hydrochloric acid and probably nitric acid; (5) dilute solutions of quinine, of quinine chlorate, and carbolic acid produce a remarkably rapid shortening of the pith.

DR. A. GATTINGER has just distributed copies of the "The Tennessee Flora," containing the Phanerogams and Pteridophytes of that state, with special reference to the Flora of Nashville. There are few regions more interesting, botanically, than Tennessee, and no botanist more competent to write of its flora than Dr. Gattinger. The summary shows the list to number 1,708 species and varieties. Several new species have been recently described from Tennessee, discovered by Dr. Gattinger, as for example, two Leavenworthias, a Hypericum, a Silphium, a Solidago, etc. An unfortunate oversight is that some of these new species appear as if described in this catalogue for the first time, when the original descriptions have been previously published elsewhere. For instance, Hypericum lobocarpum and Silphium brachiatum were both originally published in the BOTANICAL GAZETTE, but there is nothing to indicate it in the catalogue, where they are described as new species. The catalogue will be welcomed by botanists as containing the first full record of the plants of a very rich flora.

THE CONTRIBUTIONS of Dr. Asa Gray to the Proceedings of the American Academy of Arts and Sciences embrace a very large number of original descriptions of American plants and critical notes on the same, with which every systematic botanist desires to be acquainted, and to such the following list will prove serviceable. This does not include papers published in the memoirs of the society, which are alluded to in the Proceedings, or of remarks reported by the secretary. The two papers of 1860 are abstracts of observations on natural selection, about which much discussion arose in the Academy at the time, and are not strictly botanical. The articles began to be called *Contributions* with volume ix. As stated in a previous issue, the author, upon solicitation, has consented to place some of the remaining numbers in the hands of the Curator of the Harvard Herbarium, from whom they can be obtained at thirty-five cents each.

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COULTER ard ROSE on UMBELLIFERÆ.

VOL. XII. NO. 5.—BOTANICAL GAZETTE.—MAY, 1887.

Our "tripetalous" species of Iris.

SERENO WATSON.

A century has not been time enough for American botanists to become acquainted with two of the most peculiar of their species of Iris, to say nothing of other eastern species, which, after an even longer time, still remain only imperfectly known, some of them almost unknown.

In 1788 Walter described with unusual fullness his *I. tripetala*, of which nothing more was learned until the time of Elliott (1816). As there had been a prior *I. tripetala* of Thunberg, Walter's name was changed by Pursh to *I. tridentata*, but it was restored by Elliott, the African species having been transferred to *Moræa* some years before the date of Pursh's Flora, where it still remains. There is no reason why Walter's name should not hold good, in which case Pursh's falls wholly to the ground. Elliott knew the species only as growing in the ponds of St. John's and St. Stephen's parishes, South Carolina, where Walter had found it. Its range has since been extended from the low districts of North Carolina to Florida. The only figure that has been given of it is as *I. tridentata*, Pursh, in Sweet's British Flower Garden (1828), t. 274, from plants which had been recently introduced from North America and cultivated at the Fulham Nurseries. The figure is a very good one and answers closely to Walter's description.

In the next year there appeared in Curtis's Botanical Magazine (t. 2886) a figure, and a description by Sir W. J. Hooker, of an Iris under the name of *I. tripetala*, Walt., said to have been communicated by David Falconer from his collection at Carlowrie, Edinburg, but without indication of its original source. It is evidently a different plant from that figured by Sweet, and represents fairly, so far as the flower is concerned (but with broader leaves and much larger spathe), what we now know as a peculiar Canadian species. This Mr. Falconer, as appears from Loudon's Gardener's Magazine (1827), had in cultivation a very full collection of the known species of Iris and was endeavoring to make it complete. As there was frequent communication between England and Canada it is reasonable to suppose that this plant had been obtained by him directly from that province.

The discrepancy between the two figures, and between the plants in cultivation, was soon noticed, and in the same magazine for 1829 there is a note respecting an "*Iris Falconeriana*, Penny in Hort. Eps. ed. 2 ined.," named in compliment to Mr. Falconer of Carlowrie. "*I. tridentata*, Sweet, B. F. G. t. 274," is cited as a synonym, and it is said to be "very distinct from *I. tripetala*, Bot. Mag. t. 2886." The name must, therefore, have been intended for the Carolina form. George Penny was connected with the Epsom Nurseries; whether his Hortus Epsomensis, ed. 2, was ever published I do not know. He appears, however, to have not only given the above name to the species represented by Sweet's figure, but to have named the other also, for in Steudel's Nomenclator (1840) we find an "*I. Hookeri*, Penny," with "*I. tripetala*, Hook. in Bot. Mag. (non Walt.)" as a synonym, and "Am. Sept." as habitat. Granting the correctness of Steudel's reference to Penny as authority for the name, it is right that it should be adopted for the species and so credited, the citation being equivalent to a description, and sufficient for the identification of the plant to which the name was applied.

The first distinct statement of the occurrence of *I. Hookeri* in Canada is in Hooker's Flora Bor.-Americana (1839 or '40) as "I. tridentata, Ph.—*I. tripetala*, Walt. (not Thunb.) Bot. Mag. t. 2886. *Hab.* Canada. *Mrs. Sheppard.*" No doubt is expressed respecting its identity with Walter's species, but Herbert's notes cited under this species and under "*I. Caurina*" are to the effect that in his opinion *I. tridentata* is only an imperfect state of *I. Virginica* (*i. e.*, *I. versicolor*). Nothing more of moment was known or written about it until recently. In 1876 Mr. J. G. Baker of Kew wrote a revision of the genius for the Gardeners' Chronicle, in which he recognizes the two species as distinct. He retains Walter's species under his name, and transfers Pursh's name to the Canadian one, of which Pursh knew nothing whatever. He gives a description of this, not based apparently upon recent material, but chiefly upon the original figure and description. He compares it with *I. versicolor*, and suggests, with Herbert, that it may be a variety of that species. This resemblance to *I. versicolor* is much stronger in the figure, drawn from a probably luxuriant cultivated specimen, than in the wild ones which I have seen. In the Gray herbarium the species is represented by flowering specimens from Newfoundland (*Murray*), and by flowering and fruiting specimens from the rocky and gravelly shores of the lower St. Lawrence at Tamisconato (*C. G. Pringle*). In these the leaves are nearly as narrow as in *I. prismatica* (2 to 4 lines broad), but the stems are low and rather stouter, and form a somewhat thicker rootstock. The pedicels (usually 2) are shorter than the scarious spathe, which is two inches long or less. The flowers, aside from the size and coloring, are distinguished by the short oblanceolate inner segments. The capsule is oblong and obtuse, rather thinly membranous and obtusely 3-lobed laterally, and distinctly marked by transverse veins. The seeds are scarcely more than half as large as those of *I. versicolor* and are more oblong. The rigid coriaceous capsules of *I. versicolor* are usually longer, rather acutely triangular, and with the obscure veins longitudinal, while in *I. prismatica* the capsules are strongly triquetrous and cross-veined.

I. tripetala is a taller and more leafy, slender and narrow-leaved species, with firmer herbaceous bracts enclosing the short pedicels. The capsules are coriaceous, broadly oblong, with a stout beak, and veinless. The seeds (not quite mature) are large and thick.

Attention having thus been called to this northern species, it is hoped that we may soon become better informed respecting its range through the lower provinces of Canada, and the variations to which it may be subject. There is also another point to which it may be well to advert. Both Herbert, in the Fl. Bor.-Am., and Mr. Baker, in his papers, are positive respecting the occurrence of the Californian *I. tenax* in Newfoundland and New Brunswick. It is not in itself probable, nor yet is it likely, that either *I. Hookeri* or *I. prismatica* could be mistaken for it, from both of which it is usually distinguished by the separation of the bracts which form the spathe. I would like to see a specimen of that species from the Atlantic coast. In conclusion I should express my obligations to Prof. Oliver and Mr. Hemsley of Kew for a clue to the personality of Steudel's "Penny," about whom I was completely at a loss.

Notes on Umbelliferæ of E. United States. IV.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE IV.)

HYDROCOTYLE Tourn.—Fruit (and carpels) strongly flattened laterally, more or less orbicular: carpel with 5 primary ribs (additional secondary ones with reticulations in a single species); dorsal ribs marginal, broad or filiform; intermediate ribs filiform (rarely obsolete), usually curved: lateral ribs filiform or broad, distinct or confluent: a prominent oil-bearing layer beneath the epidermis (except in H. Americana), occasionally containing small oil ducts[1]: a thick layer of strengthening cells surrounding the seed cavity (except in H. ranunculoides) (figs. 43-56).—Low herbaceous perennials, growing in or near water, with slender creeping stems, orbicular-peltate or reniform leaves, and small white flowers in simple or proliferous umbels. Flowering all summer. In figure 44, *a* indicates the oil-bearing layer, *b* ordinary parenchyma, *c* the layer of strengthening cells.

* Fruit with pericarp thin except at the broad thick corky dorsal and lateral ribs (figures 43-50): leaves orbicular-peltate, crenate: peduncles as long as petioles, all from slender creeping rootstocks.

+ Fruit notched[2] at base and apex; intermediate ribs corky (figures 43-48).

1. **H. umbellata** L. Spec. 234. Umbels many-flowered, simple (sometimes proliferous): pedicels 2 to 6 lines long: fruit about 1½ lines broad, strongly notched (figs. 43, 44). —Massachusetts to Minnesota and southward to the Gulf.

2. **H. prolifera** Kellogg, Proc. Calif. Acad. i. 15. Umbels mostly proliferous, with 5 to 20-flowered whorls: pedicels 1 to 3 lines long: fruit about a line broad, but slightly notched (figs. 45, 46).—Texas, to Arizona and California. This species is too near H. umbellata. In the great majority of specimens they can be distinguished easily, but the occasional forms of H. prolifera which are not proliferous, and

[1] This character of a prominent oil-bearing layer differs from any other group yet studied. In the European H. vulgaris the oil-bearing layer breaks through the epidermis in places covering the fruit with oil vesicles.

[2] This notching may not be apparent except in fully matured fruit.

with many flowers and long pedicels, can be distinguished with difficulty. The fruit sections are but slightly different. If this is a good species, the following is a better one.

3. **H. Canbyi.** Umbels 3 to 9-flowered, generally proliferous: pedicels very short, but distinct: fruit about 2 lines broad; carpels broader and more flattened than in the preceding forms, sharper margined, dorsal and lateral ribs much more prominent; seed-section much narrower (figs. 47, 48). *H. umbellata* var? *ambigua* Gray, Manual, 190.—New Jersey to Maryland. It would be proper to call this species H. ambigua, but that name already has a place among the synonyms of Erigenia bulbosa.

The three foregoing species, with H. vulgaris of Europe, form a very natural group, closely resembling each other in the anatomical details of the fruit. H. vulgaris is most nearly related in external appearance to H. Canbyi, but differs in its smaller fruit more or less dotted with oil vesicles, its less flattened carpels, and less prominent dorsal and lateral ribs, thus intermediating between H. Canbyi and the first two species. There can be no doubt but that our three species are the North American representatives of H. vulgaris.

++Fruit not notched; intermediate ribs not corky (figs. 49, 50).

4. **H. interrupta** Muhl. Cat. 10. Umbels few-flowered, proliferous, forming an interrupted spike: pedicels very short or none: fruit $1\frac{1}{2}$ to 2 lines broad; dorsal and lateral ribs very prominent (figs. 49, 50).—Massachusetts to Florida and Texas; also in Utah.

** Fruit with pericarp uniformly corky thickened and ribs all filiform (figs. 51-56): leaves not peltate: peduncles much shorter than petioles.

+Fruit small ($\frac{3}{4}$ to $1\frac{1}{2}$ lines broad), without secondary ribs or reticulations: involucral bracts small or wanting.

5. **H. Americana** L. Spec. 234. Stems filiform, branching and creeping: leaves thin, round-reniform, crenate-lobed and lobes crenate, shining: few-flowered umbels axillary and almost sessile: fruit less than a line broad; intermediate ribs prominent; no oil-bearing layer; seed-section broadly oval (figs. 51, 52).—Throughout the North and southward to North Carolina.

6. **H. ranunculoides** L. f. Suppl. 77. Usually floating: leaves thicker, round-reniform, 3 to 7-cleft lobes crenate: peduncles 1 to 3 inches long, reflexed in fruit: capitate umbel

5 to 10-flowered: fruit 1 to 1½ lines broad; ribs rather obscure; no layer of strengthening cells about seed cavity; seed-section oblong (figs. 53, 54).—E. Pennsylvania to Florida, thence westward to Texas and California.

++Fruit larger, with prominent secondary ribs and reticulations: the 2 to 4-flowered umbel subtended by an involucre of two conspicuous bracts.

7. **H. Asiatica** L. Spec. 234. Petioles and peduncles (1 to 2 inches long) clustered on creeping stems or runners: leaves ovate-cordate, repand-toothed, thickish: fruit about 2 lines broad: seed-section narrowly oblong (figs. 55, 56). *H. repanda* Pers., Benth in Fl. Austral. iii. 347.—Maryland to Florida and westward.

EXPLANATION OF PLATE IV.—All surface views are × 15; all transverse sections are × 27.

Fertilization of Epipactis latifolia.

A. D. WEBSTER.

[It is not our custom to reprint articles, but a good contributor has made request for the following, on the plea of its interest, and the comparative inaccessibility of the original publication. It appears in the *Transactions and Proceedings of the Botanical Society* of Edinburgh, vol. xvi, part iii, 1886. The author is of Llandegai, Penrhyn.—EDS.]

Having during the past few years, but particularly the summer of 1885, devoted considerable attention to the above interesting subject, I have thought the following observations not unworthy of record, as contributing to a subject which, as yet, has received little investigation. In the woodlands of this county (Carnarvonshire), where the plant grows in unusual quantity, exceptional opportunities have been afforded me of studying it under various conditions as to soil, altitude, and situation.

All, or nearly all my observations tend to show (1) that *Epipactis latifolia* is very imperfectly fertilized; (2) that, although visited by insects, cross-fertilization seldom takes place; and (3) that self-fertilization by the pollen falling spontaneously on the stigma is not uncommon.

1. That the plant is very imperfectly fertilized is evident from the small quantity of seed produced. On examining

nearly one hundred plants when the seeds were ripe in October, I was surprised at the small number of capsules produced. (The ovules of unfertilized flowers drop from the plant at an early date, thus affording an unerring guide as to the difference between barren and well-filled capsules.)

I examined nineteen plants growing in consecutive order in one wood, and out of a possible 492 capsules only 38 produced seed. Thinking that perhaps the density of foliage or maritime situation might account for this unusually small production of seed, I examined the plant in quantity in two other warm, shady woodlands, but with almost similar results. Sixteen plants, growing within a short distance of each other, produced only 32 capsules from 516 flowers; while in another wood similarly situated 26 were produced out of a total of 215. This small production of seed, in an unusually fine season like that of 1885, clearly proves that *Epipactis latifolia* is very imperfectly fertilized, and, as will be seen hereafter, that cross-fertilization by insect agency seldom takes place. The conclusions naturally arrived at are, that this orchid is more frequently self than cross-fertilized, but when the small production of seed is taken into account, very imperfectly by either method.

2. That, although visited by insects, cross-fertilization seldom takes place, is proved by the following observations: Amongst insects of sufficient size to remove the pollinia that I have seen visiting the flowers of this *Epipactis*, I may mention the red-tailed humble bee and our common wasp, the latter, however, but very rarely. On the other hand, the red-tailed humble bee visits the flowers of this plant frequently, but, owing to its peculiar method of sipping the nectar without entering the flower, never removes the pollinia. On August 21, 1885, being in a wood where beds of this plant were in full flower, I saw the above bee enter several flowers on two different plants growing side by side, without in any case removing the pollinia. On the 24th of the same month, and in the same wood, I saw a red-tailed humble bee visit successively no less than sixteen flowers on a spike of this *Epipactis* without removing any of the pollinia. In this case the spike of flowers was so dense that the bee crawled from one to the other in a spiral fashion from bottom to top without once bringing its head or proboscis in contact with the viscid disc at the base of the pollinia. After sucking the nectar from the last flower, it flew off for a few yards, but immediately returned and revisited three of the

same flowers, but this time in a half discontented fashion, as if striving to improve on work that had been already well done. Again, on the 26th of the same month, I saw several visit the flowers of this plant (one visited most of the flowers on seven plants in succession) without removing the pollen, although, being near, I noticed them visit numerous flowers that contained the pollen masses. The bees hung on the distal portion of the labellum and inserted their long proboscis without the head coming in contact with the viscid disc. The evening was lovely, and I spent an hour watching the plants, but during that time, although wasps were flying about in number, not one visited a flower. (This certainly was the opposite of what I expected, as several naturalists are under the belief that this *Epipactis* is constantly fertilized by this insect, one indeed going so far as to say that if wasps were becoming extinct in any locality, so, in all probability, would *Epipactis latifolia*.) On other occasions, however, I did see the common wasp visit several flowers, but the visits were short, and, if I may use the expression, heartless, as if it could derive little therefrom. Owing to their long, narrow shape and short proboscis, wasps remove the pollen masses with ease, for I have caught them immediately after coming out of the flower with the pollinia attached to their head; but as these visits are few and far between, fertilization by this way is of rare occurrence. In numerous instances, also, the pollen masses will be found glued to the upper sepal of the flower, which is done as follows: The wasp on entering, particularly a newly-opened flower, gets the pollinia attached to its head when sucking the nectar; but immediately on entering another flower, the upper sepal is so situated that the sharp stiff edge comes in contact with the viscid substance, which, with the pollinia, is left attached to it. This, I have never seen take place, but repeated experiments bear out the statement. It is also readily illustrated with a pencil. In various other parts of the plants it is not uncommon to find the pollen masses attached as if the discs were not sufficiently viscid to retain their hold on the insect's head, and on more than one occasion I have found them unbroken, on their stigmatic surface. Small insects also visit the flowers in numbers, as I have watched them creeping about within the labellum and other parts; but in numerous instances many of those which come in contact with the viscid stigma are unable to free themselves, and so perish. The largest insect that I have seen killed in this way was $\frac{3}{16}$ of an inch in length.

When the plants begin to wither, or immediately after fertilization takes place, the distal portion of the labellum curves upwards, and effectually closes the entrance to the basal portion or nectary, but for what end I am unable to say.

3. That self-fertilization by the pollen falling spontaneously on the stigma is not uncommon. I have frequently observed that the pollen masses in a few days, or perhaps a week, after the flowers open become swollen, or the particles of pollen disunited so as to protrude slightly beyond the sharp upper edge of the stigma. At the same time, or later on, the pollen becomes remarkably friable, and before the plant withers, either spontaneously or by the action of the wind, falls on the stigma and other parts of the flower. The peculiar position of the pollen masses—hanging directly above the stigmatic surface—insures this the more readily. That the pollen masses become detached and fall apart is beyond dispute, as I have on many occasions found the grains scattered over the leaves, flower and stem of the plant, as well as, in one or two instances, noticed the pollen masses still within their cells, but with the corners broken off and lying on the stigmatic surface. This breaking up of the pollen masses may be spontaneous, but it is materially assisted by both wind and rain.

On examining numbers of the plant I have found it a general rule that the entire pollinia, or a large part of them, have not been removed from such flowers as bear well-filled capsules. Now, this of itself seems to me to indicate self-fertilization by particles of the pollen falling on the stigma, for it is quite evident that if wasps (the only insect, so far as is known, that in this country does fertilize the plant) visited and impregnated the flower they could hardly have avoided removing the pollinia. To make sure, I examined several withered flowers with swollen ovaries on different plants, and was surprised to find that in most cases remnants of the then musty pollen could be distinctly detected within the shriveled anther.

After reading the above remarks one is naturally led to ask: Why, if *Epipactis latifolia* is so imperfectly fertilized, is the plant so abundant?

This I can only answer as follows: (1) Nature, as if to make up for the small production of seed, has endowed this plant, unlike the generality of our native orchids, with special facilities for the perpetuation of its race. The original roots do not, as in most other orchids, die off annually, but serve for collecting nutriment for the succeeding plant, the eye or bud of which is formed close to the old or last year's stem. At times the plant produces several of these eyes in one season; indeed, during the present summer I counted sixteen and twenty-six flowering stems on two plants, and it is not at all uncommon for three or four stems to be found attached to the same plant. (2) Each capsule (judging by the number in the almost equally sized *Cephalanthera grandiflora*) will contain about six thousand seeds; so that, even if one only were produced on each plant, it would be more than sufficient to keep up the stock.

In conclusion, one can not but wonder how remarkable it is that the nectar of *Epipactis latifolia* should be so highly attractive to the red-tailed humble-bee, that can not fertilize the flower; while to the wasp, that can remove the pollen masses with ease, and thereby insure cross-fertilization, it offers but little attraction, as is clearly shown by the almost total absence of its visits. I have mentioned above that, under certain conditions, the roots of this plant produce eyes or buds; but, strange as it may appear, this is not the case in all, for I have examined numbers without any such means of reproduction. In many instances, also—indeed, it is the general rule in this district—the plant in question is destitute of a rostellum, the viscid matter at the base of the pollinia being free or uncovered, thus imitating in structure the degraded and self-fertilized *Cephalanthera grandiflora*.

Now, can it be that *Epipactis latifolia*, from not being sufficiently attractive to insects, or from the want of proper insects in this country to fertilize it, is gradually becoming modified, and propagation by increase of the root slowly but surely taking the place of seed, or at least materially assisting to prevent the extinction of the plant, as would in all probability result from the present imperfect fertilization and subsequent small production of seed? This is rendered all the more probable by the curious fact that in most, if not all, of our native orchids that are either partially or wholly self-fertilized, nature, as if to make up for the small production of seed, has endowed them with special facilities for perpetuation, namely, by increase of the root.

Take the example of *Neottia nidus-avis*, which is very imperfectly cross-fertilized, but in which nearly all the rootlets produce young plants; also, that of *Epipactis latifolia*, which, under certain circumstances, behaves in a similar manner. Again, *Ophrys apifera*, which is, perhaps, the most noted example of constant self-fertilization in British Orchideæ, is well known to appear and disappear somewhat mysteriously from certain localities by the young tubers increasing beneath ground until of a flowering size. *Cephalanthera grandiflora*, which is fertilized in the bud state by the emitting of tubes from the pollen grains, also increases by the root; but of this rare species I am able to give little original information.

BRIEFER ARTICLES.

Zannichellia palustris L. var. pedunculata.—In a rather remarkable pond, botanically speaking, this plant was observed as early as February 12, and was collected in full fruit March 19, 1887. The pond is formed by the waste water from a large blast furnace, and never freezes, so far as I can learn. A series of tests made when the weather was quite cool, ranging from 16° to 40° F., gave the temperature of the water from 76° to 82° F., and that of the sandy bottom from 80° to 90° F. In it Spirogyras and Zygnemas, Œdogonium and Vaucherias were found during all the winter months, in the vegetative state, at times in wonderful abundance, giving place at certain seasons to the profuse growth of Hydrodictyon. The pond is perhaps twenty feet wide by sixty long, and has never been visited when not completely filled with some of its habitués. At times our Spirogyras would all be Zygnemas. Again, both would give way to Œdogonium. Another day would show Hydrodictyon in full possession, with all the others crowded into the little bays and harbors of the pond. On April 23 I made a trip to the pond, and was surprised to find that Zannichellia had taken almost exclusive possession of nearly one-half its extent, and could be collected in all conditions from the beginning of its growth to the perfect fruiting stage. Its growth was as vigorous and its life apparently as happy as if had been flourishing in July, its proper fruiting month. Yet all about in other ponds were little films of ice, and the collectors were in winter overcoats.—STANLEY COULTER, *Terre Haute, Ind.*

Nymphæa lutea in Brazoria county, Texas.—In May, 1873, Mr. Wm. T. Horner, of Georgetown, Mass., then in Texas, while going from Galveston to Columbia, in crossing Oyster creek at a small place called Liverpool, saw what he thought were yellow pond lilies. He took a boat and went out on the creek to assure himself that he was not mistaken. He found them growing in deep water, the stems six or seven feet long. He sent a single specimen to Mrs. Horner. On his return to Georgetown, Mrs. Horner wrote to the only person Mr. Horner knew to get some of the roots. In the course of a few weeks they learned that this person was dead, and nothing more was done about it.—E. H. HITCHING.

Key to Forest Trees.—It was thought advisable to introduce for twelve weeks, daily, the study of botany into the Sophomore year of the mechanical course at Michigan Agricultural College. This is all the time the student is expected to give to botany, and even this is to be of practical value in the study of woody plants. The first five weeks were occupied in learning how to distinguish the trees of Michigan; mainly by a study of leaves, twigs, buds, outer bark, sections of wood, all aided by a simple microscope. No attention was paid to the flowers. To aid the memory the following artificial classification was devised, and it worked well:

A. *Leaves alternate and two-ranked.*
- Basswood.
- The Elms: American, Red and Rock.
- Mulberry.
- Hackberry.

B. *Leaves opposite.*
1. *Simple.*
   - The Maples: Sugar, Red and Silver.
2. *Pinnately compound.*
   - The Ashes: White, Black and Blue.

C. *Leaves five to eight ranked.*
1. *Simple.*
   - Whitewood.
   - Buttonwood.
   - Cherry.
   - Sassafras.
   - Birches: Yellow, Canoe and Cherry.
   - Poplars: Cottonwood, Aspen, Large-toothed Aspen.
   - Willows.
   - Oaks: White, Red, Black, Yellow, etc.
   - Chestnut.
   - Beech.
   - Ironwood.
2. *Compound.*
   1. *Pinnate.*
      - Black Walnut.
      - Butternut.
      - Hickory: Shagbark, Pignut, Bitternut.
   2. *More than once pinnate.*
      - Honey Locust.
      - Kentucky Coffee Tree.

D. *Conifers.*
1. *Deciduous.*
   - Larch.
2. *Evergreen.*
   - Pines: White, Red, Scrub.
   - Arbor Vitæ.
   - Spruces: Hemlock, Black, White, Balsam.
   - Cedar: Red, Juniper.

The other seven weeks were mainly occupied in the use of the compound microscope in the study of a few sorts of woods, as white oak, white ash, sugar maple, and white pine. Some attention was given to fungi acting on wood to produce decay; the different accidents which injure trees; the effect on the appearance and durability of timber when cut in different directions. Each student wrote an essay on some topic in keeping with those above named.—W. J. BEAL, *Agricultural College, Michigan, March* 23, 1887.

Scoliopus Hallii Watson.—I collected this little Liliaceous plant last week in fine flower. As the floral characters have never been made out, it may be as well to record the following amended description:

Rhizoma very short or none: leaves oval-elliptical to narrowly lanceolate, at length 4–6 inches long, not brown punctate, sessile: pedicels (2–8) 4–6 inches long, slender: outer perianth segments lanceolate or oblanceolate, 3–4 lines long, a line and a half wide, narrowed to a claw below, yellowish green speckled with red outside, striped with dark purple inside, bent at a right angle in the middle so that the upper half is spreading or deflexed; the inner ones are linear-spatulate, shorter than the outer ones, not bent in the middle, but incurved and conivent over the stigmas: stamens 1–1½ lines long, about half as long as the red speckled ovary.—On Silver creek, about a mile above the town of Silverton, at the late Elihu Hall's original locality. In fine flower March 20.—THOMAS HOWELL.

Solidago bicolor L., and var. concolor Torr. & Gray.—While botanizing along the western side of the Green Mountains, in Vermont, last season (1886), I gave particular attention to the golden rods, and collected many interesting things; the most interesting being the above mentioned forms growing from the same root. I found *S. bicolor* L. very abundant, at middle elevations, but saw comparatively little of the var. *concolor*, except in the town of Ludlow, where both forms were in profusion. The remarkable specimen in question consisted of four stalks; two being typical white-rayed *bicolor*, and the other two being none the less typical yellow-rayed *concolor*.—F. H. KNOWLTON, *Washington, D. C. March* 31, 1887.

How humblebees extract nectar from Mertensia Virginica DC.—In the October number of the GAZETTE I recorded an observation of the manner in which humblebees extract the sweets from the flowers of *Physostegia Virginana* Benth. without entering the corollas, by making a slit at the base with the mandibles. In the April number Mr. G. von Ingen records a similar observation in regard to the common *Petunias*. To-day I observed a similar habit on *Mertensia Virginica* DC. It appears that the insect is well up to the work of splitting corollas; it is done quickly and easily, and if the old slit, made at the former visit, is not easily found, a new one is made. I found corollas that had as many as three parallel slits near the base. As this is near the beginning of the botanizing season, it would be well if botanists generally would keep this in mind, and at the end of the season record their notes. We might thus learn how general this habit is. It would add to the interest if the insects, thus engaged, were captured, and their specific names published with the notes. —J. SCHNECK, *Mt. Carmel, Ill.*

EDITORIAL.

THE MEETING of the A. A. A. S. in New York City next summer will give botanists a privilege that they will much prize. The Botanical Club will, in a certain sense, be the guests of the Torrey Botanical Club, and under the guidance of that well-organized body everything of botanical interest that is within reach will be laid tributary to the entertainment of the club. The Torrey herbarium, the Meisner collection, and all the other riches of the Columbia College collections will be objects of great interest. The salt marshes, the sea beaches, the New Jersey collecting grounds, all offer attractions and easily accessible fields. The greatest attraction, however, should be the presence of botanists from all parts of the country. The social pleasures of such a meeting, the stimulus to more and better work which comes from it, are simply incalculable. We bespeak the largest attendance of botanists that has yet graced the meetings of the Association—botanists who have come prepared to give as well as to receive, and who will take a prominent part in the work of the biological section as well as in that of the club. How the improbability of obtaining special rates in these days of interstate commerce law will affect the attendance from the west remains to be seen, but it will probably seriously interfere with it.

MR. J. B. ELLIS, in a recent number of the *Journal of Mycology*, has criticised the wording of the title of Professor Scribner's paper on black rot, read before the Botanical Club of the A. A. A. S. and published in the GAZETTE for last November, because the name of the fungus Physalospora Bidwellii is credited solely to Dr. Saccardo, whereas the species was originally described by Mr. Ellis as a member of the genus Sphæria. Mr. Ellis contends that in changing the species to another genus his name should still have been retained as authority, either with or without being included in a parenthesis, whether the name of Saccardo were added or not, and in support of this view cites the usage of Drs. Winter, Cooke and Fries. Dr. Roumeguère has a note on the matter in the last *Revue Mycologique*, in which he expresses his disapproval of "the incorrectly abbreviated form" used by Professor Scribner, but is not willing to subscribe in full to the views of Mr. Ellis. There is much diversity of opinion and usage touching the subject, and support can be found for both sides of the present question; but we think the form *P. Bidwellii* (Ellis) Sacc. would receive nearly universal approval, although many would consider it equally satisfactory to omit one or the other authority.

OPEN LETTERS.

Raising Diatoms.

In reference to your kind words in the April GAZETTE, on my "Raising Diatoms in the Laboratory," I would have been further gratified had the fact been noticed of my experiments of passing the spores through filter paper, that they antedated the experiments of Mr. F. Kitton fully two years. How much of time and care these experiments cost me will never be known. As to your remarks on the March number of the *New York Microscopical Journal*, that its leading articles seem addressed to amateurs, this is in part true of the article which occupies the most space, my lecture, "The Life of a Diatom." The audience was chiefly composed of the families and friends of the members, but unfortunately the part which chiefly interested the members could not be given in print. It was illustrated with the lime-light, and a set of new photographs that would have delighted any botanist, Habirshaw's photograph of Pleurosigma, was shown to an audience, with lines a third of an inch thick and beautifully clear. Besides other nice points, a feature of which no mention is made in the printed lecture was the exhibit of lantern slides of Mr. Christian's new and very curious diatoms. As pictures these interested all, but their scientific side could only be seen by the diatomist. This much seems due from me to whom so much space was generously given in the *Journal*, and which could only present it as popular matter. SAMUEL LOCKWOOD.

Freehold, N. J.

Antidote for Cicuta poisoning.

A case came under my observation of a young man who, while suffering from thirst in the hayfield, chewed the root of what he thought was spikenard, Aralia racemosa. In less than two hours he became extremely sick. The first sensation experienced was like a stroke on the head, with unconsciousness for a few seconds, followed by sickening nausea. Upon reaching home the mother suspected he had made a mistake in the plant, and not daring to wait to send several miles for a physician she procured a stalk of Eupatorium perfoliatum, made a tea of it, and gave freely as warm as could be taken. This assisted nature to relieve the stomach and caused a warmth and moisture of the whole system. In an hour the dangerous symptoms had disappeared. It was discovered that he had chewed and swallowed the juice of more than half of a four ounce root of Cicuta maculata. The physicians who afterwards saw the amount of the root which he had taken were surprised at the result.

Harmonsburg, Pa. J. E. WHITESIDE.

Autumnal blooming of Oxalis.

On the 18th of last September, while out on a little excursion along the B. & M. railroad near here, I found quite a patch of Oxalis violacea in full bloom by the side of the track. The individual flowers were a little above the ordinary size and several in a cluster, the whole plant seeming to be exceedingly vigorous. However, the strangeness of this freak of autumnal blooming was perhaps equaled by the fact that there was not a single leaf on the hundred or so plants scattered for some distance along the railroad. The top soil had lately been removed by the section hands and these plants were growing on the south side of the track where the sun shone fairly upon them. Could this removal of the soil, and consequent bringing of the scaly bulbs nearer the surface have induced this very premature blooming? Or could any of the readers of the GAZETTE offer any other explanation in connection with the location of the plants? I expect to keep a watch over these plants this spring to see what they do when the ordinary time for blooming comes.

Hastings, Neb. HARVEY THOMSON.

Solidago erecta PURSH.

The herbarium of the United States National Museum has for distribution a good number of duplicates of the above species, which has recently been reinstated by Dr. Gray [Proc. Am. Acad. XXII, p. 308]. This form, so well represented in the District of Columbia, has been variously referred by Dr. Gray to *S. bicolor* L., var. *concolor* Torr. & Gray, and *S. speciosa* Nutt., var. *angustata* Torr. & Gray, and may have been so distributed from here, but its distinctness from either of these forms has long been recognized by many Washington botanists. F. H. KNOWLTON.

Assistant Curator Botany, U. S. Nat. Mus.

An aid in description.

In writing out descriptions it is important to have in mind the range of variations in the size of each organ. With microscopic objects this requires great familiarity with the specimens. A single figure, while it may be typical, can not show the range of variation. As an aid in making up descriptions, and to use for reference, tables like the following, which can be quickly made, have been found convenient. The vertical columns show the length in lines of each organ, while the horizontal rows show at a glance the amount of their variation. Other points can, of course, be added on the same plan, and the number of recorded observations be increased as circumstances require.

Muhlenbergia argentea Vasey. Palmer, Mexico, 1885, No. 160.

Lower empty glume	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$	$1\frac{1}{4}$	1
Upper empty glume	$1\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{1}{2}$	$1\frac{1}{3}$	$1\frac{1}{4}$
Flowering glume	$1\frac{3}{4}$	$1\frac{2}{3}$	$1\frac{1}{2}$	$1\frac{3}{4}$	$1\frac{2}{3}$
Palet	2	$1\frac{3}{4}$	$1\frac{1}{3}$	$1\frac{1}{2}$	$1\frac{2}{3}$
Awn of flowering glume	5	5	4	$2\frac{1}{2}$	2

A. A. CROZIER.

Dep't Agriculture, Washington, D. C.

Exploration of San Domingo.

Baron Eggers has been engaged by the undersigned, and under the patronage of the Royal Academy of Sciences at Berlin, to undertake a journey of botanical research in the higher mountain regions of San Domingo that have not yet been explored. The plants to be collected will be distributed in two series with corresponding numbers. The first series will embrace only such plants as have not already been distributed in Eggers' *Flora Indiæ occidentalis exsicc.*, and will cost forty marks per hundred. The second (and larger) series will omit only the ubiquitous tropical species, especially those of the sea coast, and will cost thirty marks per hundred. The determinations will be elaborated by the undersigned, assisted by various monographers. He will be pleased to receive subscriptions to either series, but without prepayment. In view of the difficulties of transportation in the island, only a limited number of sets will be collected; and a prompt notification is requested from those who wish to subscribe. DR. IGN. URBAN.

Friedenau bei Berlin, Germany.

A new lichen.

In 1886 I found a peculiar lichen on rocks in Catawba River. I sent it to Dr. J. W. Eckfeldt, of Philadelphia, and he to Mr. H. Willey, of New Bedford. The latter called it an Opegrapha. Lately I sent Mr. Willey better plants than he had seen, and he says it is not an Opegrapha, and has named it *Buellia Catawbensis*, n. sp. He gives the following description: Thallus thickish, squamulose, peltate, orbicular, about $\frac{1}{8}$ inch in diameter (I should say from $\frac{1}{8}$ to $\frac{3}{8}$), sub-entire, white, beneath black and naked: apothecia innate-superficial, the disk even with the thallus, black, at length crowded and confluent in the center of the thallus: hypothecium black, the proper exciple deficient: paraphyses distinct, agglutinate: spores oblong-ellipsoid, 2-loc., brown, .015–18 mm. by .007–8 mm.—On rocks along Catawba River Landsford, S. C., *Prof. H. A. Green*, 1886. A singular plant without near affinity. Taken from "Introduction to the Study of Lichens," by H. Willey. H. A. GREEN.

Chester, S. C.

CURRENT LITERATURE.

Physiological Botany: An abridgement of the student's guide to structural, morphological and physiological botany, by Robert Bentley, F. L. S. Prepared as a sequel to "Descriptive Botany," by Eliza A. Youmans. pp. xiv, 292. New York: D. Appleton & Co. 1886.

If any single term is to be used for this book, it should be *structural* rather than physiological botany, for it deals mostly with anatomy, less than one-third being devoted to physiology. We can not see that it is properly a sequel to Miss Youmans' "Descriptive Botany," for, with the exception of the impracticable "popular flora" of that work, this one covers much the same ground. It is a book of the old style, a compendious mass of facts, essential and trivial, about structure and function, condensed to the last degree, and therefore more useful as a book of reference than as a text book. Viewed in that light, it has not been improved by abridgment. It is of the "old style," in that it has no open questions. Its dictum, *ex cathedra* alike on fact and hypothesis, leaves the student no reason to doubt that all questions are forever settled.

With the structural part we have little fault to find, except with the illustrations, which are very uneven in quality; a few good, the majority only tolerable, and some very poor. The statements are in the main accurate, and in this it excels its predecessor. The physiological part of the book is of the least value. It is not entirely reliable, nor up to the date at which it was written (1883), if we may judge fairly by the abridgment. The treatment of assimilation, respiration and fertilization may be pointed out as especially weak, though it is difficult to get at the first two topics because of the illogical way in which the subject is presented. The author devotes a section each to the functions of the various sorts of cells, the nutritive organs, and the whole plant. As the functions of the whole plant depend entirely on the functions of its organs, and ultimately on the functions of the cells, we can not see the advantage of such a method. It involves much repetition and dissociation of allied topics.

Altogether the book is a compact text book, with no special excellences and some serious faults. It is no better and no worse than the common run of school books. There *is* a need for a small text book suitable for high schools and lower college classes, but this does not meet it. The book that does must present the essentials of botany clearly and attractively, without the encumbrance of trivial details, and with constant recognition of the biological significance of structure and function. Who will write it?

Sylloge Fungorum Omnium Hucusque Cognitorum. Digessit P. A. Saccardo. Volume iv, Hyphomycetes. Padova, 1886. Roy. 8°. pp. 808.

One can scarcely accord too much praise to the author of the series of works of which this is the fourth volume, for his untiring devotion to botanical science as shown especially in this monumental undertaking. The number of described species of fungi is very large, embracing a large proportion of cosmopolitan or widely distributed forms. To bring together the works containing the original descriptions is well nigh impossible to the ordinary student of fungi; and to have these descriptions collated, systematically and critically arranged, and issued in handy volumes is a service that the mycologist will appreciate, the more work he does.

The author has not hesitated to take the most difficult classes first, those in which assistance is most needed. The present volume includes forms of superficial growth, having conidial spores borne free upon aerial branches. Although this grouping makes a convenient classification for the purpose in hand, it brings together orders of very unequal grade, which in many instances have but slight relationship. The majority of the forms are undoubtedly to be set down as *fungi imperfecti*, whose real standing can not be fully determined until their life history is better understood; some of them, however, have had their sexual condition well worked out, and in a more natural system of classification could find a more appropriate place elsewhere.

In a work of this kind one is not surprised to find such slips as the insertion of *Ramularia Astragali* Ell. & Hol. twice, once under Ramularia

(p. 202) and once under Didymaria (p. 184), each with an independent translation of the characterization, but this detracts little from the general accuracy of the volume, and less yet from its serviceableness.

Grasses of North America for Farmers and Students. By W. J. Beal, Professor of Botany in Michigan Agricultural College. Published by the author, 8°., pp. xiii, 457. 1887. Price $2.50.

Profesor Beal is so well known as a teacher of botany that he does not need introduction to botanists by means of a book. In this volume, which is intended chiefly for farmers, he endeavors to put the subject in such a way as to inform his readers of the general structure of those forms of plant life in which they are so vitally interested. Chapters on the structure, form and development of the grasses, power of motion, plant growth, classification, native grazing lands, grasses for cultivation, early attempts to cultivate grasses, testing seeds, grasses for pastures and meadows, preparation of the soil, care of grass lands, etc., put the farmer in a fair way to cultivate his grass lands intelligently. Prof. A. J. Cook contributes a chapter on insects injurious to grasses and clovers, and Prof. William Trelease writes of the injurious fungi. Mr. F. L. Scribner has contributed much to the value of the work in his excellent drawings. This volume can not help being greatly useful to the farming community, while the promised second volume will be of no less interest to botanists, as it is to contain descriptions of all known grasses of North America, with illustrations of at least one species in each genus.

Microscopy for Beginners, or Common Objects from the Ponds and Ditches. By Alfred C. Stokes, M. D., pp. xiii, 297. New York: Harper & Brothers, 1887.

This delightfully written book comes to a place almost unoccupied among American publications. Its chief object is to aid the uninstructed owner of a microscope first, to an intelligent use of the instrument; second, to the identification of the common aquatic objects; finally, and *most important of all,* it seeks to point out unoccupied fields and stimulate to the persistent study of some special subject. Many persons possessed of a microscope have almost ruined it before they found out how to use it, and many others have been at a loss to know what they saw when water from some stagnant pool swarming with living organisms was examined. This book will do much to help the novice to the names of aquatic organisms, and the name once known, the search after information more extended than this guide could furnish can be intelligently prosecuted. It is to be hoped that every one who buys a microscope for his amusement will buy also this book and that he will be led by it to see that *he* can add to the sum of knowledge if he will only single out some group of organisms for steady work. We have no patience with that "microscopy" which occupies itself with looking at gold-plated diatoms and with making "beautiful mounts" of "triple-stained vegetable sections," caring not for structure if they are only "handsome!" Let the microscope be a tool for earnest study—not the plaything of an idle hour!

The book is amply illustrated with useful, though small, drawings—not pictures—and contains many helpful artificial keys to genera and species, with references to standard works of more special character. It deserves a large sale.

NOTES AND NEWS.

M. PHILIBERT describes a new Bryum, B. Corbieri from northwestern France in the *Revue Bryologique* No. 2, 1887.

DR. ALBERT KELLOGG, the veteran botanist of the Pacific slope, died March 31st, at Alameda, California, at the age of seventy-four years.

AN AMATEUR botanical club has recently been formed at Washington with a membership of about twenty-five. Miss Flora N. Vasey is secretary.

IN THE *Revue Bryologique* No. 2, 1887, Dr. S. O. Lindberg describes three new species of Hepaticæ from Portugal, Marsupella profunda, Anthoceros constans and A. multilobulus.

A YOUNG Italian mycologist, the Abbe Ben. Scortechini, an explorer of Australia and further India, died a short time ago at Calcutta. A genus of fungi commemorates his services.

THE AMERICAN ASSOCIATION for the Advancement of Science will meet in New York City, beginning August 10. It will probably be interestingly warm in the city at that date, but the sea beach is near.

DR. DIDRIK FERDINAND DIDRICHSEN, seventy-two years of age, died on March 19. He was professor of botany in the University of Copenhagen from 1875 to 1885, and for thirty years previous held important botanical offices.

THE CORNELL BOTANICAL CLUB, of Chenango County, New York, has recently been organized, with F. V. Coville as president. It is the direct outgrowth of the enthusiasm in the study of the flora of Central New York, emanating from Cornell University.

MR. A. P. MORGAN, in continuation of his "Mycologic Flora of the Miami Valley, Ohio," has just distributed a paper on Hydnei. The seven genera are represented as follows: Hydnum 30 species (one new), Irpex 6, Radulum 3, Phlebia 3, Grandinia 1, Odontia 2, Kneiffia 1.

ONE OF THE rarest and least known mosses of Europe, Didymodon subalpinus, has lately been collected in Switzerland, on the Rigi, at an altitude of 1,400 meters, by MM. Van den Broeck and Dens. Heretofore it has been known only from a small specimen without a capsule in the herbarinm of De Notaris.

PROFESSOR PENHALLOW, of Montreal, has issued a quarto memoir, reprinted from the Transactions of the Royal Society of Canada, on "Mechanism of movement in Cucurbita, Vitis, and Robinia." The memoir puts into final form the work already recorded by the author in the *American Journal of Science*, under the title "Tendril movements in Cucurbita maxima and C. Pepo," with some additional notes on the tendrils of Cucurbitaceæ.

THE ITALIAN JOURNAL OF BOTANY for April contains an account of experiments on the parasitism of *Agaricus melleus* Vahl, by L. Savastano; a new species of Tecoma (*T. Ricasoliana*), by E. Tanfani; some Venetian Diatomaceæ, Cyanophyceæ, and Chlorophyceæ, by G. B. de Toni and David Levi; and Flora of Otranto, by Enrico Groves.

AT A RECENT meeting of the Linnæan Society Sir John Lubbock, among other phytological observations, accounted for the peculiar shape of Liriodendron leaves by the manner in which the young leaves are packed in the bud. He affirms that the peculiar arrangement of the young leaves will satisfactorily account for the remarkable form of the leaf.

THE FIFTH *livraison* of Husnot's *Muscologia Gallica* has been issued. It contains descriptions and figures of the species of Grimmia (continued from part four), Rhacomitrium, Hedwigia, Coscinodon, Ptychomitrium, Glyphomitrium, Amphoridium, Zygodon, Ulota, and the first five species of Orthotrichum. The illustrations are lithographed by the author, and are improving. The difficult genus Orthotrichum is being specially elaborated by Dr. Venturi.

PROF. N. S. SHALER presents a thoughtful, instructive and well illustrated article upon the forests of North America in the May number of *Scribner's Magazine.* He considers the rôle of the forests in geological periods, the factors which have determined the relative abundance of different species, the relation to moisture precipitation, the production and maintenance of soils, the supply of timber, and many other questions of scientific, economic and general interest.

IN A PAPER before the Physiological Society of Berlin, February 25, Prof. Kronecker and Fräulein Rink reported an investigation which demonstrated that in peptone solution two kinds of bacteria are developed in the presence of air: Bacillus restituens, which transformed the peptone into serous albumen, exactly in the same way as did the living mucous membrane of the stomach; and Bacillus virescens, which liquified the alimentary gelatine and imparted a deep blue coloring to all sterilized substrata when exposed to the air. This latter bacillus operated poisonously on the heart.

M. THEOPHILE DURAND, sub-curator of the herbarium of the Brussels Botanic Garden, has prepared an index to the three volumes of Bentham and Hooker's *Genera Plantarum*, comprising the names of the genera, the principal synonyms, and the number and geographical distribution of the species. The genera are numbered consecutively, and arranged alphabetically as well as systematically. Such a work will be of vast service in herbaria and libraries. The subscription price is twenty francs, and application should be made to M. Durand, at the Botanic Garden, Brussels.

DR. C. C. PARRY has just distributed a short paper on "The Pacific Coast Alders," reprinted from *Bul. Calif. Acad. Sci.* ii., 7, and points out the value and importance of correcting systematic descriptions by careful and intelligent field observations. There can be no doubt that many descriptions are faulty, when made only from dried specimens, in the very points that a study of the living forms would correct. It may be said that such evanescent characters could hardly be of use in classification, which, after all, must be done mostly in the herbarium; but the question is not so much what characters we can preserve as what are the relationships of plants as shown by all sorts of characters, the best of which may only be recorded in field observations. Hence, this disposition to study plants *in situ* can not be too highly commended. In the case before us, by this sort of study, Dr. Parry is convinced that the four species of alder enumerated in the Botany of California must be reduced to the earliest described species, *Alnus rhombifolia* Nutt. It is, by the way, a more encouraging sign when open air study combines species than when it multiplies them in a way that no herbarium student can follow.

MISS J. E. WHITESIDE, of Harmonsburg, Pa., writes: "Last season a rose bush which for ten years past has borne double roses. took a strange freak. The two central stalks produced an abundance of large-petaled, perfect, single blossoms, while the outer stalks continued the usual double ones. It evidently was a reversion to the parent, which possibly had been Rosa Carolina, as the single blossoms were in clusters. The double ones were borne singly. The bush stood in a situation where it received a great deal of water, and that may have caused it to revert, as the blossoms and leaves both pointed to a healthy condition of the plant."

DR. LUCIEN M. UNDERWOOD, of Syracuse University, with the assistance of Mr. O. J. Cook, is actively engaged in getting together material for issuing sets of Exsiccatæ of the Hepaticæ. The series will commence with an issue of two decades, illustrating at least nineteen genera and, if possible, all four orders. These decades will be issued at a reasonable price in order that they may be obtained by beginners in the study of Hepaticæ, for whose help they are specially intended. It is hoped to have these sets ready this summer. Subsequent issues will illustrate rarer forms so far as they can be obtained. We are glad to be able to announce so important an undertaking and wish the projectors abundant success. They will be glad to have the assistance and co-operation of botanists. At present a supply of *Riccia* and *Anthoceros* is specially desired.

THE PROCEEDINGS of the Edinburgh Botanical Society, vol. xvi, part iii, just distributed, contains the following articles of general interest: A forest tour in Provence and the Cevennes, by Major F. Bailey; Fertilization of Epipactis latifolia, and growth and fertilization of Cypripedium Calceolus, by A. D. Webster; Method of transmitting living plants abroad, by Robert Lindsay; Adaptation of Albuca to insect fertilization, by John Wilson; Certain properties of rosewood and other hard woods, by A. Galletly; Inflorescence, floral structure, and fertilization of Scrophularia aquatica and S. nodosa, by T. W. Fulton; Marine Algæ of Joppa (County of Mid-Lothian), by Geo. W. Traill; Nature and cause of variation in plants, by Patrick Geddes; Distribution of marine algæ of Firth of Forth, by John Rattray; Certain points in the morphology of Frullania, etc., by Prof. Alexander Dickson.

MR. RALPH SYDNEY SMITH has published an earnest appeal for the preservation of a Redwood park north of Santa Cruz. In remarking upon this important subject, Dr. Gray (*American Journal of Science*) says: "If nothing is done to preserve for posterity a specimen of Redwood forest, including if possible some of the large trees, future and not far distant generations of Californians will have cause to revile the memory of their forefathers. Time was when we had hoped for a government reservation of such forest, of ten miles square, in the northwestern part of the state, and it would have cost nothing. But the plan now broached, although it will cost something, has the great advantage of fairly securing this object and at the same time giving to San Francisco an unrivaled park quite within reach of its citizens. Let us hope that the few great Redwoods which survive above Santa Cruz may form an annex to this reservation. Unless something of this kind is speedily done, one of the peculiar glories of the state of California will in the next century be only a tradition."

DR. MAXWELL T. MASTERS has just distributed his paper "On the floral conformation of the genus Cypripedium," as a reprint from the *Linnean Society's Journal*, vol. xxii, pp. 402–422. After speaking of the general conformation of orchid flowers, he takes up the conformation in Cypripedium. This is followed by an account of the distribution of the vascular bundles, and then the main part of the paper is taken up with the teratology of Cypripedium. Only those cases are considered which "directly elucidate the plan of orchid-structure." These malformations are grouped under the heads of defect, excess, or perversion of the natural process of development, using the following terms: oligomery (a dimerous condition being the commonest), pleiomery (usually increased lips or stamens), partition (in which primarily simple organs become divided by fission), displacement, and peloria (tendency towards regularity).

PROF. A. B. SEYMOUR has just distributed as a reprint from the *American Horticultural Report*, a paper on "Orchard Rusts," which contains an interesting account of the Gymnosparangium-Rœstelia forms. The paper is written in reply to complaints of injury to fruits in various localities. The condensed life history of these forms is very pleasantly and plainly put in these words: "These fungi have two distinct forms and two distinct phases of development, which occur on two very different kinds of plants, and would at first appear to have no connection whatever. But investigations have proved that each stage of growth in turn comes from the growth of the spores of the other stage. This is called alternation of generations. The rust upon apples develops through the summer, and toward autumn produces spores, which are carried to the cedar tree. Here they germinate and produce a different form of the fungus, which begins its growth in the fall, lives through the winter and matures in the spring, expanding into conspicuous, yellow, jelly-like masses. The spores now formed are carried in the air to the apple tree, or some tree of that group, where they produce the apple rust or quince rust, as the case may be."

THE *Gardener's Chronicle* (April 23) says that Mr. W. Sayer, an emissary of the Botanical Department of Victoria, presided over by Baron Sir Ferdinand von Mueller, accompanied by an English tourist—Mr. Alexander Davidson—succeeded lately in ascending Mount Bellenden-Ker, the highest mountain in tropical Australia. They had to cut their track for many miles through dense jungles of virgin forest, and they had previously to encounter the hostility of the savages. Two cataracts of considerable magnitude were discovered during the ascent. This mountain has a particular horticultural interest, it having been named at the suggestion of Robert Brown (like Mount Dryander), during Flinders' expedition, in honor of a botanist—Mr. Bellenden-Ker, the great investigator of iridaceous and amaryllideous plants in the early part of the century. When, in 1855, Baron Mueller went with Mr. Aug. Gregory to Northwest Australia (where then what now is so famous as the Kimberley country was discovered), he saw from the sea, he tells us, the bold outlines of Mount Bellenden-Ker, towering to 5,000 feet, and could well appreciate the feelings which prompted Robert Brown to suggest a botanical name for that mountain; indeed, unexpectedly, it has proved the only one in all tropical Australia which has a really cool zone. In a discourse given at the School of Mines in Ballarat, and on some other public occasions, the baron pointed out many years ago that, if any Rhododendron, Vaccinium, Quercus, Impatiens, Begonia and other plants of the cooler Malayan regions existed at all in Australia, it would be on the almost constantly clouded and temperate heights of Mount Bellenden-Ker. This anticipation has now been verified as regards the two first mentioned genera, a Rhododendron (R. Lochæ, allied to R. Javanicum) and a Vaccinium of the section Agapetes having been discovered at an altitude of about 5,000 feet, where they are strangely associated with a new arborescent Dracophyllum, a Spiræanthemum, a new Argophyllum, and other extra Indian types of vegetation specifically here endemic. New genera for Australia from the same high region are, also, a Didymocarpus, a Pentapanax; besides these were obtained new species of Helicia, Tristania, Morinda, Eugenia, Fagodea, and some others. The remarkable manner in which the Malayan and Australian plants meet others of New Caledonian type on the summit of Mount Bellenden-Ker (among the Australian being such typical forms as Trochocarpa and Arites) renders this high, though not extensive, region singularly remarkable for phytogeography. A new undescribed Proteaceous genus occurs, we are told, lower down on the range, and should, on account of its many large seeds, prove a new tropical nut tree.

In noticing in the *American Journal of Science*, Warming's "Entomophilous Flowers in Arctic Regions," Dr. Gray remarks: "Greenland is very poor in insects, especially of insects which perform an important part in the fertilization of the entomophilous blossoms of northern regions generally. Dr. Warming undertook a careful comparative study of these northern flowers, to learn whether those in Greenland were identical in floral biology with the same species in Europe. In many no differences were found, but in not a few certain modifications were detected in the Greenland flowers which rendered them more adapted to self-fertilization than those of the same species on the European continent, where the appropriate visiting insects are more abundant. In answer to the question whether the attractiveness of these blossoms for insects remain unaltered in Greenland, Dr. Warming is able to state that with three or four exceptions, the nectar secretions seemed not to be diminished; but that the odors were feebler, the size of corolla less, and the colors not so vivid as in the same species on the continent. As the entomophilous flowers of Greenland manifest an increased adaptation to self-fertilization, it might have been expected that the diœcious or polygamous tendency of some of them would disappear, but it proved not to be so. But the Salices were found to be remarkably fruitful, and it seems that they had become anemophilous."

COULTER and ROSE on UMBELLIFERÆ.

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The occurrence and function of certain nitrogenous bodies in plants.

W. E. STONE.

The nitrogenous bodies are probably the least understood of all plant constituents; indeed, the whole question of the relation of nitrogen to vegetation presents many unsolved problems. Its source, assimilation, various forms of existence, destruction, transformation and functions are all subjects of discussion at present, as they have been for many years. Something of the difficulty met with in the study of these questions arises from the chemical indifference of the element, and the difficulty of recognizing and isolating its various compounds as such. Micro-chemical methods fail for this purpose except in one or two cases, and, while purely chemical processes have accomplished a great deal, the discoveries announced from time to time, and the still existing gaps in theories, show that all the data are not yet at hand. A very practical and tangible illustration of this state of our knowledge occurs in the estimation and valuation of vegetable nitrogen as a food element. For lack of a better general knowledge and methods the total nitrogen present is regarded as existing in the form of albumin, or in a few cases is classified as albuminoid and non-albuminoid, although it is well known that it may be present in a variety of forms of very different value and structure. If these different nitrogenous bodies have different values to the animal system, it is quite certain that they represent different physiological offices and uses in the living vegetable organism.

During the past decade certain German investigators have done much toward determining (1) what these nitrogenous bodies are, and (2) what their functions may be. The results of their work, scattered through various chemical and botanical journals, are not generally available to American botanists, nor have they, so far as I know, been connectedly presented to them. For these reasons, no less than because it is a very important physiological subject, a general résumé has seemed desirable.

For the sake of convenience the vegetable nitrogenous bodies may be classified under two heads: those which play the part of reserve material, and those which are involved in the vital processes of the germinating or growing plant, or, passive and active forms. The work of the past few years has pointed out the existence of these classes and indicated their different values in the vegetable economy.

The reserve nitrogenous bodies occur chiefly in the form of albumin, or according to Ritthausen[1] *conglutin* and *legumin*, terms commonly applied to vegetable albumin or casein. These compose almost exclusively the nitrogenous constituents of seeds, but in roots and tubers are often accompanied by other bodies of a secondary and derivative nature, which may be regarded as surplus untransformed materials left by the cessation of the vegetative processes. The albumins, legumin and conglutin, which may be regarded as the true reserve forms ot nitrogen, are colloids, are insoluble in acid fluids and, usually existing in a solid condition, are not directly available for the processes of transmutation or assimilation.

The active or secondary forms, occurring rarely in seeds but always present in germinating and, at least locally, in growing plants, we will discuss more in detail. They are chiefly amido compounds, crystalloids, and soluble in fluids of the plant. Because of their unstability and great solubility, their isolation is very difficult; for a long time their existence was not recognized, and even at present it may be affirmed safely that still others await discovery.

The most common of these, and, because of its comparatively easy recognition, the first which attracted attention, is asparagin,[2] now regarded as a generally disseminated plant constituent and proved to be present in a large number of families.[3] It was found in the young germs of *Lupinus luteus* by Beyer,[4] and subsequent study showed that the seeds and germs of this plant were peculiarly adapted to the investigation of these secondary nitrogenous compounds. The 10 to 12 per cent. of nitrogen in the seeds is almost entirely in the form of albumin, unaccompanied by asparagin, while the germs are unusually rich in asparagin and other non-albuminous nitrogenous bodies.

Pfeffer[5] made this the subject of especial study, and found

[1] Die Eiweiss Körper der Getreidearten, p. 188.

[2] $C_4H_8N_2O_3$. Discovered by Vauquelin and Robiquet in asparagus shoots, in 1805.

[3] For a list of plants in which it had been found at that date, see Die Pflanzenstoffe, Berlin, 1871, A. & T. Husemann.

[4] Landwirthschaft. Versuchs-Stationen, vol. 9 (1867), p. 168.

[5] Pringsheim's Jahrbuch für Botanik, vol. 8 (1872), p. 429.

that if the germs were excluded from light the amount of asparagin formed was greatly increased, particularly in the last stages of germination. He concluded that the asparagin was derived from the albumin originally occurring in the seed, and served for the transportation of the same to the growing parts of the plant—a process analogous to the solution and transmutation of insoluble carbohydrates. His deductions were confined, however, to the Leguminosæ, outside of which he does not mention the occurrence of asparagin.

In 1876 E. Schulze[6] published the first of a notable series of contributions upon the subject. Lupine seeds which contained 45 per cent. of albumin were germinated and grown fifteen days under exclusion of light. At the end of this time the total amount of nitrogen present was unchanged, but only 8 per cent. of albumin remained; 37 per cent. had been changed to a soluble form, of which nearly two-thirds was asparagin. By repeated experiments it was found that the most favorable conditions for the formation and accumulation of asparagin were germination in the dark for ten days, and then exposure to faint light for some weeks[7]; the germs thus produced contained usually 27 to 28 per cent. of their dry weight in asparagin. The quantity produced was proportional to the time of growth, and it was found in the greatest abundance in the axial organs. These observations were supplemented by those of Borodin,[8] who gave to the question a new aspect by investigating the different parts of growing plants.

In the young shoots of many trees and shrubs he found appreciable quantities of asparagin; in some, however, only traces; while in others, as Larix, Betula, Alnus, Syringa, Lonicera, etc., none at all could be recognized. But by modifying the conditions, viz., by detaching the twigs and allowing the buds to develop in water at ordinary room temperature, he was able to produce asparagin in all of the many species examined. He concluded, with Pfeffer and Schulze, that it could only come from a breaking down of albumin, and that it probably served as a source for the regeneration of the latter at a later stage.

The study of the problem thus far had been prosecuted

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[6] Berichte d. Deutschen Chem. Gesellschaft, vol. 9 (1876), p. 1314. Also Landwirthschaft. Jahrbücher, vol 5 (1876), p. 821.

[7] Journal für Practische Chemie, vol. 27 (1883), p. 337.

[8] Botanische Zeitung, vol. 36 (1878), p. 801.

chiefly by micro-chemical methods, with the result of establishing the general occurrence of asparagin, and the theory that it served as a transferring agent between reserve albumin and the vegetative organs of the plant. This theory lacked general application because in some cases asparagin could not be detected and in others occured in too small quantities to satisfy the requirements of the plant if the theory was true. Either the hypothesis was not correct or there must be other products of the breaking up of albumin which the methods thus far used could not detect.

The identification of such products by chemical methods not only supplied facts of the most vital importance to the question under consideration, but serves to illustrate the dependence of vegetable physiology upon the chemist as well as the microscopist for the solution of its problems.

Shortly before Borodin's investigations Schulze had taken up the study of the seeds and young germs of Cucurbita Pepo.[9] Pfeffer had not found asparagin here, but Sabanin and Laskowsky[10] had obtained secondary ammonia salts in watery extracts from them, without, however, determining their nature. Schulze, by a peculiar method of treatment, was able to isolate glutaminic acid, which was assumed to exist originally in the juices of the germ as an amide.[11] This amounted to 1.75 per cent. of the dried weight of the germs, which were grown sixteen days under exclusion of light. As no such substance occurred in the ungerminated seeds he concluded that like the asparagin of the lupine it was derived from the breaking down of albumin, and performed a similar office to the plant. Later[12] traces of asparagin were found together with small quantities of tyrosin and leucin,[13] all secondary, soluble, nitrogenous bodies, to which were subsequently added vernin,[14] xanthin bodies, ammonia salts and nitrates.[15]

Meanwhile the lupine which had produced asparagin so freely, had also been examined for other nitrogenous bodies, with rich results.[16] Beside the small quantities of glutamin, leucin, tyrosin, and possibly ammonia salts, which it pro-

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9 Berichte d. Deutschen Chemischen Gesellschaft, vol. 10 (1877), p. 199.
10 Landwirthschaft. Versuchs-Stationen, vol. 18, p. 405.
11 Probably as $C_5H_6(NH_2)_2O_3$.
12 Journal für Practische Chemie, vol. 20, p. 385.
13 Tyrosin=$C_9H_9(NH_2)O_3$. Leucin=$C_6H_{11}(NH_2)O_2$.
14 Vernin=$C_{16}H_{20}N_2O_2$. See Zeitschrift für Phisiolog. Chem., vol. 10, p. 80.
15 Journal für Practische Chemie, vol. 32, p. 433.
16 Journal für Practische Chemie, vol. 27, p. 337.

duced in common with Cucurbita, two *amido* acids[17] and peptone were found ; while during the last year it has yielded still another new body, arginin.[18]

These substances are all regarded as secondary products derived from the albumin of the seed in a manner analogous to the formation of asparagin. Confirmatory of this view is the fact that the albumin of lupine seeds when subjected to artificial chemical action is converted into amido acids which seem to be identical with those produced in germination.[19]

It was noteworthy that the amido acids which were so distinctly present in the germs of lupine were not found in those of Cucurbita, and that the asparagin of the former was substituted by glutamin in the latter.

Following Borodin's study of the occurrence of asparagin in the young shoots of woody plants, Schulze conceived that other bodies might be found here as well as in the germinating stages already examined. Twigs of Platanus occidentalis were removed from the tree in April and kept in a warm room until no further growth was made. The young shoots thus developed contained, besides asparagin, an appreciable quantity (.5 to 1 per cent.) of a substance corresponding in its reactions to allantoin.[20] Repeated investigations showed this to be a constant constituent of young shoots of Platanus treated in this way, but it could not be detected in shoots or leaves growing normally upon the tree. Leucin and bodies of the xanthin group were also found in Platanus. Allantoin also occurs in the shoots of Acer pseudo-platanus.

The vernin, already mentioned in connection with lupine, seems also to be widely disseminated, occurring in the germs of Vicia sativa (in which it was discovered), Trifolium pratense, Cucurbita Pepo, the sclerotium of Claviceps purpurea, and the pollen of Pinus sylvestris and Corylus avellana.[21]

The examples given show that in the germinating and vegetative stages of the plant, secondary nitrogenous bodies appear in considerable variety of form, and in sufficient quantities to imply some important use or office. The idea that nitrogenous, and particularly albuminous, substances undergo changes during growth and assimilation is by no means

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[17] Phenyl-amido-propionic acid=$C_9H_9(NH_2)O_2$. Amido-valerianic acid $C_5H_9(NH_2)O_2$

[18] $C_6H_{14}N_4O_2,HNO_3+\frac{1}{2}H_2O$. See Berichte d. Deutsch. Chem. Gesellsch., vol. 19 (1886), p. 1177.

[19] Schulze Zeitschrift für Physiol. Chem., vol. 9, p. 63; same vol., p. 253: vol. 10, p. 134; vol. 11, p. 210. Also Gorup-Besanez, Berichte d. Deutsch. Chem. Gesellsch., vol. 10, p. 780.

[20] $C_4H_6N_4O_3$. Berichte d. Deutschen. Chem. Gesellschaft, vol. 14 (1881), p. 1602.

[21] A. von Planta. Landwirthschaft, Versuchs-Stationen, vol. 31, p. 97, and vol. 32, p. 215.

new. Liebig regarded these bodies as possessing the nature of ferments,[22] but Hartig first indicated the probable breaking up of reserve albumin into crystallenic compounds.[23] Pfeffer in his thorough discussion of the appearance of asparagin, already referred to, ascribed its origin to the original albumin present, and pointed out that in the change C and H were set free, either to be exhaled or adapted to the building of new tissue.[24]

The exclusion of light favored its formation, but he afterwards found that the process followed equally well in the light if CO_2 was excluded. This led him to conclude that the formation of asparagin was in some way connected with the presence or absence of carbohydrates in the plant. Borodin found it accumulating in young shoots and buds not alone when detached from the parent stem, but equally as well when, remaining in position, they were protected from light. He also concluded that the phenomenon was caused by the lack of non-nitrogenous substances, based upon one of two principles, either, first, albumin undergoes no breaking down in the presence of carbohydrates; or, second, it constantly undergoes transformation, but in the presence of carbohydrates is constantly regenerated to new albumin, and no accumulation of the secondary products takes place.[25]

The latter supposition seemed the more probable, since the asparagin which collected in etiolated growths disappeared again when they were exposed to light, and albumin increased proportionally.

Schulze's discovery of so many other bodies homologous to asparagin, served to strengthen and broaden the application of the theory of the transformation of albumin. He showed farther that in the germs where the secondary products accumulated, there was an increase of H_2SO_4 corresponding to the amount of S set free from the broken down albumin molecules,[26] and Pfeffer regards the exhaled CO_2 as also coming from this source.[27]

The dependence of these bodies upon the absence of nitrogen-free substances for their formation seems also clearly indicated by the observations upon etiolated growths, and

[22] Die Organische Chemie in ihrer Anwendung auf Agricultur, 1840, p. 220.

[23] Entwickelungs-Geschichte der Pflanzen-Keim, 1858, p. 126.

[24] Botanische Zeitung, vol. 8 (1872), p. 429. See also Physiological Botany, Goodale, p. 365.

[25] Botanische Zeitung, vol. 36 (1878), p. 801.

[26] Berichte d. Deutschen Chem. Gesellschaft, vol. 9 (1876), p. 1314; vol. 11 (1878), p. 438; vol. 13 (1880), p. 21.

[27] Handbuch der Pflanzenphysiologie, p. 295.

the effect of withholding CO_2. Farther Schulze has shown[28] that those seeds containing proportionally large amounts of albumin and small quantities of carbohydrates, produce amide compounds most abundantly in germination. The ratios of albumin to nitrogen-free substances in seeds of lupine and Cucurbita were respectively 1 : 0.35 and 1 : 1.56. After fifteen days' germination, the lupine produced 19.43 per cent. of the dry weight of the seeds in asparagin and glutamin, and Cucurbita only 5.78 per cent.

The office of the vegetable amides is, therefore, as at present understood, to serve as a transferable form of nitrogen from reserve supplies to the place of growth, and farther, probably, as an indirect source of non-nitrogenous materials. Schulze has shown that they may also act as reserve material, in certain cases, in roots and tubers.[29] They occur universally in the germinating and vegetating stages of the plant, but fail almost as invariably in seeds. By their formation, through the breaking up of the albumin molecule, C and H are liberated, which may assist in the formation of new tissues, especially when assimilation has been artificially prevented or before it has begun in the germ. A like checking of assimilation in growing shoots, or a cutting off of the supply of nitrogen-free materials from the main stem, also results in an accumulation of these bodies. The small quantity of amides, formed by normal germination, is regenerated to albumin as soon as assimilation begins, while in the normal growth of plants they are found only sparingly, and in some cases not at all, or at least are not detected by our present methods. So much has been determined with reasonable certainty in our knowledge of these substances.

There remains the question whether the amides serve ordinarily for the transfer of nitrogen alone, while their ability to assist in the formation of carbohydrates is exerted only at stated periods or in emergencies, or whether these two processes are supplementary and constantly operating.

Pfeffer advances two hypotheses.[30] Either in every cell of growing tissue a transformation of albumin to amides is constantly occurring, and under normal conditions an equally constant regeneration to albumin follows, or such transformation occurs first when other nitrogen-free materials are

[28] Landwirthschaft-Jahrbücher, vol. 9 (1880), p. 733.

[29] Berichte d. Deutsch. Chem. Gesellschaft, vol. 16 (1883), p. 312; vol. 18 (1885), p. 390. Landwirth. Versuchs-Stationen, vol. 29, p. 295.

[30] Handbuch der Pflanzenphysiologie, p. 299.

lacking. Both may be true, and he points out the analogy of fungi which are able to make growth, forming cellulose and oils, with a nourishment of only nitrogenous substances, but if carbohydrates be also furnished them, a much smaller quantity of the nitrogenous matter will be made use of.

The principal amides observed under normal conditions, are, as already stated, asparagin and glutamin. Schulze assumes[31] that this does not indicate a larger production of these particular bodies, but that they are less easily regenerated than some other forms. In this way he explains the fact that the amount of asparagin in lupine germs continued to increase for some time after their exposure to light, at the same time assuming that the first carbohydrates formed by renewed assimilation are employed for the formation of new tissues, and not for the formation of albumin from amides.

The observations of Borodin and Schulze also indicate that not all carbohydrates or nitrogen-free substances have the properties for influencing the formation of amides or their regeneration. For instance, sugar beets contain considerable quantities of amides and cane sugar, existing side by side, and the conclusion is that cane sugar is unable to promote the regeneration of the amides or participate in the formation of new tissues. Fungi invert cane sugar before transmutation, and a similar process may be necessary before the regeneration of amides is possible. Probably only a few of the nitrogen-free bodies have this property; perhaps only glucose.

The question as to why the presence of nitrogen-free bodies is necessary to the regeneration of the amides also presents some difficulties. Since asparagin and glutamin contain less C and H than albumin, an addition of these elements is necessary to the formation of the latter. But tyrosin and leucin contain comparatively more C and H than albumin. Judging from their elementary composition, therefore, if one group requires the presence of carbohydrates for regeneration, the other does not. It is possible that direct combinaton between the two groups occurs with the co-operation of carbohydrates. At least Schulze's conclusion, that the carbohydrates *promote* the reconstruction of albumin from the secondary nitrogenous compounds, seems safely acceptable in the light of our present knowledge.

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[31] Landwirthschaft. Jahrbüch, vol. 9 (1880), p. 731.

Undescribed plants from Guatemala. I.

JOHN DONNELL SMITH.

VOCHYSIA GUATEMALENSIS. (Series *Lutescentes*, Warm., Fl. Brasil. xiii.[2] 59.)—Smooth and shining except the puberulous leaf-buds, stipules, rachises and calyx-lobes: purplish branchlets costate-angled by a decurrent line from each stipule, interpetiolar sides concave: stipules persistent, subulate, 1½ lines long with an acute canescent tip; petioles an inch long; leaves 3–4–verticillate, opposite, or uppermost rarely alternate, oblong-lanceolate, acuminate at each end, 5–6 inches long, less than a third as broad: thyrsi composing leafy panicles, terminal and from upper axils, cylindrical, 4–7 inches long, rachis angulate and sulcate: cicinni approximate, 3–4-flowered, mostly about an inch long without the flowers, peduncles and short pedicels suberect and triquetrous: flower-buds linear, scarcely 1½ lines broad, slightly recurved, acuminate; calyx sparsely dotted with red glands, anterior lobes broadly ovate and a line long, lateral ones rounder and smaller, posterior lobe 8–10 lines long and reflexed-patent after anthesis with its slender terete deflexed spur half as long as calyx; petals oblong-obovate, the anterior one half as long as calyx and 2 lines broad, the others a little shorter and much narrower; stamen linear-spatulate, nearly twice longer than petals, the 5-lines-long and 1-line-broad anther narrowing at base into the tapering filament; staminodes tipped with a red gland; style not thickened above; stigma minute; capsule (immature) oblong, thrice longer than broad, obtusely trigonal.—Leaves nearly of *V. magnifica* Warm., but longer-acuminate, mucronulate, costal arches less distinct, reticulation more minute, and stipules conspicuous for the series; distinguished better by floral characters.—A lofty tree, not rare in its locality, with vast panicles of shining-yellow flowers, discovered by Mr. H. von Türckheim in the mountain-forests of Pansamala, Dept. Alta Vera Paz, altitude 3,800 feet, June, 1886. (Plantæ Guatemalenses Tuerckheimianæ, a John Donnell Smith editæ, 943.[1]) Remarkable as the only species of a large genus, and with a single exception the only representative of its order, that has been found outside of South America.

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[1]Sets of this series of plants are in course of preparation for distribution to Gray Herb., Harvard University; Torrey Herb., Columbia College; National Herb., Washington; Kew Herb., London; Muséum d'hist. nat. de Paris; Königl. botanisches Museum, Berlin.

HAMELIA CALYCOSA.—A shrub 9–12 feet high, glabrate: stipules filiform, 2 lines long, with a ciliated interpetiolar line: leaves ternate, lanceolate, 2–4 inches long, one fourth as broad, acuminately produced, finely attenuated into a short pubescent petiole, margins revolute, punctate and with scattered cystoliths, veins not reticulate: cymes pubescent, compound, trichotomous, umbelliform; lobes of turbinate calyx linear to oblong, 2½ lines long and equalling the tube, sinuses truncate; corolla yellow, ventricose-campanulate, 12–14 lines long, narrowed below into a cylindrical tube 3 lines long; anthers mucronately produced at base, four times longer than the complanate filament; stigma about equalling style; capsules glabrate, elliptical, 10-costate, 5 lines long, half as broad.—Resembling *H. ventricosa* Sw., but flowers differing by the calyx-lobes large for the genus, short broad filaments, and long stigma.—Pansamala, alt. 3,800 feet, June, 1885. (Pl. Guat. Tuerckh., a I. D. S. edit., 454.—De Türckh. Fl. Guat. Edit. Keck 454.)

ARDISIA PECTINATA.—Arboreous: branchlets knotted, warty, pitted with large scars of fallen petioles: leaves crowded at end of branchlets, pergameneous, pellucid, nitidous, oblong to oblanceolate, 10–13 inches long, 4–5 inches broad, abruptly short-acuminate, cuneately narrowed to a channeled petiole half an inch long, margins finely pectinate throughout by excurrent nerves, lineolate-glandulose beneath, reticulately veined, with free veinlets, the 20–22 stronger lateral costæ joining in two series of conspicuous arches and a less distinct marginal one: panicle terminal, nearly sessile, ferruginous pubescent, broadly pyramidal, about equaling the leaves, rachises angulate and sulcate, 5-merous flowers subumbellately racemose at the end of tertiary branches, linear-bracted spreading pedicels 4 lines long: calyx-lobes ovate, 1 line long, 4-nerved, ocellate and at length glandular-thickened beneath, margins scariose; corolla-segments rose-colored, broadly ovate-lanceolate, obtuse, 2½ lines long, reflexed, 4-nerved, corrugate above, margins scariose and undulate, æstivation dextrorsely convolute and contorted; stamens two-thirds as long as corolla, oblong apiculate anthers thrice longer than filament, connective not dilated above, cells dehiscing by elliptical apical pores one-fourth their length; style straight, flat tapering, a little exceeding the stamens; ovary ovoid, rubro-punctate, 15–20-ovulate.—Related to *A. pellucida* Œrst. as described without flowers.—Forests of Pansamala, alt. 3,800 feet, June, 1886. (Pl. Guat. Tuerck., a I. D. S. edit., 942.)

MYRIOCARPA HETEROSPICATA.—Monœcious: a shrub with pale smooth verrucose branches: leaves glabrate except the ciliate veins and axils of under surface, lanceolate-acuminate, 3–5 inches long, less than a third as broad, narrowed to a pubescent petiole 10–16 lines long, margins entire or with a few callose points, tri- or tripli-nerved with 2–3 pairs above the middle, loosely reticulate beneath, above conspicuously beset with cystoliths not radiately arranged: spikes unisexual, approximate, single in the axils, secund, forking once shortly above the peduncle, the closely-flowered staminate spike about a third as long as the loosely-flowered 6–9-inches-long pistillate one: male flowers 4-merous, perianth-segments roundish and marked with cystoliths, rudiment of ovary indistinct and peltate; female flower sessile in a 2-phyllous calycle.—Distinct by its spikes not androgynous as in the only other monœcious species, *M. bifurca* Liebm. The absence of both hairs and glands, as radiating points for cystoliths, is also special.—Forests of Pansamala, alt. 3,800 feet, March, 1886. (Pl. Guat. Tuerck., a I. D. S.edit., 892.)

NEPHRODIUM TUERCKHEIMII. — Rhizome stout, creeping, forking: stipes loosely clustered, ascending at base, 2–2½ feet long, a third of an inch thick, stramineous, pubescent, densely clothed throughout with brown triangular-lanceolate patent scales 3–4 lines long with a punctiform cellulation: frond oblong-acuminate, 3–4 feet long, half as broad, subcoriaceous, strigillose or glabrate above, paler and pilose beneath; main rachis thickly paleaceous, secondary ones with smaller scattered scales; pinnæ closely 35–40-jugate below the pinnatifid apex, linear-tapering, the lower ones not reduced, 16–20 lines broad, cut down to within a sixth of the space to the midrib; segments 60–70-jugate, linear-oblong, 8 lines long, 2 lines broad, oblique, acutish, margins revolute, veins 18–20-jugate with the lowest one terminating at the sinus; basal segments of lower pinnæ enlarged to 17 lines long and 8 lines broad, ovate-lanceolate, pinnatifid: sori submarginal, small, 9–12 to the series, persistent indusium reniform and hirsute.—Allied to *N. patens* Desv., and especially to the var. *stipulare* Bak. (*Aspidium stipulare* Willd.), but differing by the chaffy stipe and rachises, deeply cut pinnæ, numerous segments and veinlets with sori nearer the margin.—Swamps near Coban, Alta Vera Paz, alt. 4,300 feet, September, 1885. (Pl.Guat.Tuerck.,a I. D. S.edit., 704.)

NEPHRODIUM FENDLERI, Hook., var. PAUCIPINNATUM.—Rhizome short, thick, erect; scales matted, blackish, lanceolate, 4–5 lines long, cells punctiform; rootlets with a heavy brown tomentum: stipes few in the crown, scaly at base, smooth, stramineous, 2 feet long, thick as a crow's quill: frond about as long as stipe, quite smooth throughout, minutely bullate-punctate; pinnæ 8–14, not in pairs, 8–10 inches long, 15–20 lines broad, terminal one distinct and not larger than the lateral, caudate entire apex 2 inches long, cut almost half-way to the rachis into 20–24 lobes; veinlets 10–12-jugate, only two or three from adjoining groups uniting at or below the sinus: sori on each veinlet, those above the sinus marginal; indusium pallid, not corrugate, reniform, center depressed, sinus open.—Prof. Eaton has examined this fern, and advises that it comes very close to his *Aspidium Fendleri* (Mem. Ac. Sc. viii. 210), but has fewer pinnæ. In that respect as well as others the numerous specimens are uniform.—Rock-crevices in Petet, near Coban, alt. 4,300 feet, September, 1885; copses, Pansamala, alt. 3,800 feet, July, 1886. (Pl. Guat. Tuerck., a I. D. S. edit., 767, 667.)

Notes on Umbelliferæ of E. United States. V.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE V.)

[In addition to the collections mentioned in the April GAZETTE, we have now to add those belonging to Brown University. Prof. W. W. Bailey has thus kindly put at our disposal, not only his own large collection of Umbelliferæ, but also those of Olney and Bennett.]

THASPIUM Nutt.—Fruit ovoid to oblong, slightly flattened dorsally: carpel with 5 primary ribs, 3 or 4 or all of them strongly winged: oil-ducts solitary in the intervals, two on the commissural side: seed-section round or somewhat dorsally flattened, indented beneath the oil-ducts: stylopodium wanting; styles long (figs. 57–62).—Perennials (2 to 5 ft. high), with ternately divided leaves and broad serrate or toothed leaflets (or lower leaves simple), mostly yellow flowers, and all the fruit pedicelled.—The species of Thaspium are in great confusion. In Gray's Manual *T. aureum* Nutt. and

T. trifoliatum Gray each have an apterous variety. These apterous forms were taken from Koch's genus Zizia and placed under the Thaspium species apparently from the close resemblance of the foliage. The fruit characters, however, are abundantly distinct, for the Zizia forms have simply ribbed fruit flattened laterally, the central fruit of the umbellets sessile, and flower early in spring; while T. aureum and T. trifoliatum of the Manual have winged fruit flattened dorsally, central fruit pedicelled, and flower late in summer, maturing fruit in the fall. Bentham and Hooker have transferred these apterous Zizia forms to a section Zizia under Carum, from which genus they differ in the absence of stylopodia, central sessile fruit, more prominent ribs, and Thaspium-like foliage. The same authors seem to have made no disposition of T. aureum of the Manual, unless it went with the apterous variety, while the group of forms under *T. trifoliatum* Gray of the Manual has been taken as representing *T. cordatum* Torr. & Gray. For this latter species Bentham and Hooker seem to have had in mind only Gray's apterous variety, and so referred it to Carum § Zizia as one of the two species. In Watson's Bibliographical Index the synonym *Carum cordatum* Benth. & Hook., under T. trifoliatum, is correctly quoted, so far as literature is concerned, but apparently should be transferred to *T. trifoliatum*, var. *apterum* Gray, to express the real form Bentham and Hooker had in mind. This leaves the Manual forms T. aureum and T. trifoliatum with its var. atropurpureum unprovided for by these authors, the two apterous varieties only having been used to form the section Zizia under Carum. An explanation of this may be found in the fact that most of the herbarium specimens labeled Thaspium aureum and T. trifoliatum are really the so-called apterous varieties. The specific forms with winged fruit are quite uncommon among herbarium specimens, while the apterous forms are very abundant.

1. **T. aureum** Nutt. Genera, i. 196. Glabrous: root-leaves mostly cordate, serrate; stem-leaves simply ternate (rarely biternate); leaflets ovate to lanceolate, round or tapering at base, serrate: flowers deep yellow: fruit globose-ovoid, about 2 lines long, all the ribs equally winged (figs. 57, 58).—Thickets and woodlands, as far west as Illinois. Flowering in summer and maturing fruit in late summer or autumn. This species has a wide range of variation in the division and toothing of its leaves, but they are so inconstant that it seems impossible to found specific distinctions upon them.

In characterizing T. aureum, Nuttall has laid some stress upon "lateral divisions of the upper leaves subsessile," a character which means nothing, as these divisions may be sessile, subsessile, or petioled on the same plant, either in T. aureum or the T. trifoliatum of Gray. So far as foliage characters are concerned, serrate leaflets point to Nuttall's form, while crenately toothed leaflets stand for Gray's T. trifoliatum, exclusive of his vars. apterum and atropurpureum.

Further confusion in leaf characters has arisen by including the so-called apterous varieties, which we have transferred to Zizia. An extreme variation in leaf characters, but merging completely into the type through intermediate forms, is presented by

Var. **trifoliatum,** in which all the leaves or leaflets are crenate or crenately toothed. *T. trifoliatum* Gray, Manual, 195, in part.—Ohio to Illinois and westward to Oregon. This seems to be the common western form of the species, as our Pacific coast specimens are all distinctly var. trifoliatum. From Ohio to Illinois there is an interminable intermixing of the species and the variety, while in Pennsylvania the specific form is well represented.

Var. **atropurpureum.** Petals dark-purple. *T. atropurpureum* Nutt. *T. trifoliatum* var. *atropurpureum* Gray, Manual.—With the preceding forms. This variety has the leaf characters of the species, and if var. trifoliatum had been retained as a species, var. atropurpureum would have been transferred to T. aureum.

In giving the range of the above group of forms it has been impossible to use published ranges owing to the great confusion as to what forms were intended. Discarding the apterous varieties, the true Thaspiums of this group are but scantily represented in our herbaria, far more so, probably, than their occurrence would justify. The early spring and summer flowers and fruits of the apterous forms have probably too often satisfied collectors that they had already secured good material of forms which only appeared in collecting condition in late summer and autumn. Therefore we could only cite such range as our material indicated, confident at the same time that it could not represent the whole range. We would call the attention of collectors to this point, that the true range of T. aureum and its var. trifoliatum may be obtained.

2. **T. barbinode** Nutt. Genera, i. 196. Loosely branched, pubescent on the joints, sometimes puberulent in the umbels:

leaves 1 to 3-ternate; leaflets ovate to lanceolate, acute, with cuneate base, coarsely cut-serrate, often ternately cleft or parted: flowers light yellow: fruit broadly oblong, about 3 lines long and 2 lines broad, with mostly 7 ribs prominently winged, the other three not at all winged or but slightly so (figs. 59, 60).—Banks of streams, New York to Minnesota and southward. Fl. May and June.

Var. **angustifolia** has narrower, more sharply cut leaflets, and is readily distinguished from the type.—Marion Co., Illinois *(Bebb)*, Westmoreland Co., Pennsylvania *(W. W. Bailey)*, Montgomery Co., Indiana *(Rose)*.

3. **T. Walteri** Shuttlew. Loosely branched, pubescent on the joints, puberulent on branchlets, umbels, and fruit, with fewer leaves: leaves 1 to 3-ternate; leaflets 1 to 2-pinnatifid, lobes linear or oblong, one or two leaves near the base often very large and long petioled (petioles sometimes a foot long): flowers light yellow: fruit oblong, 1½ to 2½ lines long and 1 to 1½ lines broad, all the ribs winged, generally three of them narrowly so (figs. 61, 62). *T. pinnatifidum* Gray, Manual. —Barrens and mountains, North Carolina to Kentucky.

ZIZIA[1] Koch.—Fruit ovate to oblong, flattened laterally: carpel with 5 primary ribs (not at all winged): oil-ducts large, solitary in the intervals, two on the commissural side, and a small one in each rib: seed-section round, indented beneath the oil-ducts: stylopodium wanting; styles long (figs. 63–66).—Smooth perennials (1 to 3 ft. high), with mostly Thaspium-like leaves, yellow flowers, and central fruit of each umbellet sessile (in ours). Flowers in early spring, in open prairies and upland meadows.

In separating the species of Zizia from the Thaspium aureum group we are very much indebted to Mr. M. S. Bebb, who has placed the careful observations of ten years at our disposal, and who is convinced that they are abundantly distinct. His field observations concerning their decided differences in habitat and time of blooming very strongly confirm the differences discovered in fruit structure.[2]

1. **Z. aurea** Koch, Umbel. 129. Radical leaves very long-petioled, all but the uppermost leaves 2–3-ternate; leaflets ovate to lanceolate, sharply serrate: rays 15 to 25, stout, 1 or

[1] It must be remembered that the Zizia of Gray's Manual is a Pimpinella.

[2] The western species that has been variously called Seseli Hallii, Musenium Greenei, and Carum (?) Hallii is evidently a Zizia. Its fruit characters are identical with those of Zizia, and had Koch's genus been retained it would probably have already included this species as Zizia Hallii.

2 inches long: fruit oblong, about 2 lines long (figs. 63, 64). *Thaspium aureum* Nutt., var. *apterum* Gray, Manual, 195. *Carum aureum* Benth. & Hook. Gen. Pl. i. 891.—Throughout our range, extending westward as far as the Saskatchewan and Texas.—Although Thaspium aureum, var. apterum is the real synonym of this species, botanists will find in their herbaria many specimens of Zizia aurea labeled Thaspium aureum and Thaspium trifoliatum.

Var. **Bebbii.** A more slender, mountain form, with leaflets more coarsely serrate or even toothed, the radical leaves smaller and more simple: rays 2 to 8, slender, 2 or 3 inches long: fruit mostly smaller, oval, 1 to 1½ lines long.—Virginia and North Carolina. Collected by *Curtiss* (1868), *Canby* (1876), *Meehan*, *Porter*, *Leidy* and *Willcox* (1880).

2. **Z. cordata** Koch, Umbel. 129. Radical leaves mostly long-petioled, cordate or even rounder, crenately toothed, very rarely lobed or divided; stem-leaves simply ternate or quinate, ovate to lanceolate, simply serrate, incised, or even parted: fruit ovate, 1½ lines long; seed-section larger than inthe last (figs. 65, 66). *Thaspium trifoliatum*, var. *apter um* Gray, Manual, 195. *Carum cordatum* Benth. & Hook. Gen. Pl. i. 891.—Same range as last and extending to Oregon. As in the last species, herbarium specimens of Zizia cordata will be found labeled almost anything under the Thaspium aureum section.

CARUM L.—Fruit ovate to oblong, flattened laterally: carpel with 5 primary ribs: oil-ducts large, solitary in the intervals, 2 to 6 on the commissural side, none in the ribs: seed-section dorsally flattened, more or less indented beneath the oil-ducts: stylopodium conical (figs. 67, 68).—The American species are western, with tuberous or fusiform roots, simply pinnate leaves with linear leaflets, and white flowers. The common garden caraway from Europe seems to have become naturalized in many places, and is

1. **C. Carui** L., with pinnately compound leaves and filiform divisions.—Apparently more commonly naturalized to the north and northwest.

EXPLANATION OF PLATE V.—Fig. 57, fruit of Thaspium aureum; fig. 58, section of carpel of same; fig. 59, fruit of T. barbinode; fig. 60, section of fruit of same; fig. 61, fruit of T. Walteri; fig. 62, section of fruit of same; fig. 63, fruit of Zizia aurea; fig. 64, section of carpel of same; fig. 65, fruit of Z. cordata; fig. 66, section of carpel of same; fig. 67, fruit of Carum Carui; fig. 68, section of carpel of same. All surface views are × 7; transverse sections × 22.

HALSTED on POLLEN TUBES.

BRIEFER ARTICLES.

"Crazy" pollen of the bell-wort (with plate VI.)—The pollen of the great-flowered bell-wort (*Uvularia grandiflora* Sm.) is of good size, smooth coated, nearly colorless (yellow in mass) and in many ways well adapted for use in laboratory work with students. The two nuclei may be easily demonstrated by using methyl violet or methyl green. The best reagent, however, out of a large number employed, is azo-rubin when used in a very dilute solution. Picric acid brings out the smaller nucleus in a very satisfactory manner. The larger nucleus is nearly as long as the pollen grain (55μ–65μ) and usually occupies its center. The appearance of the pollen after treatment is shown in figures 14-17, plate VI. The larger nucleus is many times longer than broad, and somewhat bent and pointed at each end. The smaller nucleus is oval shaped and not more than one-eighth as large as the long nucleus. It occupies a nearly central position in the pollen grain,

These Uvularia pollen grains germinate quickly in a medium sugar solution and exhibit a fine circulation of protoplasm within the larger tubes. In germination a tube arises seemingly at any point upon the surface of the grain. It as frequently grows from the side as from the end, and occasionally there are two tubes from the same grain when growing under ordinary conditions (figures 14, 15 and 17). Large numbers of pollen grains were found with tubes a millimetre in length when first removed from the anthers. It was therefore not necessary to wait upon the cultures for a supply of germinating pollen. In the culture medium some tubes obtained a length of two millimetres in fifteen hours. In many instances the large nucleus was found in the tube, and in one case it was in the somewhat enlarged tips of the tube. A portion of the end of a pollen tube is shown in figure 18. The granular contents of the tubes were arranged in well-defined rows which occupied a somewhat spiral direction beneath the wall of the tube. The protoplasm in its motion observed the same direction, and reminded the observers of what is to be seen within the long cells of a Nitella. The granules could be followed to the enlarged tip of the tube, where they passed by the nucleus upon one side and turned and returned upon the opposite side. The cyclosis was quite rapid, and it is to be regretted that measurements of the movements of the granules were not recorded.

One of the culture slides lost a large part of the nourishing sugar solution by absorption into the pieces of surrounding blotting paper, and the pollen grains upon the under surface of the suspended glass cover produced tubes of very strange abnormal forms. The germination of a dozen such grains is shown in figures 1-13. These grains were selected from among hundreds of others as exhibiting the more extraordinary forms. The original grain in each case is indicated by a darker or dotted shading, while the outgrowth is shown as a less colored portion. It will be seen at a glance that there was seemingly no "method in their madness." Some germinate from the side, others from the end, while others still send out tubes from both side and end. In some cases the remnant of the pollen grain is like a shell that is found upon the back of a snail, while the irregular growth of short tubes resembles the living portion of the snail. In some instances the pollen grain looked as if it had undergone a process similar to that of the popping open of a grain of corn. In others there was an amœba-like mass, projecting from one side of the grain, having not less than a dozen arms extending in as many directions. In one case there is shown a grain with a broad zigzag extending band, as if the point of growth had changed alternately from right to left as the tube increased in length. It is doubtless true that the projecting pollen tube in each of the abnormal cases met with more than usual resistance and the place of growth was shifted to another part of the tube. In this way, by the increase in size taking place at points of least resistance, each pollen grain built up a structure peculiar to itself, determined by its surroundings. It is not entirely unlike the formation of irregular, lifeless structures when liquids undergo solidification or even crystallization under unfavorable circumstances.

These unfortunate Uvularia pollen grains teach us of the persistency that is inherent in these highly vitalized cells. After successive failures to develop long tubes they still boldly attempted to send out new ones until they perished victims of adverse environments.—BYRON D. HALSTED

EDITORIAL.

IN THE SUBJECT of botany this seems to be an era of text-books and laboratory guides. Never before have so many authors essayed to satisfy the demands of the student and teacher, and never before have students and teachers looked so eagerly for some book to suit their needs. The harvest of books is large, but the quality is of all grades. The publication of worthless botanical text-books is often deprecated, but it is not a serious evil, except to the publishers. No text-book in these days can be otherwise than short-lived which does not "fill the want" it proposes to, and in no other department is the working of the law of natural selection more apparent than in that of text-books. There is a class of botanists who are never satisfied until they write a book. With no disposition to add something to the sum of botanical knowledge by patient work (they call it lack of opportunity), they conceive that the easiest thing to do is to grind over the knowledge of others and make a text-book. If there is anything that requires complete mastery of the subject of botany, a keen and critical judgment, a happy method of thought and expression, it is to write a text-book that will live. The young worker begins by readjusting classification, and the young writer by preparing a text-book, both of which attempts require the most mature judgment backed by the fullest experience. And so we must continue to have a perennial supply of these attempts: some will do good, none will do serious harm; and any of them may serve to introduce a working botanist whose subsequent performance will atone for the crudity of his first appearance. The day of the well-nigh universal use of any text-book is probably past, for there is such a diversity of opinion concerning methods of presentation that there must needs be text-books equally diverse. Besides, text-books are becoming more and more books of reference for library rather than class-room use. However, the high schools, and colleges of equal rank in botanical equipment, are clamoring for a text-book, or rather the botanists are telling them that they need one. Several attempts have been made to supply this demand, but the failures may be grouped under four heads: (1). Some have attempted too much, apparently lacking the power of judicious omission, and the book is so bulky and technical that the untrained teacher (and they are mostly untrained in the high schools) will never attempt it but once. The authors of these books have kept an eye on the criticism of fellow botanists rather than the need of high school classes, and have feared if they omitted anything they might be accused of not knowing it. We fear that the hypercriticism indulged in by some of our leading scientific journals has developed this spirit. For it is their custom to pass over the whole well-constructed bulk of the book to condemn some little detail which more than likely holds no relation to the general purpose. (2). Others have gone to the opposite extreme, and having young pupils constantly in mind, have endeavored to attract and simplify at the expense of accuracy, a method that should be heartily condemned. (3). A third class of books, worse than either of the former, are those that treat the science of botany as a vocabulary of scientific terms. A full and illustrated glossary is not a botanical text-book, and the attempt to use it as such is to bring discredit upon botany. (4). A lack in all our recent text-books, which is against a long life, is the lack of a manual for the determination of plants. Modern methods may claim that we do not want to "analyze" plants, but we do and we always will, and it will remain the chief means of exciting a living interest in the subject of botany. Hence that modern text-book only can be a permanent success which combines with it a manual, and a manual is no easy thing to prepare. When a book can be prepared technically accurate and full enough for scientific botanists, elementary enough for beginners, perfectly easy for untrained teachers to use, suggestive enough for the experienced worker, large enough to contain all the science of botany and a manual, small enough to be completed in a term of twelve weeks and sell for a dollar or two, then will every one commend it as the book to "fill a felt want;" but the man who can accomplish this must be one who speaks "as never man spake."

OPEN LETTERS.

Humblebees and Rhododendron nudiflorum.

In the April number of the BOTANICAL GAZETTE, mention is made by Gilbert van Ingen of the manner in which humblebees extract honey from Petunias. A similar instance has been presented to my attention in the case of Rhododendron nudiflorum. The humblebees uniformly alighted upon the limb of the corolla, and, crawling along the upper or inner side of the tube nearly to the calyx, punctured the corolla just above the ovary, and through the hole thus made, extracted the nectar. During the time I observed them, none attempted to obtain the honey in the legitimate method. To such an extent had these marauders carried their ravages, that it was with difficulty that a fully opened flower could be found on the whole bush that was not punctured. At the same time, however, several lepidoptera were observed extracting the nectar in the legitimate manner.

E. R. MEMMINGER.

Flat Rock, N. C.

Autumnal blooming of Oxalis.

I have just read (in the May GAZETTE) Professor Thomson's account of the autumnal blooming of Oxalis. I observed the same thing in an entirely undisturbed locality. Between Silesia and Crystal City, in Jefferson county, Mo., there is a sandy rock about two miles in length, and in its crevices this Oxalis was blooming, but without leaves. And curious enough the flowers were mostly white, so that at first I thought I had found a new species. I also found on the top of the rock Allium striatum blooming a second time, but when I went this year (in May) to the place I did not find many plants blooming. Last year we had a very dry summer, and in the fall good rains, and this, I think, will account for the autumnal blooming of these plants.

HENRY EGGERT.

St. Louis, Mo.

Letter to Botanical Club of A. A. A. S.

At the 36th meeting, to be held August 10-17 in New York City, the members of the Botanical Club will be entertained by the Torrey Club, and all pains taken to make the session memorable to both. The plans for entertainment have not yet been completed, but with the many places of interest in the vicinity of New York it is certain that the meeting can be made profitable to the botanists of the Association. Collections of plants from the vicinity are being made for distribution to the members, and it is proposed to give them an opportunity to collect fresh specimens. Arrangements are being made for receptions to promote social intercourse and mutual acquaintance, and a special effort will be made to present as many papers and matters of botanical interest as time will permit.

New York City.

ELIZABETH G. BRITTON,
Secretary of Botanical Club.

CURRENT LITERATURE.

An Introduction to the Study of Lichens. By Henry Willey. 72 pp. and 10 plates. Printed for the author, New Bedford, Mass.

No more competent lichenologist could have been found in this country, since the death of Professor Tuckerman, to prepare this introduction to the study of lichens. It is a group beset with great difficulties, and hence discouragements, for the beginner, and this must account, to some extent, for the limited number of lichen students in this country. Mr. Willey has thus done good work in exactly the direction it was needed, and under the guidance and stimulus of this simple introduction the way into this department has been made as easy as was possible. There are six chapters, with the following subjects: On collecting and mounting lichens; The lichen, its structure and organs; The distribution, etc., of North American lichens; The history of lichens; Helps to the study of lichens; and Arrangement of North American lichens. Then follows a supplement giving a list of the names of all published lichens. The ten plates display the structures of the thallus, gonidia, apothecia, spermagones, and pycnides, and end with illustrations of the spores of all the seventy-six genera. We mistake the effect of this pamphlet greatly if it does not very much stimulate the study of this difficult and interesting group in this country. It can be procured from the author for $1.

Die natürlichen Pflanzenfamilien, nebst ihren Gattungen und wichtigeren Arten insbesondere den Nutzpflanzen, bearbeitet unter Mitwirkung zahlreicher hervorragender Fachgelehrten, von A. Engler und K. Prantl. Royal, 8°. Leipzig: Wilhelm Engelmann.

The first two fascicles of this important work are at hand. Each fascicle is to consist of 48 pp., and it is expected that about sixteen parts will appear yearly, which will complete the work in six or seven years. The first part is to embrace the Cryptogams, and is under the supervision of Dr. Prantl. The second to the fifth parts include the Phanerogams, edited by Dr. Engler. The list of collaborators is very large, and embraces the most eminent German botanists.

The first two fascicles of Part II. treat of Palmæ, by O. Drude (already noticed in this journal, p. 89); Juncaceæ, by Fr. Buchenau; Stemonaceæ and Liliaceæ (in part), by A. Engler. The treatment of each order is very comprehensive. For example, the topics treated under the Liliaceæ are: the most important literature; characteristics; organs of vegetation; anatomy; arrangement and growth of flowers; pollination; fruit and seeds; geographical distribution; affinities; and classification. The latter includes an account of each tribe and genus, with remarks on the principal species. The work is liberally and admirably illustrated. The ninety-six pages now published contain 564 single figures! The very low subscription price for each fascicle (M. 1.50=35c) makes this one of the cheapest, as it promises to be one of the best, botanical works ever published. It strikes us as unfortunate, however, that the fascicles should be separately paged.

NOTES AND NEWS.

DR. STERNBERG has gone to Rio de Janeiro to investigate yellow fever.

MENYANTHES TRIFOLIATA turns up in Rhode Island this year with trimerous and tetramerous flowers in one raceme.

THE YEARLY increase of cork is said by Gerber to vary from one row of cells in Salix to one hundred rows in Quercus suber.

HARDWICKE'S *Science Gossip* for May has a very interesting description of Australian forests by the editor, Dr. J. E. Taylor.

MANY new and interesting species are being discovered in the Philippine Islands by Dr. Sebastian Vidal, Director of the Botanic Garden at Manilla.

THE catalogue of Rhode Island plants, by Mr. James L. Bennett, is to be published by the Providence Franklin Society, and is understood to be in press.

DR. THEOBALD SMITH, of the Bureau of Animal Industry, Washington, D. C., has just closed a course of six lectures on bacteria before Cornell University.

THE May number of *The Microscope* contains "Staining and mounting plant sections," by C. Wellington, and "The movement of diatoms," by Cornelius Onderdonk.

THE CHEMICAL relations of bacteria is the title of a long and interesting article by Dr. Charles E. Fairman, of Lyndonville, N. Y., printed in the *Medical Register* (Phila.) of April 27.

DR. MANLY MILES has an article in *Agricultural Science* for May on the microbes of nitrification, based upon cultures and experiments which he has been prosecuting for some time.

PROF. BESSEY, in the *American Naturalist* for April, has done a capital thing for botanical students in publishing a list of the best and most accessible manuals in the various groups of plants.

THE Linnean Society has recently elected the following foreign members: Dr. George A. Schweinfurth, Cairo, Egypt; Count H. Solms-Laubach, University of Göttingen; Dr. Melchior Treub, Buitenzorg, Java.

THE SPECIES of Peronosporeæ found in Scotland, are enumerated by Dr. J. W. H. Trail in the *Scottish Naturalist* for April. The list gives 1 Pythium, 3 Cystopus, 1 Phytophthora, and 24 Peronospora, being eleven less than the United States' list, published by Dr. Farlow in this Journal, 1884-5.

A HAND-BOOK of the other orders of vascular cryptogams, by Mr. J. G. Baker, is announced in continuation of Hooker & Baker's "Synopsis Filicum." It will include Equisetaceæ, Lycopodiaceæ, Selaginellaceæ and Rhizocarpeæ, in which there are eleven genera and about seven hundred species.

THE FOLLOWING corrections should be made on page 101 of this volume: line 2, for "Tamisconato" read "Temisconata"; line 4, for "form" read "from"; line 8 from bottom, place a semicolon after "probable" and dele the comma after "likely."

A DOZEN years ago Vogel and Reischauer observed yellow crystals covering the outer coatings of walnuts, a substance found also in the expressed juice, and called by them nucine or juglon. And now Bernthsen and Semper have just built it up artificially—another instance of the synthesis of a natural product.

PROF. W. W. BAILEY writes that a lady pupil had brought him a spray of an apple-tree with peculiarly monstrous flowers. The petals were aborted and green, and there were no stamens. The carpels, with style and stigma, were fairly well developed. The tree is reported to bear fruit from these curious flowers.

A COURSE of botanical lectures by Rev. F. D. Kelsey, illustrated with crayon drawings by F. W. Anderson, has just been given before the high school at Helena, Montana, and is to be repeated during June before the College of Montana at Deer Lodge. This is the first instruction of the kind given in the territory.

AT THE celebration of the seventieth birthday (March 30) of Professor C. von Naegeli, a present was made him of a basket filled with seventy different fruits, ornamented with seventy kinds of flowers, and surrounded by a garland composed of seventy plants, which belonged to as many different genera and species.

A BIBLIOGRAPHY of articles relating to North American fungi, by Drs Farlow and Trelease, is begun in the *Harvard University Bulletin* for May. It includes 338 numbers, and extends to and includes the first entry under H. A more extended notice of this important work will be given when the complete work is received.

THERE IS REASON to believe, according to Van Tieghem, that the forming branches of roots do not merely push aside the tissues of the main root, but actually absorb the cell-contents, and finally the cell-walls of these overlying tissues. We should expect some such action to accompany the mechanical pressure from the analogy in animal tissues.

A NEW Aroid, *Hydrosome Leopoldiana*, is described and figured by Dr. Masters, in *Gardener's Chronicle*, May 14. It is from the Congo country and has a remarkable spathe and spadix ("astonishing rather than beautiful," as Dr. Masters puts it). The very much divided leaves are three feet across and spread horizontally from a petiole two feet in length.

IN THE *American Garden* for May, Prof. L. H. Bailey, Jr., has defined for horticulturists six terms which are often confounded in their literature. The terms are acclimation, acclimatization, naturalization, domestication, hardiness and winter-killing. He also correctly remarks that "good English, considerately employed, is requisite to great advancement in horticultural literature.

A REALLY instructive teratological note in the *Bulletin* of the Botanical Society, of France, details the finding of specimens of Caltha palustris having two extra sepals within the usual ones which bore a row or two of apparent buds on their edges. M. Mangin investigated the structure of these buds and found that each possessed the structure of a perfect ovule, even to the egg-apparatus and antipodal cells!

PROF. HUXLEY recently read a paper before the Linnean Society on "The Gentians; Notes and Queries." He divides the Gentianeæ into two great series, characterized by the disposition of nectarial organs and a gradation of forms of the corolla from deeply-cleft rotate to funnel-form. The two series are called Perimelitæ and Mesomelitæ. He also considered their evolution and geographical distribution.

MR. J. KRUTTSCHNITT'S persistent assertion that the fecundation of the ovule by pollen tubes entering it was a myth has at last had attention in Europe, where Guignard, who has made himself famous by his investigation of fertilization, has studied Mr. Kruttschnitt's chief reliance, the genus Cereus. He finds fertilization, as was to be expected, accomplished in the usual way, through in C. tortuosus the pollen tubes may be as much as three weeks in reaching the ovules.

THE *Bulletin of the Torrey Botanical Club* for May contains "Notes on the American species of Marsilia," by L. M. Underwood and O. F. Cook. Five species are described: *M. polycarpa* Hook. & Grev., West Indies and South America; *M. quadrifolia* L., Connecticut, and cultivated elsewhere; *M. macropoda* Eng., Texas and New Mexico; *M. uncinata* A. Braun, Louisiana and Texas; *M. vestita* Hook. & Grev., widely distributed throughout the west, and extending into Mexico.

NOW COMES A. Meyer and denies *in toto* the Nägelian theory of the composition of the starch grain, viz: that it consists of two substances, granulose and starch-cellulose intermixed. He concludes from his researches that in ordinary starch, which turns blue with the iodine test, there is but one substance, and that it is alike throughout, the layered appearances being due to the varying porosity. Starch which turns red with the iodine test has other materials mixed with the true "starch-substance."

MR. DOUGLAS H. CAMPBELL has just completed his studies in the laboratory of Strasburger, and is now under Pfeffer at Tübingen. As a result of his work at Bonn, he has published in the *Bot. Gesellschaft* (March, 1877) a paper "On the development of spermatozoids." It is accompanied by a plate illustrating the subject in such groups as Gymnogramme, Alsophila, Adiantum, Pellia, Sphagnum, Salvinia. The results were obtained in the use of the very complete fixing and staining reagents in use by Dr. Strasburger, and which lie at the basis of so many of his astonishing results.

THE JOURNAL of the Royal Microscopical Society for April contains a valuable summary of the various contrivances, known as warm and cold stages, for keeping organisms at a given temperature while being studied under the microscope. The article is thoroughly illustrated and will be very helpful to any who wish to know what is the best thing to have in this line. Dr. Dallinger's thermostatic stage for the continuous observation of septic organisms is a most ingenious affair, without which the patient studies he has made on the life histories of these organisms would have been impossible.

DR. BYRON D. HALSTED has just issued a bulletin of the Iowa Agricultural College, showing the work done in the botanical department. It is one of the best we have ever seen, and represents an amount of good work done by the professor and his students that is really surprising. Part I. gives the result of work with the students. Some of the subjects reported on are as follows: Effects of drought upon grasses; Weeds on a square rod of ground; Largest and smallest leaves (Tilia and Picea nigra); Largest tree (white elm); Five worst weeds (Xanthium strumarium, Ambrosia artemisiæfolia, Portulaca oleracea, Setaria glauca, and Bidens frondosa); Pigment cells of bloodroot; Young prothallus of Equisetum; a Study of pollen, etc. Part II. contains observations and experiments, treating of such subjects as germination of ergot from the wild rye, germination in red clover and timothy, is the cup-plant insectivorous?, observations on common thistle, pumpkin pegs, notes upon the Peronosporeæ for 1886, and several other groups of fungi, the "cedar apples," the Erysiphei, etc. This represents a very partial list of the subjects treated, and it will be inferred that the bulletin must represent the work of a very busy year.

MR. GEORGE E. DAVENPORT, of Medford, Mass., has just sent us a photograph of a complete set of Ophioglossaceæ for the United States, which he had put up for the Middlesex Institute. The specimens are shown just as they lie on the sheet, with diagrammatic notes and names. With a hand lens they may be studied in the photograph with a completeness only second to examining the specimens themselves. The photograph would be a very valuable thing to slip in among the Ophoiglossaceæ of a herbarium to represent a type set. Mr. Davenport informs us that he can furnish copies to botanists for 35 cents.

DR. H. MOLISCH proposes[1] the following new test for sugar in plant sections: "A not too thin section laid on a slide is treated with a drop of 15-20 per cent. alcoholic solution of *a* naphthol; then two or three drops of concentrated H_2SO_4 are added. If the section contains sugar the violet coloration appears in less than two minutes. In other carbohydrates the color appears in a quarter to half an hour. In practice two sections are used; one of these is boiled for a few minutes in water, whereby sugar, dextrin, gum and glucosides are dissolved. The two sections are then submitted to the same test, and if sugar is present in the unboiled section, the coloration immediately appears. As dextrin, gum and glucosides may be usually disregarded, the appearance of the violet staining indicates, with great probability, the presence of sugar. The forgoing test may be used to demonstrate the presence of inulin, which, by Sachs' method, is liable to be confounded with sphæro-crystals, for these become immediately stained deep violet with *a* naphthol and sulphuric acid, and on the addition of thymol, are dissolved with the production of a red color."

MR. GEORGE MASSEE calls attention in the April number of the *Journal* of the Royal Microscopical Society, to the well-marked differentiation of a tissue for mechanical support in the stems and pileus of various species of Polyporus. It is especially striking in P. Pisochapani in the stem of which it forms a central hollow cylinder, composed of thick-walled hyphæ, eseptate and often polygonal in section. "At the apex of the stem this tube widens out into a funnel shaped body which becomes broken up into a number of ribs, radiating from the central portion to the margin of the pileus." The hyphæ of the other parts of the plant are very thin-walled and septate. There seemed to be no connection between the two sorts. "No member of the Agaricini, so far as I have been able to ascertain, shows such a marked division of labor amongst its component hyphæ for purposes of support." Mr. Massee also refers to the well-known laticiferous vessels of Lactarius and Russula, which contain glycogen and other substances. He affirms that the cystidia of the

[1] Sitzung-berichte der Königl. Akad. Wissen. Wien xciii (1886) pp. 912--23; fide Jour. Roy. Mic. Soc. April, 1887.

gill-bearing fungi are simply the terminal cells of laticiferous vessels, but can suggest no function for them unless the pouring out of their contents is for furnishing food to the developing spores, which, in many species, are bathed with it during growth.

THE FOLLOWING notice from Prof. W. W. Bailey in a Providence (R. I.) paper finds such an extensive application among botanists that we give it for their benefit. His experiences have evidently been the common ones of the fraternity, but his spirited rejoinder is not so common:

The writer esteems it a privilege, as he implied last summer, to answer any inquiries of a botanical nature which are within the range of his study. This always provided that the trusting public will thoughtfully remit the stamp or stamped envelope for the reply.

The announcement before made has resulted in an extensive correspondence, profitable we hope on both sides; we mean profitable in the sense of knowledge given or received. A teacher's work, especially in science, does not stop with the lecture-room. He is, or should be, the servant of the people, helping when he can, and owning up to ignorance when his knowledge fails him. It is from this diffidence only that we ever avoid an offered occupation.

It will aid very much in the work of the writer—save him, indeed from labor which it is sinful to thrust upon him—if people will only attend to the few following directions:

I. Collect plants both in flower and fruit, if possible. If herbaceous, take root and all, or, if too large, representative portions of root, stem, leaves, etc. Bend the plant into a Z or N, if necessary. Pare down the roots if too thick.

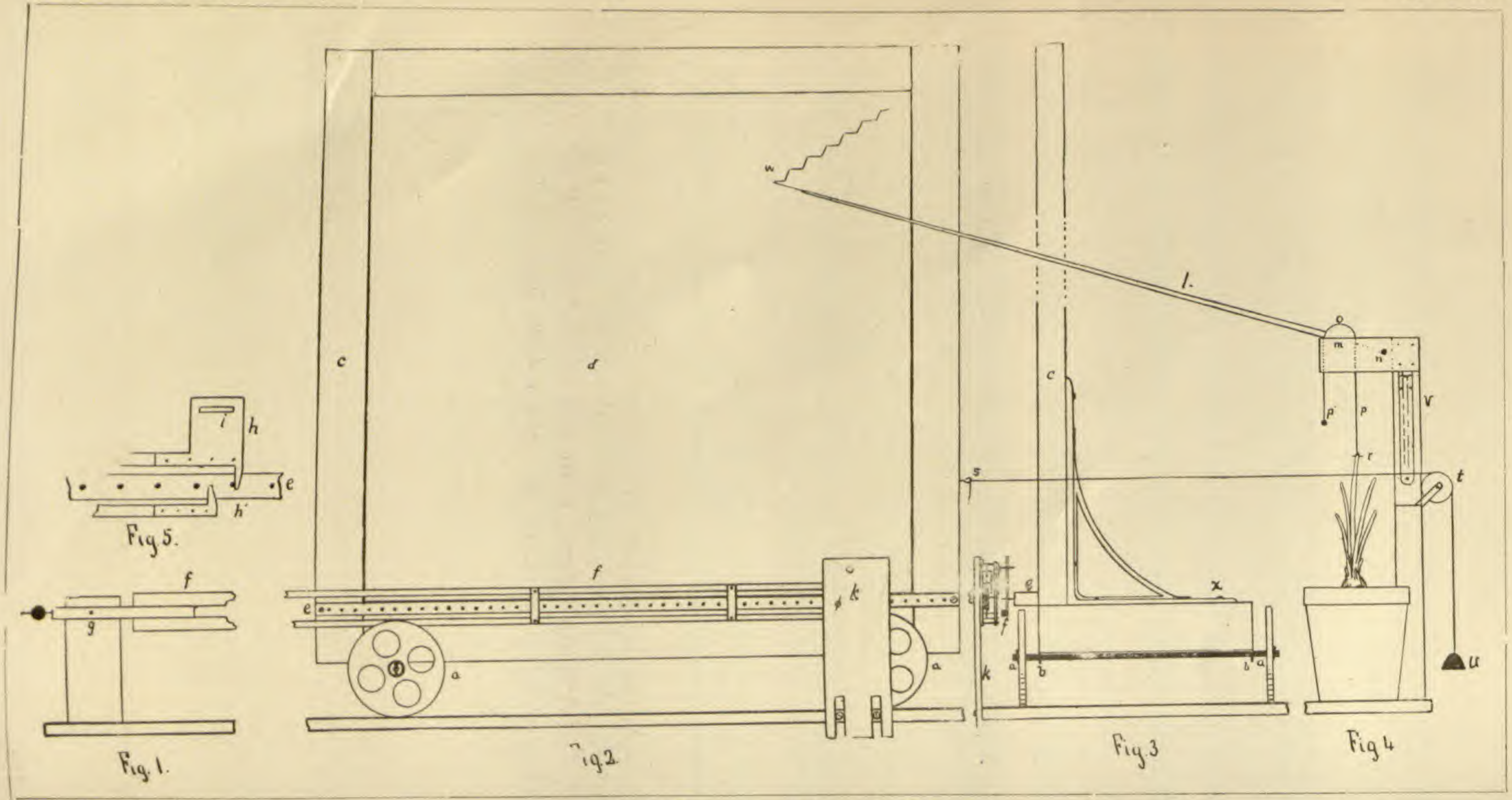
II. Do not snip off the tip end of a plant, even in flower, and send the cluster. Often a botanist can name such a fragment, but it is unfair to ask him. Moreover, it imperils his soul.

III. Tell by whom and where the plant was collected. A specimen unlocalized is worth next to nothing. It deserves to go into the waste-basket with poems on spring. The old curator has an underground railway for running such trash into the ash-heap.

IV. Don't think because a plant was collected at the tomb of Burns, or grew out of the rudder-hole of Noah's ark, that its botanical interest is at all enhanced. A good, well-collected plant from St. Helena is no better because it grew in the paths of Longwood. Sentiment is wholly apart from our special work. We often indulge it, but always with a Spanish rein.

V. Send the plants well pressed. Do not wrap them up in a wad, as if they were to be fired from a cannon.

VI. Trustingly believe that the writer, who here offers his service without price, is not so ferocious as his articles above denote.



BUMPUS on an AUXANOMETER.

VOL. XII. NO. 7.—BOTANICAL GAZETTE.—JULY, 1887.

A simple and inexpensive self-registering auxanometer.

HERMON C. BUMPUS.

(WITH PLATE VII.)

Wishing to try a few experiments on the growth of plants, and not having the ordinary self-registering apparatus used by Pfeffer, Baranetzky and others, I was led to improvise the instrument which is figured in plate VII. For a support for both apparatus and plant, I found a broad window-sill was quite free from any appreciable jar.

The auxanometer proper (fig. 4) is very similar to that figured by Dr. Goodale, consisting of an horizontal arm supported to the casing by the bracket *v*, and bearing two strips of tin, notched at *m*, where rests the axis of the spool, *o*, over which the thread, *p*, is allowed to pass twice, being attached to the plant at *r* by means of a small needle thrust through the leaf, and kept taut by the light weight *p'*.

The indicator, *l*, is easily made by joining two or three straws, as recommended by Prof. Bessey, which may be found at any apothecary's. The terminal portion may then be made into a style by carefully splitting back a sliver until it makes an angle of about 30° with its former position, and the tip, nicely sharpened, again bent abruptly at an angle of nearly 90°. This long arm, *l*, should be balanced by a movable weight at *n*. The axis, *m*, should be rather long, that the arm may swing, if necessary, in several parallel planes.

The registering surface (figs. 2 and 3) is a piece of flat glass which has been held over a burning rag previously saturated with turpentine. The smoked plate, *d*, is held by a frame, *c*, which is free to move, in obedience to the weight *u*, in the same plane as the arm *l*, by means of the wheels *a*, *a*, the axes of which are held by pieces of notched tin at *b*, *b*, bearings which have but little friction.

By moving the axis at *m* the style may be gently placed against the smoked glass, and as the plant grows an arc will be drawn from top to bottom, or if the weight *u* is allowed to act a line will be drawn from right to left. The motion in obedience to the weight may be made regularly intermittent, and as a result we shall have a zigzag line, the distance between every two angles of which signifies a regular interval.

The interrupted movement may be brought about by having a strip, *e*, bearing at regular intervals round wire nails, attached to the lower portion of the carriage.

One of these nails is held for a certain time by the hook *h* (fig. 5), which is attached to the strip *f* (figs. 5, 2, 1), which moves about the pivot *g* (fig. 1). Finally, when *h* is elevated, *h'*, which is attached to a similar and parallel rod and moves with *f* about *g*, catches the next succeeding nail, and holds it a regular period, before allowing it to reach *h*. A short horizontal line is thus drawn by the style at *w* (fig. 2).

The elevating and depressing of the escapement at *h h'* is brought about by attaching the works of one of the cheap nickel-plated clocks, which will run when held in any position, to a board, *k* (figs. 2 and 3). In place of the "long hand" there is attached a crank which will play through the slot *i* (fig. 5). As the post turns the crank toward XII o'clock *h* will be elevated, and at VI o'clock, thirty minutes later, *h'* will be depressed to its greatest, one nail thus sliding by every half hour. The escapement hooks may be easily cut out of two pieces of tin.

If the arm does not swing parallel with the smoked surface, change the screws at *x* (fig. 3).

One recommendation the apparatus has is its inexpensiveness, costing, with the clock, if one is his own carpenter, not more than three dollars. Another is the ease with which the records for several half hours may be compared, and the little labor necessary to prepare permanent records, by simply placing the glass on a piece of "blue print" paper and exposing to sunlight.

A registering auxanometer.

CHARLES R. BARNES.

(WITH PLATE VIII.)

In January last my class in physiology had occasion to study the rate of growth of seedlings under various conditions. I needed an instrument to keep a continuous record of their growth, and Germany was too far away to send for one. With the help of the students in the mechanic shop I arranged and constructed the instrument here described. It is comparatively simple and inexpensive, and requires no work which can not be done by a turner and a machinist, at slight cost.

R, plate VIII, is a cylinder of pattern pine, twelve inches long and three in diameter; centered in its ends are two pieces of brass rod about three-eighths of an inch in diameter, the lower and longer of which, *h*, is coned on its free end and carries about its middle a drum, *f*. This is a silk-spool bored out a little. The lower axle of the cylinder rests upon a piece of glass hollowed to receive its point, and the upper passes through a small plate of brass, *z*, (figs. *A* and *D*), bored to fit it smoothly and screwed to a light frame of wood, $\frac{3}{16} \times 2$. The upper or cross-piece is seen at *D*, with ends dovetailed to fit the side pieces. This top piece can be lifted out so as to allow the removal of the cylinder.

Around the drum, *f*, passes a cord, over the pulley, *r*, to the weight, *m*. The pulley is made of a section of a spool with a groove filed around it, revolving on a glass rod. By the fall of the weight, *m*, the cylinder would rotate continuously were it not for twelve equidistant pins, *o o*, which engage with the armature, *p*, of an electro-magnet, *e*. The pins are wire-nails, driven in and cut off, and in a second instrument were placed radially around the lower end of the cylinder so as to use a straight armature.

The electro-magnet is one of the simplest form and can be had of dealers in electrical apparatus. I first adapted a relay instrument to this use, but afterwards wound a magnet with number twenty-four silk-covered wire and made it a permanent part of the apparatus. The magnet is connected, as shown in the figure, with a battery, *W*, through the clock, *Q*, so arranged by tying the striking wheel as to strike but once each hour. One wire from the battery (the LeClanché cell used for door-bells) is soldered to the hammer arm, *v*. Its continuation is soldered to a piece of watch-spring, *d*, so fixed that the hammer, *v*, as it draws back to strike will come in contact with it.

The tripod lamp-stand, *g*, carries an arm, *u*, shaped like a tuning-fork, between whose arms the wheel, *a b*, (seen in section at *B*), revolves on a wire axle pointed to fit into holes in the arms. This axle can be taken from the works of an old clock. The wheel *B* is of wood and can be made by the turner who makes the cylinder. It is double, having a large part, *b*, and small part, *a*. This wheel must be so balanced that it will stop at any point indifferently. If not turned accurately counterpoises of flat bits of metal can be attached on the light side by gummed paper. From the weight, *y*, the thread *c* passes over *b*, in the groove cut for it, and carries *t*, the recording needle. This, as shown in *E*, is a common needle heated and bent, and inserted in a block of lead which is grooved for the supporting threads. The point of the needle should be blunted, and the sides filed flat to prevent turning. Of course *t* and *y* must balance each other.

From the plant *n* around whose tip it is looped, the thread *k* takes a complete turn around *a* and is just kept taut by the weight *s*.

The apparatus, spread out in the plate, can be compactly arranged on a base-board 14 × 18 inches, which is supported by four leveling screws, *l l*. These are ordinary long wood screws with the points rounded. If desired a strip of metal can be soldered in the slits, so that they can be turned with the fingers.

When ready to operate, the cylinder *R* must be smoothly covered with a sheet of glazed paper, the edges gummed and overlapping in such direction as not to catch the needle point. Smoke the paper evenly over a *turpentine* flame. Camphor smoke adheres too firmly. Having arranged the threads *c* and *k*, twist *c* so as to make the point of the needle bear against the smoked paper. The growth of the plant *n* will, as the slack of *k* is taken up by the weight of *s*, cause the wheel to revolve and will raise *t* as many times as far as the plant grows, as the diameter of *b* divided by the diameter of *a*. While *R* remains still, the lifting of *t* will make a vertical mark. But at each hour the hammer of the clock touching *d* makes *e* a magnet, which draws up the armature, *p*, releasing the pin *o* and allowing the cylinder to revolve. The armature is released the next instant and returns in time to stop the next pin. By this partial revolution the needle makes a horizontal line. The record of a sunflower from 3 P. M. to near 11 is shown in *S*.

When the needle has risen to the top of the cylinder the paper may be slit along the line of union, removed and immersed in a solution of white shellac in alcohol. When dry the soot can not be rubbed off and the record may be studied and compared with others.

The total cost of the apparatus, including the clock, will be from $10 to $15, according to the amount of work put upon it. The results are entirely satisfactory.

Spirogyra under shock.

STANLEY COULTER.

At the December meeting of the Indiana Academy of Science I presented a paper showing a peculiar action of the young chlorophyll band of *Spirogyra quinina* Kütz. under shock, which indicated its extreme sensitiveness and very considerable tension. The question arose as to whether this action was constant, or merely the result of peculiar conditions. If the latter, what were those conditions?

The observations upon which the conclusions of the paper were based were briefly as follows:

Certain vigorous vegetative filaments, being cut with a scalpel for the purpose of reducing their length, showed that the chlorophyll band was broken up in the cells adjacent to the cut. This breaking up seemed to have followed a somewhat definite plan. In the cells immediately adjoining the cut the band was broken into twice as many parts as there were turns of the band, and these parts were coiled closely

1

about a darker colored center, which appeared in no wise different from the nodules. As the distance from the laceration increased the closeness of the coil diminished, but the number of parts was still double the number of turns in the cell. Still further from the cut, instead of the simple coil, the band on either side of the "darker spot" broke away from its surroundings, and showed a marked tendency to coil about this "dark spot" as a center. In cells still further removed from the wound, while the band was not completely broken up, it never failed to show a strong tendency on the part of certain regions of the band to gather about certain definite centers, and these centers were always twice the number of turns in the cell. However sharp the instrument, however deft the stroke, the chlorophyll band never failed to respond to the laceration through from eight to ten cells in both directions. The only peculiarities observed in the specimens examined were:

1. The band rarely, if ever, filled the entire cell length.
2. The edges of the band were entire—not "wrinkled and crenulated."

3. The band was almost entirely destitute of nodules.

4. The specimens were collected in November and December.

The fact of the parts of the band coiling, or showing a

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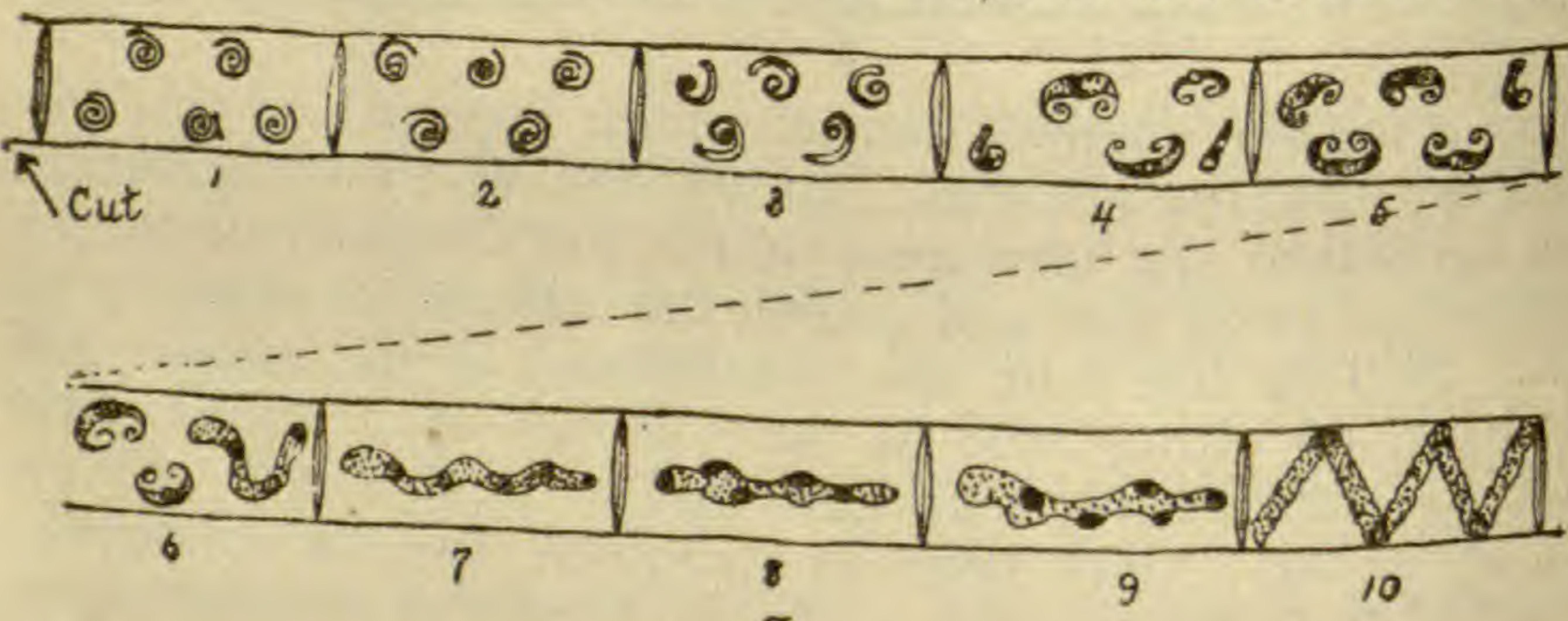
tendency to coil, about certain points suggested the possibility of these points being "centers of growth."[1] Although having very much the appearance of nodules, a careful examination seems to prove them nothing more than closely compacted, well defined masses of chlorophyll bodies. The immediate response to laceration, and the comparatively large number of cells through which the action took place, led to the conclusion that the band was extremely sensitive, while the coiling of its parts gave evidence of a very considerable degree of tension. Pressure, or other forms of mechanical violence than cutting, disintegrated the band completely, and never gave the results indicated above.

Figs. 1, 2 and 3 will, perhaps, illustrate the results more clearly than the description. The figures are drawn simply



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to illustrate the appearances, and are not drawn to any scale.

In Fig. 1 is shown the only case in which, in a series of some hundreds of slides, the nucleus was seen after the band was broken up.

Fig. 2 gives a case in which there were four turns of the band to the cell, and also shows a peculiar condition in cells 3 and 4, in which the protoplasm is gathered about the coils as indicated by the lighter shading, and seems to bind them together.

[1]Cf. Sachs, 2d Eng. ed., p. 48.

Fig. 3 shows a series of ten cells immediately adjoining the cut, and illustrates fairly well all the points indicated above. In all the figures the cut is at the left, and the darker shading represents the apparent centers.

A series of experiments made in January and February verified the results upon which the paper was based. The effect of other shocks was then tried, with the following results:

Filaments plunged into boiling water showed a large distension of the cell, accompanied by disintegration and diffusion of the band; a result presumably caused by the expansion of the cell contents by the heat, although possibly the water may have penetrated the cell walls.

Filaments were then frozen in water by an improvised ice-cream freezer, and were kept packed in ice for twenty-four hours. No change was shown, if we except the evident checking of all vegetative processes. It is possible that a greater degree of cold might have produced different results.

Filaments were also subjected to an electric shock; but in every case, even with the feeblest current I was able to secure, the result was the utter destruction of the filament.

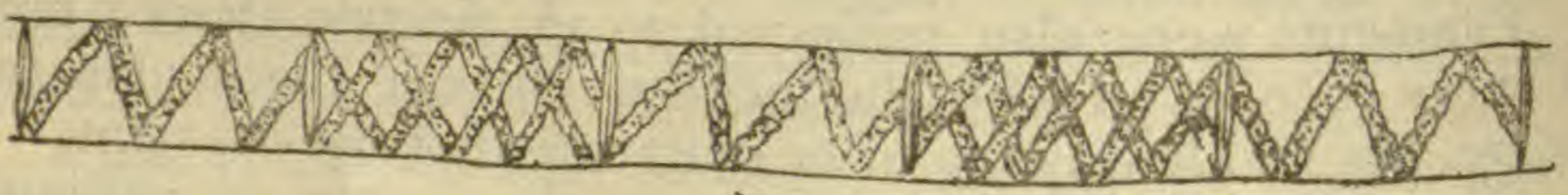
Filaments were then subjected to the action of various dilute acids. In all these cases the entire protoplasmic contents of the cell were contracted, involving, of course, the band. Brine gave similar results. In none of the cases was there even an approach to the forms shown above except in the case of brine, which, when very strong, would sometimes give forms resembling those shown in cells 7, 8 and 9 of Fig.

4

3. [See Fig. 4, which shows general action of acids and brine.]

At the close of these experiments the cause of this action was still problematical. In March, however, the pond from which all my Spirogyra had been collected failed to honor my demands. Zygnema had taken its place completely, and I was at a loss for further material. Some unused portions of previous collections had been thrown into a tub, and in this tub was found a new supply. These filaments, though evidently Spirogyra quinina, surprised me by failing to respond to laceration as readily and uniformly as I could wish. The band was more wrinkled, abounded in nodules, and uniformly stretched from end to end of the cell. Thinking I had not secured growing tips, I cultivated a small lot in a jar; but even then, while the results were occasionally satisfactory, they were far from constant, and were secured only after a laceration that would have completely disintegrated the band in my first experiments. Material collected from other places also failed to produce the results expected. This pointed to some special local condition as the cause of the peculiar action of the band. Investigation showed the following facts:

The pond was formed by the waste water of a blast furnace. Its water was always warm. Its sandy bottom was warmer than the water. In the coldest weather it never froze. (This last fact is given upon the authority of employés of the furnace.) Thermometric tests showed that when the temperature of the air was from 16° to 20° F. that of the water of the pond was from 68° to 76° F., while that of the bottom was from four to seven degrees higher still. The



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fact that there was no time during the winter in which I was not able to collect Spirogyra or allied forms, and the collection of Zannichellia palustris, var. pedunculata, in full fruit in March [ante, p. 109], lead me to a ready belief of the statement that it never freezes.

This comparatively high and even temperature seemed, then, to be the lacking condition in the environment of the filaments grown in the tub. After numerous trials, I succeeded, by the use of a series of water baths, in securing a temperature of from 70° to 90° F. which was reasonably constant. I then cultivated some of my "unresponsive" Spirogyra with this added condition. It grew with astonishing rapidity. Examining the filaments thus grown, I found the exact conditions noted in those collected from the blast furnace pond, and a repetition of the experiments produced the same results.

The sensitiveness and tension of the young chlorophyll band noted in the paper read before the Academy may therefore, I think, be safely attributed to the influence of a comparatively high and constant temperature. The uniform results obtained in numerous repetitions of these experiments

BARNES on an AUXANOMETER.

lead me to the conclusion that this peculiar action will always be found under the above conditions.

A further fact observed during these studies may here be noted, though not connected with the main point of this article. In many cases one or more cells in a filament may be found with two bands, while the cells on either side have only a single band (Fig. 5). The frequency of occurrence of this condition would seem to indicate that the "number of bands" in a cell is an unreliable specific character.

Notes on Umbelliferæ of E. United States. VI.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE IX.)

PIMPINELLA Linn.—Fruit oblong to ovate, flattened laterally: carpel with 5 equal slender primary ribs (sometimes almost obsolete): oil-ducts 2-6 in the intervals, 4-8 on the commissural side: seed-section somewhat dorsally flattened, the face from slightly convex to more or less concave: stylopodium cushion-like or conical (figs. 69–74).—Glabrous perennials, with ternately or pinnately compound leaves, involucre and involucels scanty or none, and white or yellow flowers.[1]

1. **P. integerrima** Benth. & Hook. Gen. Pl. i. 894. Glaucous, 1-3 feet high, branching: leaves 2 to 3-ternately compound; leaflets lanceolate to ovate, entire: flowers yellow: fruit broadly oblong, 2 lines long; oil-ducts mostly 3 in the intervals, 4 on the commissural side: seed-face almost flat:

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[1] Our two western species are:

P. apiodora Gray, of the Pacific slope, from Northern California and Nevada to Oregon, of which no good fruit has been collected, and the very distinct new species from Southern California:

P. Parishii Smooth, erect, 1-2 ft. high, from a deep-seated fleshy root: radical and lower cauline leaves ternate, on petioles 2-4 in. long; leaflets linear-lanceolate, entire, 1-3 in. long, upper leaflet more or less distant; upper cauline leaves gradually reduced to bracts: peduncles 2-6 in. long; rays 8-10, glabrous; involucre of one or two bracts, or wanting; involucels of 2-6 linear bractlets: flowers white or pinkish: calyx-teeth prominent: fruit ovate to oblong, 1½-2 lines long; carpel with 5 slightly prominent equal ribs; oil-ducts 2-4 in the intervals, 6 on the commissural side: seed-face more or less concave: purple styles recurved in fruit, with conical stylopodia (figs. 73, 74).—Damp meadows, Bear Valley, San Bernardino Mts., California, August, 1882, *S. B. & W. F. Parish*. This is 987 Parish in part, and was detected in Mr. Martindale's collection. The original specimens under this number were collected in the San Jacinto Mts., in June 1881, and were distributed as *Carum Gairdneri* Benth. & Hook., but are probably *C. Kelloggii* Gray. In 1882 specimens were collected in Bear Valley, San Bernardino Mts., and referred to the same number, and so distributed. All of this latter collection is the very distinct new species described above. Mr. Parish writes that the species is very abundant in Bear Valley, but is quite inaccessible, and that his specimens of it have mostly been distributed among European herbaria.

stylopodium small or wanting (figs. 69, 70). *Zizia integerrima* DC.—Rocky hillsides throughout our range. Fl. May.

2. **P. Saxifraga** L. var. **major** Koch. Leaves simply pinnate, with sharply-toothed leaflets: fruit oblong, about a line long, ribs sometimes almost obsolete; oil-ducts 2-3 in the intervals, 4 on the commissural side: seed-face somewhat convex; stylopodium cushion-like (figs. 71, 72).—Along rocky shores of the Delaware river and roadsides near Easton, Pennsylvania, *Thos. C. Porter*. Fl. July to September. This European species has been collected by Prof. Porter since 1877, and is reported by him as well established.

EULOPHUS Nutt.[2]—Fruit ovate, flattened laterally: carpel with five equal slender primary ribs (sometimes very indistinct): oil-ducts large, almost contiguous, mostly 3 in the intervals, 4 on the commissural side: seed-section dorsally flattened, with concave face: stylopodium thick conical (figs. 75, 76). Glabrous perennial from fleshy fascicled roots, with ternately or pinnately compound leaves, involucre and involucels scanty or none, and white flowers.

1. **E. Americanus** Nutt. DC. Mem. Umbel. 69, t. 2. Branching, 3 to 5 feet high: radical and lower cauline leaves large, 1-2-pinnately compound, with leaflets cut into short narrow segments; upper cauline leaves ternate, with long linear entire segments: calyx-teeth prominent: fruit 2-3 lines long (figs. 75, 76).—Ohio to Illinois and Arkansas.

The close relationship between Pimpinella and Eulophus (as here defined) is very evident. The character of deeply sulcate seed apparently fails in E. Americanus, as testified by a very large collection of well-matured fruit from Mr. Bebb's herbarium, which apparently has also supplied many other herbaria. The fruit from the Harvard Herbarium is not perfectly mature, and hence the concave face in a few cases seems slightly sulcate, but the ordinary section of the mature seed is as shown in figure 76, with concave face much as in certain species of Pimpinella. In the western species there is a remarkably deep sulcation, but E. Americanus seems to be most unnaturally allied with them, not only in fruit characters, but in vegetative characters as well. How it is to be separated in generic characters from Pimpinella is what we have been unable to discover, but for the present we have retained the old name.

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[2] This generic description is based on E. Americanus, as the western species (E. peucedanoides and E. Texanus) differ in certain important characters.

BUPLEURUM Linn.—Fruit oblong, flattened laterally: carpel with 5 equal very slender primary ribs: oil-ducts present or (in ours) wanting: seed-section dorsally flattened, with face broadly sulcate: stylopodium flat (figs. 77, 78). Plant with simple entire ovate perfoliate leaves, no involucre, involucels of 5 ovate leaflets, and yellow flowers.

1. **B. rotundifolium** L[3].—Introduced from Europe into fields and cultivated ground, New York to North Carolina and Tennessee.

CHÆROPHYLLUM Linn.—Fruit narrowly oblong to linear, notched at base, flattened laterally, with short beak or none: carpel with 5 equal primary ribs, each of which is subtended by a large group of strengthening cells usually occupying the whole thickness of the thick pericarp: oil-ducts small, mostly single in the intervals, two on the commissural side: seed with more or less deeply sulcate face: styles short (figs. 79–84).—Annuals in moist ground, with ternately decompound leaves, lobed or toothed leaflets, usually no involucre, many-leaved involucels, and white flowers.

1. **C. procumbens** Crantz, Umbel. 77. More or less hairy: stems slender, spreading, 6 to 18 inches high: fruit (in the type) narrowly oblong, glabrous, contracted but not tapering at the summit; intervals broader than the ribs: seed-face deeply sulcate (figs. 79, 80).—New Jersey to Iowa and southward to North Carolina and Mississippi. We consider this polymorphous species to include all our forms of Chærophyllum. The only characters that can be used to separate them specifically must be drawn from the beaking of the fruit, the size of the ribs, and the depth of the sulcus in the seed-face. Isolated specimens can be selected which seem distinct enough in these particulars, but a study of a great number of specimens from all regions shows an inextricable running together, and it seems impossible to draw specific lines. Characters that have been used to define species are found displayed on the same plant. Owing to intergrading forms even varieties can not in all cases be distinctly set apart, but the following extreme forms may, in most cases, be distinguished from the specific type by means of mature fruit:

Var. **Shortii** Torr. & Gray, Fl. 1. 637, has more broadly oblong to ovate fruit, not at all contracted at the summit (fig. 81; section as in fig. 80).—Kentucky to Louisiana.

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[3] *B. protractum* Link, which differs from B. rotundifolium chiefly in its tuberculate fruit, has been collected on ballast ground by Mr. Martindale.

Var. **Tainturieri** has fruit tapering at the summit or beaked, ribs very prominent and much broader than the intervals, and seed-face with a shallower sulcus (figs. 82, 83). *C. Tainturieri* Hook.—From Florida to Texas.

Var. **dasycarpum** differs from the preceding variety in having pubescent fruit, with ribs prominent but narrower than the intervals (fig. 84; surface outline as in fig. 82). *C. Tainturieri* var. *dasycarpum* Hook.—Texas. This is Hall's 260, "pubescent form," and Lindheimer's 616.

ANTHRISCUS Hoffm.[4]—Fruit linear, notched at base, flattened laterally, long beaked (in ours): carpel without ribs, but beak ribbed: thin pericarp with no strengthening cells nor oil-ducts: seed with sulcate face (figs. 85, 86).—Resembling Chærophyllum in vegetative characters.

1. **A. Cerefolium** Hoffm.—Mature fruit smooth and shining. *Chærophyllum sativum* L.—Naturalized in Eastern Pennsylvania, *Thos. C. Porter.*

EXPLANATION OF PLATE IX.—Fig. 69, fruit of Pimpinella integerrima; fig. 70, section of carpel of same; fig. 71, fruit of P. Saxifraga, var. major; fig. 72, section of carpel of same; fig. 73, fruit of P. Parishii; fig. 74, section of carpel of same; fig. 75, fruit of Eulophus Americanus; fig. 76, section of carpel of same; fig. 77, fruit of Bupleurum rotundifolium; fig. 78, section of carpel of same; fig. 79, fruit of Chærophyllum procumbens; fig. 80, section of carpel of same; fig. 81, fruit of C. procumbens, var. Shortii; fig. 82, fruit of C. procumbens var. Tainturieri; fig. 83, section of carpel of same; fig. 84, section of carpel of C. procumbens var. dasycarpum; fig. 85, fruit of Anthriscus Cerefolium; fig. 86, section of carpel of same. Figs. 75, 79, 81, 82 are × 4; figs 69, 71, 73, 77 are × 7; fig. 76 is × 20; figs 70, 72, 74, 76, 78, 80, 83, 84 are × 36.

BRIEFER ARTICLES.

Fasciation in Sophora secundiflora (with plate X.)—Dr. A. Schlottman, of Round Top, Tex., several years ago, sent me specimens of a curious form of fasciation in *Sophora secundiflora* Lag. (*S. speciosa* Benth.) It is an evergreen shrub or small tree indigenous to Texas. The specimens alluded to are from a tree which Dr. S. has in his garden, and which annually produces peculiar deformity of the flowering branches or racemes.

The extremity of the twigs, or racemes, become flattened and enlarged, gradually expanding and dividing toward the apex—sometimes in a few, often into a large number of segments—the surface studded with small scales and mostly dormant buds. Sometimes, however, these buds

[4] *A. sylvestris* Hoffm. has been collected by Mr. Martindale on ballast ground.

develop into more or less perfect flowers. I send you a figure which illustrates the appearance of one of these peculiar forms The shrub flowers very early in the spring, and ripens a short, thick pod, containing from one to three large red seeds, called Indian beans, which are said to be poisonous to children, who sometimes eat them.

Mr. J. H. McArthur writes: "Our Angora goats browse freely on the shrub, and frequently swallow the beans without ill effects, but that may be owing to these being too hard for their teeth to crack, as they are found about the pens, having passed through them unbroken."—GEORGE VASEY.

Thalictrum purpurascens, var. ceriferum, in North Carolina.—Though this species of Thalictrum is not mentioned in Chapman's Flora as occurring in the Southern United States, nor in Curtis' "Catalogue of the Indigenous and Naturalized Plants of the State of North Carolina,' yet I have found several plants of the variety ceriferum growing luxuriantly on rocks at Flat Rock, Henderson county It grows to the height of five feet and agrees in all respects with the description given on page 39, Gray's Manual, the fruit and leaves being covered with "waxy atoms" and "exhaling a peculiar odor;" it was in full flower May 24th.—E. R. MEMMINGER, *Flat Rock, N. C.*

Dry weather foliage of the Compass plant.—This immediate section of country has been subjected to a prolonged and severe drouth. There has been not far from one inch of rainfall since the last snow-storm of early March. In addition to this we had a very dry summer and autumn last year, so that the rainfall has been unusually light for a whole year. Nearly all wells that never fail in ordinary seasons are now dry, and the college campus exhibits the strange appearance of a brown and apparently lifeless turf studded with dwarfed red clover plants which are in feeble bloom. The leaves upon trees and shrubs are fewer than usual and much reduced in size.

There are a few kinds of plants that seem to flourish under the peculiar arid conditions which now obtain; but even these are somewhat changed in their general appearance. The foliage of the compass plant (*Silphium laciniatum* L.) is particularly noticeable at this time. The leaves of this composite have a strikingly refreshing glossy green which is in sharp contrast with the surrounding dwarfed and dried herbage. But when the foliage is compared with that of its own species, in former years, a great change is seen. There may not be very much difference in the relative size of the leaves of this year with those of last season, but they are more numerous, and each leaf exposes far less surface to the hot, drying sun. In short, the average leaf of this Silphium is reduced to the midrib, with a thin web of green tissue upon each side, and its many lateral veins and their sub-veins bearing narrow ribbons of pulpy tissue. In other words, the foliage, true to the specific name, is very thoroughly slashed or laciniated. A protracted search was rewarded by finding only two leaves which exhibited the broad and comparatively simple blade so frequently met with in ordinary seasons. There are some plants which grow in a grass field near a walk frequently passed over by the writer, and these have been watched for the last two years. These same plants have now pronounced twice pinnately parted leaves which last year and in 1885 produced several radical leaves, with broad surfaces interspersed with the "holes" or vacant places in the laminæ so familiar to every botanist in the west.

There is also a difference in the position which these much laciniated leaves assume. They are numerous; without the rigidity of normal leaves, and assume a curved or drooping attitude. More than this, they curve outward and downward about equally from all sides of the centre of the plant. In other words, in the present condition of the plant there is very little indication of polarity, and the weary traveler over the dry and scorching prairie would now find a better guidance by noting the positions of the unclouded sun than to try to gain his "reckoning" by relying upon the compass plant.—BYRON D. HALSTED, *Botanical Laboratory, Ames, Ia.*

Course of study in Fungi.—After several years of changing and experimenting, the course in the study of fungi at the University of Michigan has taken its present shape, which is substantially as follows:

The class, having already studied botany for a year or more, are familiar with the leading facts of vegetable histology, and have made a careful study of one or more typical representatives of the great classes of plants, both cryptogamic and phanerogamic, and have also done enough work in systematic botany to be able to identify species readily. Moreover, as the course can not be elected until after one or two years have been spent at the university, those who pursue it have already acquired some knowledge of French and German, and are expected to read in both those languages selections from the most important modern literature of the subject.

The first thing aimed at is to secure a reasonable degree of familiarity with the group as a whole. Notes are given on the Peronosporeæ, Uredineæ, Ustilagineæ, etc., and specimens examined in a cursory way, so that their general appearance, the hosts on which they occur, and such other general facts as are most essential to be known at the outset, are easily acquired. In connection with this class work, about ten hours a week are spent in the laboratory in identification of species. Sets of ten species each, put up in envelopes, are handed to a student, and at the end of a week or two he reports upon them. The envelopes are marked on the back like this: No. 1. On Capsella Bursa pastoris, Ann Arbor, May 21, 1887. No. 2. On leaves of cultivated peach, Ann Arbor, June 3, 1886, etc.

The student makes a microscopical examination of the specimens, writes out notes and makes sketches, and by the aid of monographs. Ellis' sets of fungi, and such other help as he can get, determines the species. The class this semester have already indentified about sixty or seventy species, and as these are selected so as to embrace representatives from the leading groups, considerable knowledge of the subject is gained even in a few weeks' time. Each student is meantime required to prepare an essay on a given subject, which is read and criticized before the close of the semester. One of these subjects given this spring reads: The Uredineæ, their life-history, with special reference to the question of heterœcism, together with an enumeration of the parasitic species that are of economical interest. In preparation for this, the student, to whom it was assigned, read largely and intelligently from de Bary, Schröter, Farlow, Hartig, Ward and other authorities.

By the time the work thus outlined has been accomplished the spring has advanced far enough to enable us to make collections, and an excursion is made every week, resulting in the collection, each time, of from one to six or eight species of parasitic fungi. We are gathering no others at present. Yesterday afternoon we gathered Synchytrium Anemones, Peronospora pygmæa, Puccinia fusca, Æcidium podophyllatum and Peronospora Ficariæ, and examined hosts for others that the class are to keep on the lookout for. The specimens obtained in this way are carried to the laboratory, identified and labeled.

In addition to this, each one in the class is doing a special piece of independent work. One is working out the histology of the common cedar apple, and another is comparing the normal peach leaf with that distorted by the Ascomyces deformans. They will spend the rest of the semester on this special work and on the collection and identification of the species gathered in our weekly trips.

There are only two students in this class. The whole number of students pursuing botany at the university this semester is about two hundred, but the course described above is carefully hedged about with requirements, so that none get into it who are not capable of doing thorough work and a good deal of it.—VOLNEY M. SPALDING.

EDITORIAL.

IN THE July number of *Popular Science Monthly* Dr. Farlow has a paper entitled "The Task of American Botanists." It is to be expected that such a subject and such an author would supply something both interesting and valuable. It touches upon a point of vital interest with scores of willing workers who are anxiously seeking an answer to the question, "What is there for me to do?" Of course, the question is difficult to answer, but never hopeless. The chief difficulty lies in the restrictions the young botanist has thrown about the answer. He must have something apparently difficult, far-reaching, exhaustive—a great subject in which he is to become an authority. Such answers are impossible, and young botanists searching for some life work must understand that they are trying to begin at the possible end of their life-work rather than at its beginning. Beginnings are always small and the subjects simple, and the botanist can not expect to begin a great work off hand; he must grow into it. The law of development in the ability of the worker and slow accretions in the range of his subjects may eventually work out to an authority and a great subject. The thing to do is the thing that can be done; and it is not only folly, but a waste of time, to sigh over lack of opportunity for great work. Dr. Farlow concludes that advanced systematic work must be done by experts having access to large collections and libraries; that physiological work of high grade can only be done at a few well-equipped laboratories; but that histology and the study of life-histories furnish subjects for every worker, whatever his locality or equipment. It must be understood that we are speaking of advanced and critical work; for every one interested in botany can furnish valuable assistance in systematic work in the way of collections and field notes. Another difficulty may be mentioned, and that is the unselfishness of good work. Patient, laborious work over details, which is the foundation upon which our science must rest, does not bring the public acknowledgment, the fame, which some superficial work may. A fairly good compiler may step at once into a certain kind of prominence, while a far superior botanist may work all his life in comparative obscurity. It needs a philosophic spirit to work patiently under such conditions. But no botanist has ever begun with the simple problems at his hand, and thoroughly mastered them, who was not led into a wider field, and soon found waiting for him more work than he could ever hope to do.

Botanists are to take it for granted that they will be well entertained at New York next August. Apart from the single fact that the Torrey Club is to be responsible nothing has been published; but this perhaps, is enough. The main thing is for the botanists to get together, and their meeting can not help being pleasant and helpful. Heretofore it has been difficult to get time enough at convenient hours for the meetings of the club; for the informality breeds a desire to speak, and the meetings have always been too short. With such a wealth of attractive places for collecting near at hand as New York affords, there will be a great temptation to overdo the excursion business. As we take it, the average botanist does not care to do much collecting upon such an occasion. He can do that at any time, in person or by exchange. What he chiefly wants is to have a sociable time with his fellows, and for this an excursion is a good excuse. The Torrey Club, with wise foresight in this particular, has arranged to distribute prepared specimens to those desir

COULTER and ROSE on UMBELLIFERÆ.

ing them; so that, while it takes away the ostensible object of the excursion, it leaves more time for the real one. It is to be hoped that this will be one of the largest and most memorable meetings of botanists we ever have had, and that the result of their meeting will be an additional stimulus to botanical work in all departments.

OPEN LETTERS.

Australian alpine plants.

In reading the "Notes and News" of the last number of the BOTANICAL GAZETTE I was led to recall a paper published in the Proceedings of the Linnean Society of New South Wales, August 23, 1886, by J. Stirling. It consists chiefly in a review and a farther account of evidences of glaciation shown in the higher mountains of the Australian Alps (S. E. Australia.) The culmination of the ice-clad period is supposed to have taken place in later Pliocene or Pleistocene times. He refers to the close relationship which the flora of those mountains presents to that of Tasmania, and that "many species found there (in the Australian Alps), between 2,000 and 5,000 feet, have a wide range, recent researches in the flora of Morocco, in Africa, and on that of Rurum Valley, Afghanistan, having disclosed the presence of numerous species of plants common to the Australian Alps." He then refers to Hooker's remark in his Australian Flora that a cooled atmosphere in intertropical regions corresponding to the glacial epochs of the temperate zones might account for the presence of European and arctic species in antarctic and south temperate zones. It seems to me the character of the mountain flora also would find its explanation here. AUG. F. FOERSTE.

Granville, Ohio.

White and yellow poplars.

While collecting specimens of our so-called poplars (Liriodendron Tulipifera) this spring I called the attention of an intelligent and observant farmer of Lincoln County (Geo. P. Bright) to the following extract from the June ('86) number of *Drugs and Medicines of North America:*

"*Varieties.*—That there are two forms of the tree, distinguished by the amount of heart wood, was early noticed by lumbermen, and that they are distinct can not, we think, be refuted. Marshall mentions them as early as 1785. Michaux distinguishes two forms with acute and obtuse leaves, which he distinguished as var. acutiloba and var. obtusiloba; and Rafinesque states that the acute-lobed form produces the white wood and the obtuse-lobed the yellow wood. Late botanical writers, however, take no cognizance of these forms; and, while we are convinced that there are certainly two distinct trees, as far as the color of the lumber is concerned, we have not been able to determine that they have different shaped leaves. From an observing farmer (Mr. Thomas Rouse, Crittenden, Ky.), who claims to know the two trees apart by the appearance of the bark, we learn the following: 'The yellow poplar grows along streams and seems to select a damper location than the white, and the trunk is almost entirely yellow or heart wood, there being but a couple of inches of sap wood on the outside. It is very easy to split, makes good rails, and the lumber lasts a long time. The white poplar grows on hilly woods and dry locations, and the trunk is mostly white or sap wood. It is very difficult to split, and decays in a few years, so it has but little value as a timber.' He states that the young trees can not be distinguished, to his knowledge, by the bark, but that the yellow poplar bark of old trees is in long, horizontal ridges, while the white poplar bark is short and choppy."

Mr. Bright has had a large amount of timber cut off his place, and has handled a large amount of "poplar" lumber. He tells me that he is satisfied that the "white" and "yellow" trees are not different varieties, but different conditions of the same variety at different ages. On a high ridge, quite dry, on his place, he has a poplar wood which he has been cutting out; all of the old trees are yellow, the young are white. In a creek bottom near by, which is occasionally flooded, there is an abundant growth of young white trees. He can not tell the color of the wood from the bark. He mentions a tree in front of his house which his father remembers, some forty years ago, as a white poplar tree. Some two years ago the tree was spilt open by lightning, and the wood—excepting two inches of sap wood—was yellow. It had changed yellow as it grew older. Even in the young trees the heart wood is yellow. I have not been able to find any difference in the appearance of the bloom or leaf. Mr. Bright's idea seems to be a very reasonable one, and is founded on observed facts. H. A. EVANS.

Lancaster, Ky.

Oxalis.

Mr. Thomson's note on autumnal blooming of Oxalis violacea relates to a well-known peculiarity of the plant. In the *American Naturalist* for January, 1882, I called attention to the constant absence of the mid-styled form from this, which should be a trimorphic species. Aside from a figure in Payer's Organogénie, and a record of one doubtful specimen in Hildebrand's paper on "Heterogone species of Oxalis," there is no evidence that this form has ever been observed. I shall be greatly obliged for specimens from any part of the country showing this form of flower—with the pistil intermediate in length between the two sets of stamens.

In going over a very full line of specimens, last winter, I discovered that our flora includes two species of the violacea group that have not been previously distinguished, viz.: O. latifolia, var. and O. divergens, both of which are Mexican species which have extended into our territory. It may be of interest to add that Dr. E. Palmer's Mexican collection of last year includes the rare O. Hernandezii, a plant related to our O. decaphylla, but distinguished by its narrow, entire, hairy leaves.

The most interesting result of this examination, however, is the discovery that we have two trimorphic yellow-flowered species of the corniculata group. One of these is the O. recurva of Elliott, a perennial with creeping rhizomes, dark-bordered leaflets, and large flowers (as compared with O. corniculata or its variety stricta), which occurs from North Carolina to Pennsylvania and Ohio. The other, an Oregon species, which has been confounded with forms of corniculata, I have called O. Suksdorfii, in a paper presented to the Boston Society of Natural History some months ago. It is lower than O. recurva, and destitute of the dark borders to the leaflets, but otherwise closely related to it. Both are clearly distinct from O. corniculata and its variety stricta, although each of these in some localities produces rather large flowers resembling the long-styled form of a trimorphic species. A repent southern and Californian form, which I have called O. corniculata, var. (?) macrantha, appears as though it might prove to be trimorphic. I shall be greatly obliged for specimens and accurate measurements of the floral organs of this plant that may throw light on this point. WILLIAM TRELEASE.

St. Louis, Mo.

A walnut sport.

J. R. Johns, Millersburg, Pa., sends an abnormal walnut, the appearance of which, he thinks, is due to pollen of the hickory. Similar nuts have been found at about the time of the first frosts in the fall, for four successive years, at about the same spot under a black walnut tree—about a dozen specimens in all. The nearest hickory tree is about 800 yards distant. "That the nut is part hickory and part walnut," he says, "can not be doubted by any one seeing it in the first state. The lower or walnut part of some was more fully developed than in the specimen forwarded."

The nut is mature, of nearly the size of an average walnut, and has its lower third seated in an adherent, two-lobed, cup-like body, in texture much like the outside of a walnut. The "shuck" of the upper part is thinner and smoother than usual, and still shows the four parts of the adherent calyx as when young, thus causing it to resemble a hickorynut. On cutting it open the shell and kernel were found to be those of the walnut. The lower adherent portion is possibly the persistent bract. A. A. CROZIER.

Dep't of Agriculture, Washington, D. C.

Preventing fertilization.

Dr. Halsted, in a recent bulletin of the Iowa Agricultural College, gives the result of some experiments on excluding pollen from squash and cucumber flowers. They were undertaken to demonstrate to his students the necessity of the pollen for the development of the fruit. The pollen was excluded by covering the female flowers with cloth sacks.

I have found other ways of excluding the pollen to answer the purpose. Five female cucumber flowers nearly in blossom, on plants growing in dry sandy soil, were each covered with paper and then each with a hoe full of earth, the places being marked by stakes. In eight days one was dead, three were yellow and one still green. All finally died after making a small amount of growth. Some other young cucumbers, covered just after the blossoms had withered, all developed. The temporary covering of dry sandy soil did not seem to affect their growth, and the paper was not considered essential.

Another method was tried with some muskmelons. Five pistillate flowers nearly in blossom were clipped off with scissors just at the top of the ovary. Five others on which the flowers had faded, and which were presumed to be fertilized, were clipped in a similar manner to determine whether any failure of the first set to grow might be due to injury by the cutting. All the first set died, the young fruits growing less and dying sooner than in the case of the cucumbers. All those clipped after the blossoms had withered fully matured, except one which the chickens got at. A. A. CROZIER.

Agricultural Dep't, Washington, D. C.

CURRENT LITERATURE.

Little Flower-People. By Gertrude Elizabeth Hale. Boston: Ginn & Co., 1887. 12°. pp. 85. Illustrated.

Here is a book to be commended, both for what it attempts to do and for what it really does. The author wishes to interest children in some of the elementary facts of scientific botany. To do this she personifies the chief organs of the plant and relates how these several members of a household assist one another and the results they bring about. Thus each flower is a mistress attended by leaf, stem and root servants, and by the activity of the servants the life and perpetuation of the plant is assured.

The literary part is well done, the botanical part irreproachable (to be said of but few children's books), and the child that can read *St. Nicholas* or *Wide Awake* with profit will find interest and instruction in this pretty volume. The amount of serviceable knowledge, overspread with a thin veil of fancy, is really astonishing, and herein lies the danger; for if the child is left entirely to himself it may happen that now and then he will find thought and language beyond his grasp.

A Primer of Botany. By Mrs. A. A. Knight. Boston: Ginn & Co., 1887. Sm. 12°. pp. 115. Illustrated.

Sachs' Text-book and Bessey's Botany boiled down for babes! That is the way it strikes one upon first looking into this work; and every prejudice against so preposterous an idea is at once aroused. But our fervor is somewhat abated when we find in the preface that the author has considered the matter from this very point of view—"as if one should read Spenser in the nursery," she says. An unbiased examination of the work, we feel sure, will convince most teachers that Mrs. Knight has really performed an excellent service.

In the first place the book is not to be put into the hands of the pupil, but is only to be used by the teacher as an outline of the subject and of the method of its presentation. Moreover, the teacher must already know botany from previous study—not the botany of the usual high school course, but that of the laboratory—the botany in which the one-sixth objective glass is no greater hindrance than the common hand magnifier, and pond scum, mildews, mushrooms and lichens are as well understood objects as trees and flowers. Presupposing this much knowledge on the part of the teacher, the possession of a good compound microscope and a moderate allotment of time, the successful teaching of pupils, who find "protoplasm" a big word to spell and remember, will depend largely upon the tact of the teacher.

Nearly fifty pages of the book are devoted to the microscopic structure of plants, as much more to physiology, and the remaining twenty pages to the plant body, the distribution of plants, and the use and care of the microscope, the last subject being treated by Mr. G. N. Cross.

VASEY on FASCIATION.

It would be downright folly to teach these subjects to children, if every step is not fortified by clear observations and experiments, for which the work provides. The book is so constructed that rote teaching is, indeed, well nigh out of the question. The limited number of well qualified teachers will restrict its use more than the inherent difficulty of the subject.

A number of errors and oversights seems to be the rule in works of this class, to which the present one is no exception. On p. 16 the pericarp of the peach and apple is spoken of as the seed coat. There ap pears to be a misconception of the limits of the epidermal system, especially conspicuous on p. 24, and also of the significance of the term, "growing point," which is made frequent use of. On p. 50 water is not recognized as a part of the food of the plant, although the way the plant makes use of it as a food is described on p. 53.

Elements of Botany; including organography, vegetable histology, vegetable physiology and vegetable taxonomy, and a glossary of botanical terms. By Edson S. Bastin, A. M., F. R. M. S., professor of botany, materia medica and microscopy in the Chicago College of Pharmacy. 8°., pp. xv, 282, figs. 459. Chicago: G. P. Engelhard & Co. 1887.

Botanical text-books are coming thick and fast. It is one of the signs of the times which indicates that botany is taking its proper place among the sciences which ought to be taught. This book is a welcome addition to the list. It does not pretend to exhaust the subject; it does state fairly and clearly the *elements* of botany. The order of presentation is good, and well adapted to the needs of a large class of students. Part I (106 pp.) treats of the various organs of the higher plants, and covers essentially the same ground as Gray's Lessons. Part II (62 pp.) gives a brief account of the cells, tissues, tissue systems of plants and their arrangement in the several organs. Part III (27 pp.) contains a condensed treatment of the functions of plants. Part IV (55 pp.) explains the classification of plants on the same system and in very much the same style as Bessey in his well-known text-book. To each chapter in parts I and II is appended a series of directions for practical study which are specially commendable. Why are they not also found in part III? This physiological portion might have been doubled in extent with great profit to students, as some important topics are omitted, or too briefly treated to be comprehensible.

The book, as a whole, is comparatively free from errors, which is a great point in its favor. It is attractively written, and everywhere exhibits a strong pedagogic spirit. Some unfortunate typographical errors have been overlooked which should be corrected in another edition. The chief fault we have to mention is the illustration. The figures, the author states, were drawn by his own hand to insure accuracy. We have no criticism upon their accuracy (with very few exceptions), but the *quality* of the majority is not at all in keeping with the beautiful text.

This is partly the fault of the printer, partly of the engraver, and partly of the artist. A judicious weeding out of the bad ones would greatly improve the appearance of the book, and remove the possibility of giving a poor impression at first sight.

We heartily commend the book to the attention of teachers as one likely to prove suitable for class use, and as one which is well up to the times, fresh and vigorous.

NOTES AND NEWS.

DR. N. CONR. KINDBERG describes a new Cinclidotus from Greece, *C. falcatus*, in the *Rev. Bryologique*, No. 3, 1887, p. 43.

DR. P. FALKENBERG has been appointed Professor of Botany and Director of the Botanical Gardens at Rostock, and Dr. August Gravis to the same offices at Lüttich.

MISS EFFIE A. SOUTHWORTH, for some time past instructor at Bryn Mawr College, is now connected with the Section of Vegetable Pathology at Washington, chiefly engaged in microscopical work.

MISS HELEN DE S. ABBOTT, known to our readers by her studies in botanico-chemistry, has been elected a member of the Philosophical Society of Philadelphia, being the sixth woman who has received that honor during the society's six score years of existence.

PROF. F. L. SARGENT has been obliged, on account of failing health, to resign the chair of botany in the University of Wisconsin. His work there is highly spoken of. Prof. C. R. Barnes has been called to the place, and will remove to Madison early in September.

DURING THE ABSENCE in Europe of Prof. W. R. Dudley, of Cornell University, who sailed from New York June 25, his classes and other college duties will be cared for by Mr. F. V. Coville, who has just been graduated from the university with special honors in botany.

GREVILLEA for June has the following note under the heading, "Waste Paper:" "Our readers should look out for another new book which professes to be a 'field book for fungus hunters,' but is really only a hunter for their spare coppers. 'Please pity the poor blind.'"

THE FOURTH PART of Th. Fischer's *Bibliotheca Botanica* is a work by Dr. Herman Vöchting, entitled, "Die Bildung der Knollen." Two other parts are in press, Dr. S. Dietz, on Blüthenentwickelung von Typha und Sparganium, and Dr. Aug. Schenck, on Fossile Pflanzen aus der Elburs-kette.

THE SECTION OF VEGETABLE PATHOLOGY of the Department of Agriculture, under the management of Prof. Scribner, has established three stations for testing fungicides, especially for the treatment of the diseases of the vine. They are at Fayetteville, N. C., at Charlottesville, Va., and at Vineland, N. J.

THE SOCIÉTÉ MYCOLOGIQUE DE FRANCE has just published the first part of its third volume. It is chiefly devoted to an account of the several meetings of 1886, and also has a paper on edible fungi, with excellent illustrations, partly photographs and partly colored plates, and a paper regarding the Discomycetes in an inedited work by Dunal.

MR. ERWIN F. SMITH, government assistant in the study of plant diseases, has been commissioned to investigate the subject of "peach yellows." It is a very obscure but highly important subject, and Mr. Smith will win laurels in the scientific field and receive applause from the cultivator if he discloses the true nature and action of the disease.

MR. L. H. PAMMEL, of the Shaw School of Botany at St. Louis, has distributed a pamphlet, reprinted from vol. xv of the Trans. Minn. Hort. Soc., on the weeds of Southwest Wisconsin and Southeast Minnesota. An account of the prolificacy, vitality, dissemination and migration of weeds is followed by a list of eighty-eight species, with remarks, a table showing the native country of each, and a list of papers consulted. The species are those of the region of La Crosse.

THE SUMMER INSTITUTE at Martha's Vineyard, which holds a five weeks' session beginning early in July, continues its botanical department under the able management of Mr. Edward S. Burgess, of Washington. The courses are graded to meet the requirements of students of varying proficiency, and the methods are those adopted by the best educators. There is provision for special studies in the fresh and salt water algæ, histology, etc. The department of microscopy, conducted by Rev. J. D. King, also gives attention to vegetable histology and to technics.

THE TEMPERATURE of the stems of plants at the surface of the ground is found by Mr. E. S. Goff (*Agric. Science*, vol. I, p. 134) to be greatly influenced by the depth from which the supply of moisture is mainly drawn. As the temperature of the air and of the surface soil rises toward the hottest part of the day, the temperature of the stem remains depressed in direct ratio to the depth of the chief part of the feeding rootlets. In the beet the temperature of the root at four inches below the surface of the ground was found to be practically the same throughout the day as that of the surrounding soil; but at the surface of the ground the stem, on the hottest day recorded, was ten degrees cooler than the soil. Observations on the cabbage, tomato and corn were specially instructive, as they respectively represent deep, medium and shallow habits of root feeding.

DR. OLIVER WENDELL HOLMES takes an interest in trees, and large ones in particular. In a recent visit to England he measured a Scotch elm at Oxford, in the grounds of Magdalen College, as he tells us in the *Atlantic Monthly*, vol. lix, p. 645, that had a girth of twenty-five feet six inches at the smallest part between the limbs and ground. This he contrasts with New England elms as follows: "I have measured a good many of these. About sixteen feet is the measurement of a large elm, like that on Boston Common, which all middle-aged people remember. From twenty-two to twenty-three feet is the ordinary maximum of the very largest trees. I never found but one exceed it; that was the great Springfield elm, which looks as if it might have been formed by the coalescence from the earliest period of growth of two young trees. When I measured it in 1837 it was twenty-four feet eight inches in circumference at five feet from the ground, growing larger above and below."

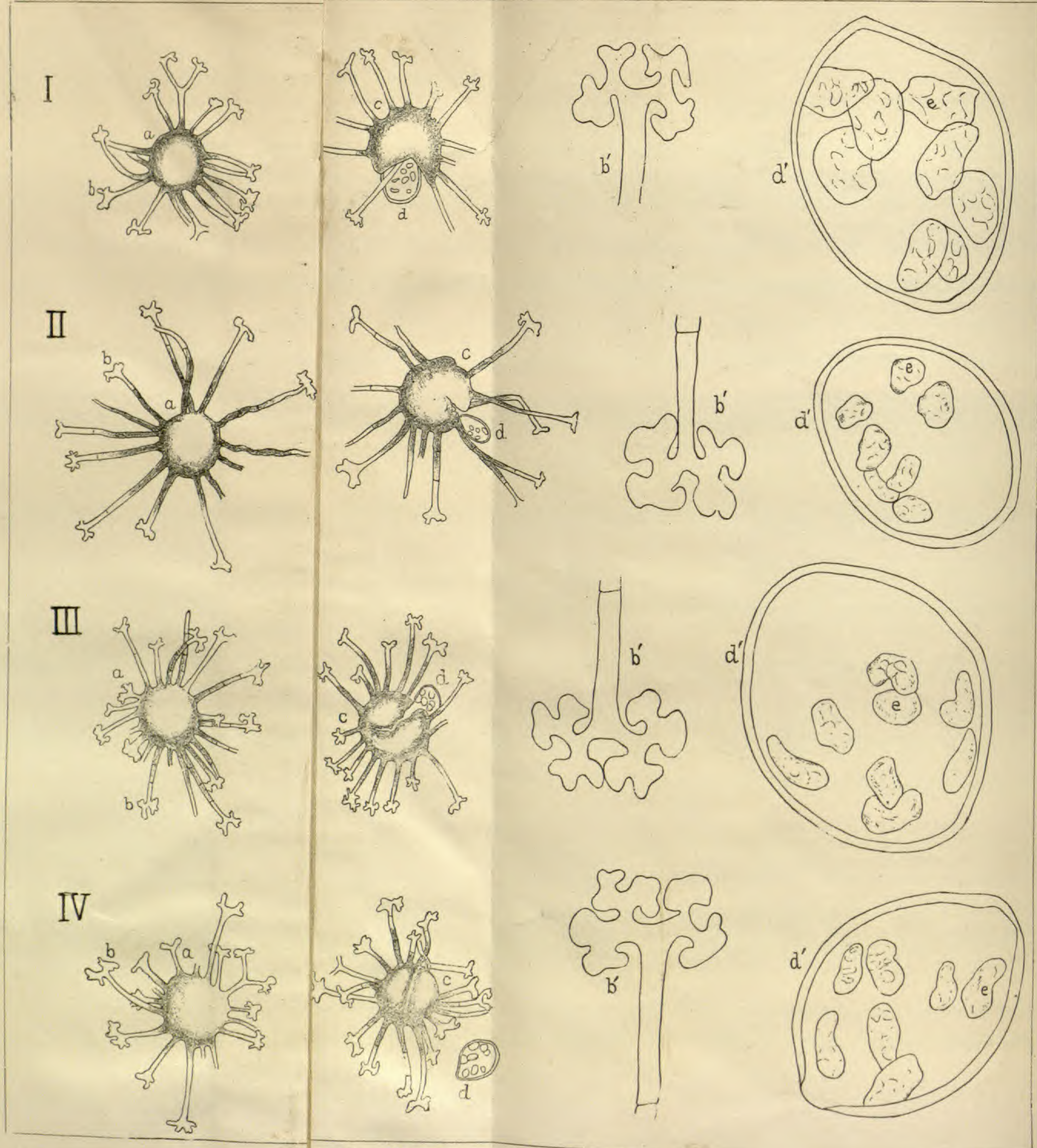
DR. F. GRAVET has translated from the Danish into French a paper by C. Jensen on the analogous variations of the Sphagnaceæ. The author points out the fact that the interminable variations of these mosses are reducible to certain form-series under each species which are closely analogous. These forms are traced by the author to their external causes as far as possible. Thus plants growing entirely under water exhibit certain peculiarities, and these variations are so similar under the different species that they may be grouped as *formæ immersæ*. In like manner *formæ compactæ et strictæ* are attributed to growth in a place more or less dry where they receive the direct rays of the sun; *formæ squarrosulæ, falcatæ, homophyllæ,* and *tenellæ* are recognized. The author then points out the varieties under each species which may be considered as belonging to the various forms. Mr. Jensen is the first to study the influence of external agents on the formation of the varieties of Sphagna, and his memoir is a very interesting and instructive one. The original appeared in the *Botanisk Tidskrift*, vol. xiii, and the translation in *Revue Bryologique*, vol. xiv (1887), p. 33.

DR. S. SCHÖNLAND, of the University of Oxford, claims to have reached the long-desired process of embedding delicate plant tissues in paraffin so that unshrunken serial sections may be cut by the ribbon method. His process is described essentially as follows in the *Botanisches Centralblatt*, vol. xxx (1887), p. 284: The object should be stained entire in borax-carmine, for which twenty-four hours suffices. Then place it in 30 per cent. alcohol, to which a trace of acetic acid has been added, and then in successively stronger alcohol up to the strongest commercial, which is 92–95 per cent.[1] It is next transferred carefully to a small vial (containing 3–4 cm.) of equal parts of clove oil and strong alcohol. At first it will float, but when it has sunk to the bottom, which often takes some time, it should be transferred to pure clove oil, and after an hour into oil of turpentine, in which it must remain about six hours. Finally it is placed in melted paraffin for 8–10 hours. The paraffin used must have a melting point of about 45° C., and its temperature must never go above 47°. For keeping the temperature constant the well-known thermo-regulator must be used. The embedding is done in the usual manner, using either the paper tray or the L-shaped pieces of metal. It is generally best to raise the temperature of the paraffin somewhat shortly before pouring it into the mold, to prevent the formation of bubbles on cooling. The manipulations for cutting the ribbons of sections with the rocking or sliding microtome are the same as with animal tissues. The sections are fastened to the slide with a mixture of one part of collodion and three parts of clove oil, or a mixture of equal parts of filtered white of egg and glycerine. The first is preferable in case one desires to stain the section on the slide, while the latter is generally reliable when the fixing only is desired. The slide is then put in a warm place for a short time or warmed gently over a flame, then plunged into turpentine or flooded with it to dissolve the paraffin. It is then ready for staining or mounting in the usual way.

Those not familiar with the treatment of animal tissues and the requisites for ribbon section-cutting will find detailed accounts in the manuals on histological technique.[2] The author adds that the results which can be attained are almost incredible. In serial sections of leaves one can, not infrequently, obtain four to six sections through the same stoma and it is easy to get several sections through the apical cell of a fern root, when the embedding is rightly done. It will be observed that this method differs little from well-known zoological methods, but that little probably constitutes the difference between success and failure in the process.

[1] Schönland used methyl alcohol, the strongest 92 per cent., but ethyl will undoubtedly answer, and is commoner in this country.

[2] Cf. Whitman "Methods of Research, etc.," Cassino, 1885. H. L. Osborn, in Am. M. Mic. Jour., May, 1887.



ERRY on MICROSPHÆRA FULVOFULCRA COOKE.

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Vegetable parasites and evolution.[1]

W. G FARLOW.

In the countless discussions concerning evolution which have followed the publication of Darwin's Origin of Species, zoölogists have gone farther than botanists in their efforts to explain the possible origin of higher forms from the lower. Botanists, as a rule, have contented themselves with a consideration of the ancestral relations of the orders of higher plants, but, until very recently, they have scarcely made any serious attempt to present a general scheme showing, from an evolutionary point of view, the relations of all the groups of the vegetable kingdom. This may be due either to their timidity—perhaps modesty is a better sounding word—or to their ignorance. If the latter, they have certainly been wise in avoiding unnecessary display of their ignorance; if the former, they can easily be pardoned, when one considers how large a part an aggressive audacity savoring of sensationalism has played in the formation of some schemes of development.

On abstract grounds alone, I presume that few botanists would object to the statement that all plants have been developed from simple ancestral forms, which were nearly related to some of the lower animals; but, when it comes to saying in anything like a definite way that certain existing forms have arisen from other lower existing forms or their immediate allies in some past epoch, and so on until the lowest form is reached, botanists may well insist that imagination should not be allowed too large a scope in supplying missing links. It is precisely in this point that zöologists have an advantage over botanists. The palæontological record of lower animals is more complete than that of lower plants, so that, where the zoölogist might reasonably form an hypothesis, the botanist must rely more on his imagination, until, in the end, he finds himself in the possession of a chain composed to a considerable extent of missing links. As it is, if we would consider the evolution of plants, not getting much light on the progress of the lower forms from palæontology, we are compelled to trust largely to plants as we now

[1] Vice-Presidential address before Section F, A. A. A. S., New York, August 10, 1887.

find them, and to ask what are the inferences which we are permitted to draw from existing structures and conditions. I shall not attempt to offer any scheme of development, or to sketch a family tree whose roots are Protococci and bacteria and whose ripe apples are the genera of Phænogams, but shall restrict myself to some considerations concerning vegetable parasites and the inferences as to their possible origin which may be gathered from what we already know of their structure and habits; partly because this is a group of plants in which I am especially interested, and partly because the problems which they offer, even if they can not be solved at the present day, are, at least, full of suggestions.

In the first place, a word as to the different kinds of plants which are included among parasites. A parasite is usually defined as a plant which is unable to transform inorganic material into organic compounds, and which is consequently obliged to obtain its organized materials from other plants or from animals. The definition, in general, is an accurate one and correctly defines the vast majority of vegetable parasites which belong to the class of fungi. That they are strictly dependent on the organized materials derived eventually from other plants or animals is sufficiently evident when we consider that fungi are destitute of chlorophyll, the necessary agent in the assimilation of inorganic material. Of the parasites proper, we have two kinds: the saprophytes, which live on dead or inert matter; and the special, or true, parasites, as they are usually called, which can only grow on the tissues of living plants or animals. Whether the line between saprophytes and true parasites is sharply defined is a point which need not at present be discussed. It is enough to say that, as a rule, saprophytes grow more or less indiscriminately on dead organic substances, while the true parasites are generally limited to a single species of plants or to the species of a single genus or order. It is almost unnecessary to cite instances of the two kinds of parasites proper, since you will at once call to mind Penicillium and other common moulds which grow as saprophytes on an endless variety of substances; while we have as illustrations of true parasites the grape Peronospora, which grows abundantly on species of Vitis, and is occasionally found on Ampelopsis and Cissus, both genera of Vitaceæ, and the potato-rot fungus, sometimes found on the tomato, which belongs to the same order as the potato, and rarely on species of Scrophulariaceæ, a nearly related order.

The proper parasites do not exclusively belong to the class of fungi. You are familiar with the Indian pipe (Monotropa) and dodder (Cuscuta), which are our common representatives of parasites, which are found in a comparatively small number of orders of Phænogams. As chlorophyll is wanting in these plants, we are forced to assume that the parasitism is as complete as in fungi. You, also, will recall the mistletoes and the Gerardias, together with other members of the Scrophulariaceæ, which are not proper parasites in the sense in which we have already spoken, but may rather be called partial parasites; because, while they have chlorophyll and are to a certain extent able to transform inorganic into organic material, they still depend in part on material taken from other plants to which they are more or less closely attached. In the discussion of the evolution of parasites, the phænogamic parasites, however, are of comparatively little importance; because, by means of their flowers and fruit, they are rightly classed as belonging to, or closely related to, well recognized orders of Phænogams, and the question of the origin of the parasites themselves is not to be separated from the question of the origin of Phænogams as a whole, so that, in this case, we have only to account for the modification of the organs of vegetation whose greater simplicity may be explained by the loss of leaves and other assimilating organs which have become unnecessary to plants that have acquired the power of living upon the food assimilated by other plants. In short, as far as parasitic Phænogams are concerned, they may be regarded as degenerate forms of other Phænogams, for, in a plant, the inability to assimilate inorganic material should be regarded as a degraded condition in which the chances of survival are diminished unless some extraordinary provision is made for reproduction, which is not the case in Phænogams, whatever may be true of fungi.

Whether any proper parasites are to be found among algæ is a question on which there is a difference of opinion. For my own part, I am unable to recognize any proper parasite among algæ, although it is tolerably certain that a number of forms generally classed among algæ may be regarded as partial parasites. This point, however, can be better considered later on.

Let us next briefly consider the mutual relations which exist between parasites and their hosts—that is, the substances, dead or living, on which they are growing. At first sight a parasite would seem to be purely destructive in its action; and that this is really the case is evident in the great majority of instances. When a piece of bread is attacked by the mould, Mucor stolonifer, its substance continually diminishes with the growth of the mould. We need not stop to consider the saprophytes, for the case of the true parasites is still stronger. There is a constant struggle between the rots, rusts and other true parasites and the hosts on which they are growing. Just so far as the fungus flourishes, so does the host suffer; and, if the conditions of temperature and moisture are favorable to the fungus, the host may be quite destroyed. If the conditions are not favorable to the fungus, the host may continue to grow, and the fungus may gradually disappear, or, at least, pass into a quiescent state. An instance of the sudden and complete destruction of the host is seen in the case of the bad epidemics of the potato rot, when whole acres suddenly rot and die. This is an extreme case. Other members of the Peronosporeæ attack young seedlings, some of which are destroyed, while others continue to grow, and may be said to throw off the fungus. From cases of the complete and sudden destruction of the host, either in its mature or seedling condition, we pass to parasites which are less virulent and whose action is more local. We have all grades of injury done to the host, from the destruction of the leaves and consequent diminution of the assimilating power, which may entail serious or fatal results; from the formation of circumscribed knots and tumors, which may cause destruction of the branches and, in course of years, the death of the plant; from fungi which attack the flowers or fruit and cause diminished reproductivity without injury to the vegetative powers, down to the insignificant distortions of scattered epidermal cells caused by Synchytria. But in all these cases the action of the parasite is destructive. We can not conceive that it is of the slightest benefit to the host. It robs the plant of the food which it needs for itself, and gives back nothing good in return.

We have, on the other hand, instances of parasitism in which it is claimed that the relation of parasite and host[2] is

[2] The word "symbiosis" was originally applied to all cases where different organisms were associated together in a community, and in this sense included the true parasites. The application has gradually been modified until, at the present day, symbiosis is generally understood to mean the association of plants with plants, or plants with animals, in such a way that the relation between them is one of mutual benefit, or in which there is, at least, no injurious action of one organism on the other. In this sense, as contrasted with true parasitism, the word is here used.

one of mutual benefit. To this condition the name symbiosis has been applied. The two most marked instances of symbiosis among plants are to be found in lichens and the fungus growth first called by Frank Mycorhiza.

The thallus of lichens, you will bear in mind, is composed of two elements: the green cells or filaments called gonidia, and the colorless threads or hyphæ. Any extended discussion of the algo-fungal theory of lichens would be out of place on the present occasion, and it is only necessary to say that I do not see why we may not consider the gonidia to be what they appear to be, viz., algæ, and the hyphæ fungi parasitic on the gonidia. Certainly, the opponents of the algo-fungal theory, in spite of all their attempts, have not, as yet, given satisfactory proof that the gonidia are produced from the hyphæ or the hyphæ from the gonidia; so that we are forced to regard them as two distinct entities. The strong point of the opponents of the algo-fungal theory has been that, if it is true that what is called a lichen is really a fungus parasitic on an alga, it is inconceivable that the alga should not be injured, or even destroyed, by the fungus. It is certainly a fact that the gonidia, or algæ, are not destroyed, and it has been assumed by both the advocates and opponents of the theory that the gonidia are not injured by the growth of the hyphæ, while some even go so far as to say that their growth is aided thereby. To account for this state of things, the advocates of the theory have advanced the view that in lichens we have a sort of mutual parasitism; and the statement has been made that "the hyphæ lie on the gonidia, and carry to them crude nutritive fluids, in return for which they receive a part of the assimilated material in the gonidia." But what good the gonidia can derive by having crude material brought to them by the hyphæ, if they must give back a part of the assimilated material to them, is not clear, since it is a well-known fact that the gonidia can, and very often do, live and flourish in a free condition, and are amply able to obtain all the nourishment they need without the help of the hyphæ, and at the same time can use for their own exclusive benefit all the assimilated material. On the other hand, it is known that the hyphæ are dependent on the gonidia for their development. The advantage to the gonidia is quite hypothetical; the advantage to the hyphæ is real; and it is, to speak mildly, a bad case of what the French call *un œuf pour un bœuf*.

The alleged proof that the gonidia are benefited by contact with the hyphæ rests on laboratory cultures in which it is claimed that, if the germinating spores of lichens be brought in contact with pure gonidia, the hyphæ at once grow more rapidly, and the gonidia also begin to multiply. But this increase of the gonidia is not necessarily a sign that the conditions of growth have become more favorable. When the black knot fungus attacks a branch of the plum tree the parenchymatous cells increase, and a knot is formed; and the same thing occurs when branches of red cedar are attacked by Gymnosporangium macropus. Here the increased growth does not indicate an increased supply of food, but an irritation caused by a noxious parasite. The increased growth of normal cells in the presence of irritating foreign bodies is well known to both animal and vegetable pathologists, and is not interpreted by them to mean an improved condition, but rather an attempt to get rid of something harmful. The same explanation may be given to the lichen cultures. But cultures on microscopic slides in the laboratory surely should not be regarded as more conclusive than what is seen on a much larger scale in nature. One has only to compare the Chroolepus-forms which constitute the gonidia of Opegrapha with the same forms when free from the hyphæ of the Opegrapha to be convinced that they grow and fructify decidedly better when free than when shut up in the lichen thallus. They are neither benefited nor destroyed, but they are weakened and injured. The same is true of the cystococcoid or protococcoid gonidia of the larger lichens, which are more luxuriant when growing free on rocks and bark. It is impossible to regard the Stigonema gonidia, distorted and broken up by the hyphæ, as in a more flourishing condition than when free.

It seems to me that the real error of the supporters of the algo-fungal theory is not that they assume that the gonidia, the algæ, can support themselves and the hyphæ too, but that they assume that they are not injured thereby. In their attempt to show how a possible advantage to the gonidia might arise, they have not sufficiently regarded the palpably injurious action of the hyphæ. From the facts which I have given it is plain that they are injured, and, if the injury is less than in most cases of parasitism—which may be due to the fact that the hyphæ of lichens grow more slowly than those of other fungi—it is nevertheless an injury, and we must recognize in lichens not a case of symbiosis or mutual parasitism, but a case of true parasitism with a minimum of injury to the host. In view of the facts, one can be an advocate of the algo-fungal theory without believing that there is a double parasitism.

In 1885[3] Frank announced the following discovery: that certain species of trees, especially Cupuliferæ, do not regularly obtain their food directly from the soil, but their roots are connected with the mycelium of a fungus by whose agency all the nourishment is transferred from the soil to the tree. He called this condition Mycorhiza, and described the fungus as intimately united with the inner cortex of the roots just back of the tips and forming a felt-like cap over the tips. He maintained that this union of mycelium and roots was of constant occurrence in the Cupuliferæ which he had examined, oaks, beeches, chestnuts, hazel-nuts and hornbeams, and more or less constant in Salicaceæ and Coniferæ. At a later date[4] he went further and stated that the Mycorhiza is a symbiotic condition which may perhaps be found in all trees under certain conditions; that it is found only where the soil consists of humus or undecomposed plant remains; that the fungus of the Mycorhiza conveys to the tree not only the necessary water and the mineral constituents of the soil, but also the organic material derived directly from the humus and decomposing vegetable matter; and that it is through the agency of the fungus alone that the tree obtains its food from the soil. If one could accept without reserve the conclusions of Frank, we have in Mycorhiza a clear case of symbiosis in which a fungus which lives as a saprophyte on vegetable mould is intimately united with the tissues of Phænogams on which it acts, not as a parasite but as a conveyer of nourishment. Unfortunately, the statements of Frank are, to a great extent, not confirmed by other competent observers. R. Hartig has shown[5] that the Mycorhiza condition is not at all necessary to the nourishment of trees even in Cupuliferæ, since he finds that, in many cases, roots of healthy trees are quite free from Mycorhiza, and, even in trees where there is a marked Mycorhiza of some roots, there are others quite free from it. He regards Mycorhiza not as a case of symbiosis comparable to that of lichens, as does Frank, but rather a case of proper parasitism, and Kamienski[6] states that, in the cases of Mycorhiza of trees which he has examined, he has always found evidences of injury done to the roots by

[3] Ber. Deutsch Bot. Ges. III, 128.
[4] l. c. III, XXVII.
[5] Bot. Centralblatt, XXV, 350.
[6] Bot. Centralblatt, XXX, 2.

the fungus, which he also regards as a parasite of a destructive nature. P. E. Mueller, to a certain extent, endorses Frank's views, as far as the Mycorhiza of beeches is concerned.

We are, on the whole, warranted in believing that the Mycorhiza condition is rather a condition of proper parasitism than of symbiosis in the case of trees. We still have the case of Monotropa Hypopitys, a small ericaceous parasite, in which Kamienski showed, as early as 1881, that the roots are surrounded by a mycelium, which, however, does not penetrate into the substance of the roots, as in the Mycorhiza of Frank. He considered that the fungus, in this case, was the medium of transfer of nourishment to the Monotropa, and did not agree with the then prevailing view that Monotropa itself was directly parasitic on the roots of other plants. We may safely consider that there is a symbiosis in Monotropa Hypopitys, and further investigation may show a similar condition in some other closely related phænogamous plants which are destitute of chlorophyll; but here the case is very different from that of the large trees, abundantly provided with assimilating organs of their own in which, if there is symbiosis at all, it certainly does not exist on the wholesale scale which Frank claims.

With regard to the symbiosis of plants and animals I will say but a word, for the subject is one which pertains to the domain of the zoölogist rather than to that of the botanist. The inherent objections against the probability that plants and animals should live in a state of symbiosis are less than in the case of symbiosis in the vegetable kingdom; because, in the former case, the plants in question belong not to the group of fungi, but are algæ possessing chlorophyll, or a modified form of chlorophyll. The symbiotic alga could ~~not~~ support itself; the animal, on the other hand, could support itself; and, bearing in mind the different products of assimilation and respiration in plants and animals, one could easily conceive the benefit which might arise from the combination of the two. Whether the combination really exists in many cases is not yet certain, because it too frequently happens that zoölogists do not agree as to whether the assumed alga is really an alga or a proper organ of the animal itself.

It becomes a question of authority, and a botanist is not in a condition to estimate the comparative merits of observations made by zoölogists. As far as I am at liberty to form any opinion at all, I should say that zoölogists were inclined to accept, at least, a mechanical symbiosis of unicellular algæ and animals in a considerable number of instances. Whether the symbiosis is physiological as well as mechanical is a point on which more light is apparently needed.

The symbiosis of plants and animals is, perhaps, better to be compared with that of Nostocs with Hepaticæ and Azolla than with the condition which exists in lichens. Some of the recorded cases show clearly a mechanical symbiosis, even if others be regarded as merely accidental and temporary unions of different organisms. Whether the symbiosis here is physiologically of advantage to both organisms is doubtful. The Nostocs are certainly not injured, and they may derive benefit from the shelter afforded. It will not do to go too far in this direction, however, because we should, at length, be forced to speak of symbiosis in cases where Nostocs grow in crevices of rocks, which would be absurd.

I have dwelt somewhat at length on the subject of symbiosis because, as it seems to me, botanists have gone too far in assuming a beneficial action of the parasite on the host in many cases where not only no direct benefit can be proved to exist, but where a closer examination shows that an injury is really done, although it may be slight. In short, symbiosis, as distinct from true destructive parasitism, is not the comparatively common condition in the vegetable kingdom which it is generally supposed to be by those whose opinion is worth considering; for we need not regard those writers who, seeing in symbiosis a charming instance of domestic felicity and concord with which they can point a moral and adorn a tale, have given to the public essays whose only proper place is on the shelves of a Sunday School library. Accepting the existence of symbiosis where both members are chlorophyll-bearing plants, we must still believe that, with rare exceptions, the cases where one member is a fungus should be referred rather to the class of true parasites, in which the advantage is altogether on one side.

If we turn now to the question of the origin of vegetable parasites we find ourselves in a dilemma. Certainly, the parasites could not have originated before the plants and animals on whose remains or in whose tissues they live. On the other hand, accepting the law of evolution, that the more complex forms are developed later than the simpler forms, the parasites must have preceded the forms on which they prey. The paradox is, however, more in words than in reality. We can only suppose that our present parasites have existed from early times, but were not always parasites. The question might arise here, What do we mean by higher and lower forms? The terms are elastic, and one sometimes suspects that they have been stretched and twisted to suit the necessities of individual writers. It is not quite plain, for instance, why we should say that the giant kelp of the Pacific, Macrocystis pyrifera, with its branching stems several hundred feet long, furnished with innumerable leaves and air-bladders, is less highly organized than the small frondose hepatics, like Riccia, or such mosses as Phascum. There is one point on which all botanists would probably agree in speaking of high or low organizations, viz.: that complications of the reproductive apparatus indicate a high organization, however simple the vegetative organs may be, and that as we advance higher in the scale we find more and more numerous embryonic conditions which represent free conditions of less highly organized plants.

Throwing out of consideration the phænogamous parasites for the reasons previously given, there is no doubt that the immense majority of vegetable parasites belong low down in the scale of development, and we can infer from the simplicity of their reproduction that they originated at an early period. Other things also point in the same direction. In the class of fungi, although the sexual reproduction is of low grade, it embraces a number of different types, and, as far as non-sexual modes of propagation are concerned, although it may be said that they only indicate an effort on the part of the plants to adapt themselves to peculiar conditions, fungi are far better provided than any other plants. We are, perhaps, at liberty to suppose a remote origin from the large number of species of fungi now in existence, and, in this connection, a few statistics may prove of interest. The question is frequently asked whether the species of fungi are more numerous than those of Phænogams. It is safe to suppose that they are, although it is not true that more species of fungi have already been described. The systematic study of fungi in Europe and North America is of so much more recent date than the study of the Phænogams of those two continents, while the fungi of a large share of the earth have scarcely been studied at all, that a comparison of the described species of the two classes fails to give a correct estimate of the real numbers. The reason for supposing that the species of fungi are more numerous than those of Phænogams is founded on the fact that, in countries where fungal flora has been most thoroughly studied, we find few species of Phænogams which are not already known to be attacked by some special parasite, while the majority of species serve as hosts for a considerable number of species of fungi. A few figures will show this point clearly. In his treatise on the fungi which attack the species of Vitis, published in 1879, Pirotta enumerates one hundred and four species of parasites. Between ten and twenty of these are fungi not found on Vitis alone, but this number is more than counterbalanced by species peculiar to Vitis which have been described since 1879. It may be objected that some of the forms called species by Pirotta are probably merely stages of some of the other species enumerated. Admitting that this is possible, and even probable, if we deduct half, or even two-thirds, which is liberal to the last degree, we still have thirty to fifty species of fungi, at the lowest estimate, which are peculiar to six species of Vitis, the number of species of the genus included in Pirotta's observations. I have little doubt that the real number of species of fungi peculiar to the genus Vitis is much larger than the estimate I have just given. If the relative number of species known to occur on Vitis is greater than that of those known on most other genera, it is due rather to the fact that, from their importance in horticulture, they have been more carefully studied than because other genera are less frequented by special fungi.

The province of Venetia is probably no richer in fungi than other parts of the world; but, as it is of small size and is the residence of a considerable number of mycologists, its flora has been more thoroughly studied than that of this country, and we can obtain a more accurate view if we examine statistics of the Venetian flora. Cuboni and Mancini enumerate sixty-five species of fungi which occur on the chestnut, and over three hundred species on Quercus, including three native species of that genus. If we deduct a large number for species which are not found exclusively on these two genera or which are merely secondary forms of other species, we still have a considerable number of fungi to a small number of Phænogams. Turning to the American flora, we find that the species of a genus as erratic as Sarracenia are not without their proper parasites; for on four species of Sarracenia we already know four species of fungi, three of which are peculiar to the genus. The list of fungi which grow on oaks in the United States includes between five hundred and six hundred species. The greater part, however, are not peculiar to oaks, and, as the synonymy of the species is much confused, the exact number of fungi known on all our oaks can-not be given exactly. On Quercus alba fifty-seven and on Q. tinctoria forty-six species are reported, about a quarter, or possibly a third, of which are probably peculiar to those species.

We can start with the postulate that vegetable parasites must have originated at an early epoch and must have been derived from non-parasitic forms. What forms? Here we enter upon the field of pure speculation. It can hardly be supposed that we shall ever know what was the earliest form of life. It may have been some protoplasmic structure which was neither strictly vegetable nor animal. Probably the earliest forms of undoubted plants were unicellular forms like Protococcus. The term Protococcus, as used at the present day, includes some forms which are claimed by zoölogists; whether rightly or wrongly is a question which need not concern us, for some Protococci are certainly plants. The Protococci are simple green cells which multiply by division into two, and so on, and which, at times, also produce in their interior zoöspores which escape and form new individuals.

How other chlorophyll-bearing plants might have arisen from Protococci we can not stop to consider, and we can only touch upon the possible origin of the colorless parasites. A vegetation consisting of simple forms like Protococci once established, there is no reason why there might not quickly have followed parasites of the order Chytridiaceæ the species of which abound at the present day in both salt and fresh water. The simple forms of the order consist of colorless cells which produce in their interior colorless zoöspores, which escape and attach themselves to submerged plants and animals.

The step from Protococcus to Chytridium is slight. We have only to suppose that a Protococcus has acquired the power of attaching itself to other Protococci or to low animals and has gradually lost the chlorophyll, which is no longer of service to a plant in a position to absorb nourishment directly from living organisms. Other natural changes would be the development of processes for attaching the Chytridium to the host or for enabling it to penetrate the walls of the host so that the parasite could make its way into the interior. In short, it is probable that, at a very early epoch, true parasites existed essentially like our present

Chytridia. If the first plants were marine, it is altogether likely that the first parasites were Chytridia, if we can judge by present conditions. In the present age comparatively few species of fungi grow in salt water. The few that we have belong principally to the Chytridiaceæ and are abundant enough on the marine algæ of all groups. Most of the other marine fungi are forms like Leptothrix, which may rather be regarded as degenerate forms of Nostocs or Schizophyceæ than as forms derived from anything like Protococcus or Chytridium. It is certainly true that there are very few species of fungi higher than Chytridium or Leptothrix, if one can call Leptothrix a fungus, found on strictly marine plants. There are a few, however, and on the New England coast the stipes of the digitate Laminariæ, while yet submerged, are attacked by a species of Sphærella belonging to the Pyrenomycetes.

Whether the filamentous and higher forms of parasites have been derived from the simple Chytridia is not easy to surmise. Among existing Chytridiaceæ we have a series of genera in some of which there are simple rhizoids, and in others, like Cladochytrium, a well-developed mycelium. Furthermore, the species of, at least, three Cladochytria have lost the aquatic habit, and live in the tissues of Iris, Menyanthes and Sanicula. In Polyphagus, Nowakowski has also observed a conjugation of the mycelium of two individuals. Admitting the fugitive character of the mycelium of Chytridiaceæ, there is still no reason why the filamentous fungi might not have developed from species of this order. The zoöspore-bearing cells, as the parasite lost its aquatic habit and became aerial, might naturally be transformed into sporangia with non-motile spores, like those of Mucor, and, as it acquired the power of growing in solid tissues, one of the conjugating cells would advantageously be developed into a pollinodium, and we should then find oösporic forms. But it is hardly worth while continuing the chain of possibilities further in this direction.

As I have said, it seems to me not unreasonable to suppose that true parasites may have originated at a very remote period primarily from non-parasitic plants. But we must also consider another question. Is it not more probable that saprophytes were first developed and from them arose the true parasites? The line between saprophytes and true parasites is not well defined among existing plants. Some species might, with sufficiently good reason, be placed in either class, for what are called by Van Tieghem facultative parasites may live ordinarily as saprophytes and yet at times live a truly parasitic existence. The great majority of fungi are saprophytes, and De Bary has shown[7] in an instructive way how Peziza sclerotiorum, during a part of its existence, is a saprophyte, and becomes later a true parasite. The germinating spores will not penetrate the living cells of the carrot on which the mature forms of the fungus is found, but live a saprophytic existence for some time. After they have attained a certain growth and strength they are then able to make their way into the carrot, which they destroy. The mechanism is as follows: after a certain time the saprophytic hyphæ excrete an oxalate which is able to destroy the superficial cells of the carrot with which the hyphæ may come in contact, and the fungus then makes its way into the plant. It is probable that a considerable number of saprophytes may act in the same way as Peziza sclerotiorum, and it is not impossible that a good many existing saprophytes are developing into parasites, and, if the present state of things correctly represents what has always been going on, it would lead us to believe that the saprophytes first came into existence and the parasites followed. Since actual knowledge is out of the question, one can take either theory without denying the other *in toto*. The probabilities seem to me to favor the origin of Chytridia from Protococci, if we regard the morphological rather than the physiological side of the question. How far the first Chytridia were true parasites rather than saprophytes may be questioned. Decidedly, the majority of the living species, I should say, are parasites; but in some the parasitism is not well marked, and they may be conveniently called epiphytic.

Still another possibility must be considered. May we not suppose that the first living beings were protoplasmic bodies, neither plants nor animals, or both, if you please, and from them parasitic and non-parasitic plants were simultaneously developed? Orders like Myxomycetes might perhaps lead us to suppose that this view was the true one. But it may be assuming too much to suppose that Myxomycetes are plants at all. If they are plants, they have remained in a low condition, and have no offshoots represented by higher forms of plants. There appears to be only one way to find out whether a given structure is a plant or an animal, and that is to see whether it is described in zoölog-

[7] Bot. Zeit., 1886.

ical or botanical manuals. Unfortunately, this does not help us in the case of the Myxomycetes. We can safely say, however, that the more highly developed parasites have not been developed from Myxomycetes, and there is very little to lead us to believe that parasitic and non-parasitic plants were simultaneously developed from primitive protoplasmic structures.

It has already been stated that phænogamic parasites should be regarded as degenerate forms of other Phænogams. Their line of development is not through the parasites of the class of fungi. If one is willing to believe that the first parasites were Chytridiaceæ, or something very much like them, from which it is possible some of the filamentous zygosporic and oösporic fungi have been gradually developed, he is not, however, forced to believe that such a course of development is probable as well as possible. The class of fungi is not an homogeneous one. It is rather an assemblage of forms which have certain common physiological resemblances, but marked morphological differences. When one regards fungi as a single class of plants, and attempts to trace a clear connection between the highest and lowest members, he finds numerous gaps which can not well be filled. A general parallelism, however, exists between chlorophyll-bearing algæ and fungi, and one is forced to ask whether the order of development has not been from the lowest to the highest algæ—the class of algæ being more homogeneous than that of fungi — and whether the fungi have not arisen, not from any one primitive group of algæ, but from different groups of algæ at different periods in the progress from below upward. This view seems to be more in accord with existing facts than any other, and brings phænogamic parasites into harmony with the rest. If the phænogamic parasites may be regarded as derived directly from other Phænogams, so Chytridiaceæ may be supposed to be derived from Protococcaceæ. It may be that some of the zygosporic and oösporic fungi have come from the ultimate development of Chytridiaceæ, but it is more natural to suppose that the greater part of them are direct derivatives of zygosporic and oösporic algæ. Special applications of this theory would lead to so many technical details that they must be omitted on the present occasion. In general, if the theory is accepted, we should expect that the fungi first derived from any group of algæ would exhibit the characteristic modes of reproduction. In the sexual reproduction both groups are much alike, and if there are fungi at the present day whose reproduction is different from that of any algæ, it is because the reproduction has assumed more and more a non-sexual character, until, as in some groups of what are called higher fungi, sexuality has quite disappeared, as is supposed to be the case in Basidiomycetes. It is sometimes said that non-sexual modes of reproduction always precede the sexual. This is true only to a certain extent. It may be true, for instance, that in the earliest forms which had zoöspores the zoöspores were at first non-sexual, and afterward acquired the power of conjugating. But in fungi, where we have more non-sexual forms of reproduction than anywhere else, they must, in most cases, be regarded as secondary and degraded, not primary forms. Fungi are plants which depart more and more from what we may call typical plants. When we speak of higher plants we mean those in which the organs of assimilation and sexual reproduction exhibit a high degree of differentiation. When we speak of higher fungi, however, we refer to forms in which the vegetative organs are represented merely by a system of colorless threads, and in which the sexual reproduction is seldom well marked, if it exists at all, and they can be called high only in the sense that their numerous and often complicated modes of non-sexual reproduction are better developed than in what are called the lower fungi. In the struggle for existence among the higher plants those succeed best which are best able to assimilate crude material in the growing season and have the largest provision of seeds and reservoirs of assimilated food to carry them over the season of rest. In the struggle for existence among fungi, although there is an advantage if the mycelium is able to assume an indurated condition, like the sclerotia, at seasons unfavorable for growth, it is of much greater importance that there should be a variety of reproductive bodies, some of which, at least, are light and easily transported, while others are denser and better able to endure extremes of temperature and moisture, so that the fungus may be able to take advantage of any chance which may arise should the proper host be present. How well they are able to take advantage of temporary favorable conditions is shown in the rapid spread of epidemic diseases caused by fungi.

But it is better not to pursue the subject further. What I have already said will, I fear, appear to you too vague and uncertain; for the balancing of possibilities, although pardonable in philosophy, should not be carried too far in natural science. Of course, no celebration of our national anniversary is complete without a balloon ascension, and the more gas the better, provided the aeronaut, or, as the papers generally call him, the professor, only lands safely. So our society sends up its annual balloons in the shape of addresses in which the professors are allowed to soar above, though not out of sight of, facts. But they must not remain too long up in the air, and the gas for their balloons should be generated in the laboratory of experience and study. In their every-day work, it seems to me that the attitude of botanists, at the present day, is the correct one. Following the prevailing tendency in business affairs, the question they ask of plants is not so much, "Who is your father, and where did you come from?" as "What can you do?"

The identity of Podosphæra minor Howe and Microsphæra fulvofulcra Cooke.

MARTHA MERRY.

(WITH PLATE XI.)

About two years ago, while making a study of the American forms of the genus Microsphæra, the *M. fulvofulcra* Cooke came to my notice. The specimen examined was from the Ellis collection of North American fungi, No. 1,321. The so-called species is described in an article on "Californian Fungi," by Rev. J. E. Vize, in *Grevillea*, vol. v, p. 110, where it is said, "asci not seen." Examination of mature specimens shows clearly a single ascus in each perithecium, thus placing it in the genus Podosphæra. It agrees with the description of *Podosphæra minor* Howe, thus necessitating the cancellation of *Microsphæra fulvofulcra* Cooke.

Several specimens of the so-called Microsphæra fulvofulcra from different localities have been examined and compared with the original specimen of *Podosphæra minor* Howe. In all essential characteristics they agree. There are slight variations, arising probably from differences in hosts, vigor of growth, locality, age, etc.; but these variations are not marked. In many cases on the same leaf intermediate forms may be seen which unite the characteristics of the different specimens. They may all be embraced in the following description, a part of which is quoted from Mr. Howe's original description in *Bulletin Torrey Bot. Club*, v, p. 3:

"PODOSPHÆRA MINOR *Howe*. Conceptacles scattered or crowded; appendages 10–20, as long or a little longer than the diameter of the conceptacles.[1]—Leaves of Spiræa."

Mycelium amphigenous, dense on upper surface of leaf, sparing, arachnoid below.

Perithecia amphigenous, usually gregarious, and abundant above, scattered on under surface, reticulated, ranging from .071 to .0968 mm. in diameter, often .08.

Appendages 8–22, or even more, often 12, 17, 16, 21, from ½–2 times the diameter of the perithecium, septate usually 3–4 times, rarely 7, branching dichotomously 3–4 times, divisions sometimes divaricate, smooth or hyaline, color brown, shading from base to last septum, branches and last cell transparent, ultimate lobes usually merely turgid, occasionally revolute.

Ascus oval from $.068 \times .045$ mm. to $.065 \times .0732$ mm.

Spores 6–8, irregular in form, granular, $.00726 \times .0209$ to $.0197 \times .0141$ mm. Usually filling about one-half the ascus cavity.

The specimens which have furnished the essential material for the notes recorded in this paper, and some of which, accompanied by their respective numbers, are figured in the plate, were derived from the following sources:

No. I. *Podosphæra minor* Howe, on Spiræa tomentosa, from herbarium of E. C. Howe; a part of the original material from which the species P. minor was described.

No. II. "*Microsphæra fulvofulcra* Cooke," "on Spiræa salicifolia, from Providence, R. I.; No. 204; collected by N. M. Mason." Described in *Grevillea*, v, 110. Dr. Harkness, from whom it was received, says it is a part of the original material from which the "*M. fulvofulcra* Cke." was described and named. The collection number, "204," on the label of II is, moreover, identical with the number accompanying the description in *Grevillea*. The appendages are somewhat fewer and longer than in I, and the spores smaller.

No. III. "*Microsphæra fulvofulcra* Cooke," from herb. of Dr. Harkness; communicated by J. B. Ellis; on Spiræa tomentosa, probably originally from E. N. Amer. The under leaf surface of the host is strongly hirsute. The specimen is characterized by a less dense mycelium than I and II, a greater number of appendages (often 21), which are shorter, with heavier branches, presenting in all respects a more vig-

[1] The remaining part of the description has resulted from careful examination and measurement of a sufficient number of specimens to give a basis of characterization.

orous growth. On the same host-specimens forms were found with fewer appendages (12), in which case they are longer, with more frequent septa, thus approaching No. II.

No. IV. "*Microsphæra fulvofulcra* Cooke," ex herb. W. A. Kellerman, on Spiræa tomentosa; Fairfield Co., Ohio, Oct., 1882; the same as 1,323 of the Ellis collection of North American fungi. This form is almost identical with No. I. Whatever slight distinctions there may be bring it nearer No. III. The branching approaches III. The septa are less distinct.

After a careful review of this somewhat important material, it seems conclusively demonstrated that these forms are the same. In a note in the *Journal of Mycology*, June, 1885, Mr. Ellis referred to the error in his "North American Fungi," and rejects the species *Microsphæra fulvofulcra* Cooke. He also says that the error fallen into by Cooke has been repeated by Dr. Winter in his Exsiccati no. 3,045. The specimens examined agree with the description of forms on Spiræa tomentosa in "Notes on the Am. Forms of Podosphæra," by F. S. Earle, published in BOT. GAZETTE for February, 1884. Whether they should be known as *P. minor* H. or as *P. Oxyacanthæ* DC., as held by Mr. Earle, I am not prepared to say. At all events, they are clearly the same as his form, numbered (4).

To substantiate the above statements the accompanying camera-lucida drawings are offered. The numbers on the plate correspond to those in the preceding notes.

PLATE XI.—I. *Podosphæra minor* Howe, on Spiræa tomentosa, from E. C. Howe. II. The "*Microsphæra fulvofulcra* Cke.," on Spiræa salicifolia, Providence, R. I.; the "204" of the Harkness herb. III. "*M. fulvofulcra* Cke.," on Spiræa tomentosa, from Harkness herb. IV. "*M. fulvofulcra* Cke.," on Spiræa tomentosa, Fairfield Co., Ohio, from W. A. Kellerman; the same material as the "No. 1,323" of the Ellis Coll. "N. Amer. Fungi."

a = perithecium × 85 diam. b′ = appendage × 375 diam.
b = appendage × 85 diam. d = escaping ascus × 85 diam.
c = broken perithecium × 85 diam. d′ = ascus × 375 diam.
e = spore × 375 diameters.[2]

[[2] Dr Peck, of the N. Y. S. Museum, forwarded two sets of specimens of the Podosphæra discussed in this paper, which were collected in Eastern N. Y., but arrived after Miss Merry had completed her work and left Ithaca. Several preparations of each were examined by myself, however, and measurements were recorded. The results are worth mentioning, because they are directly in the line of certain conclusions in the above paper, viz.: that differences of host or position occasion variations in the perithecia and the appendages of the parasite. In specimens from Spiræa salicifolia the appendages of the perithecia were from 9 to 12 in number, and in length from 1¾ to 2 times its diameter; spores 8 (and either 7 or 8 in the next). This clearly approaches the characters of the specimens on S. salicifolia already figured under II. Those on Dr. Peck's specimens of Spiræa tomentosa had from 16 to 19 or more appendages—in one case 27—whose length was from ¾ to 1¼ the diameter of the perithecium, thus agreeing with specimens on S. tomentosa figured in this paper. Furthermore, the specimens from the under surface of the S. tomentosa leaves had fewer (often only 12-15) and longer appendages than those on the upper side.—W. R. DUDLEY.]

BRIEFER ARTICLES.

Zannichellia palustris L.—Prof. Stanley Coulter's account, in the May number, of a certain pond and its contents is quite interesting to us in Montana. All the more so because we have a remarkable spring near Great Falls, known as the Giant Spring. This spring really seems to be the outlet of an underground river, the flow of water is so great and so strong It discharges immediately into the Missouri river, midway between the Black Eagle and the Coulter Falls, and has a river frontage of 500 feet. Upon a future occasion I hope to make some mention of the various forms of plant life therein found. Zannichellia palustris grows there in abundance, and may be found in flower from May to September, and yet the temperature of the water is only about 52° F., and does not seem to vary with that of the atmosphere. So far as my own observations have gone, the stems of these plants with the flowers and fruit when growing in this spring are nearly always buried in sand, only the slender grass-like leaves waving above. And yet, covered up and packed in fine mud and sand as these plants are, their essential organs perform their functions unfailingly, and a prolific crop of fruit may be found each season. When the flowers are covered up in this manner they are always pale, often white, tinged with flesh-color, but when growing exposed to the light are olivaceous and the covering of the nutlets is thicker and stronger.—F. W. ANDERSON, *Helena, Montana.*

Coloring the nuclei of living cells.—The most interesting fact brought out in my work at Tübingen is the fact that several aniline colors have the property of coloring the nucleus of many plant cells without killing them. That the living nucleus can be stained has been demonstrated by several observers in the case of animal cells,[1] but as far as I now know it has not hitherto been observed in plant cells. Though the work is not yet completed, it will perhaps be interesting to give briefly some of the processes by which the results were obtained, and some of the objects employed.

The first color used was dahlia, a violet-purple pigment by whose aid Lavalette[2] had succeeded in coloring living spermatozoa and the nuclei of sperm-cells. The most favorable object so far found by me is the nucleus of the cells of stamen hairs of Tradescantia. T. Virginica was principally used, but other species gave equally good results. Hairs should be chosen from young buds, as these are perfectly colorless, not having developed the colored cell-sap of the older hairs. The sepals and petals are removed, and the stamens thus exposed are plunged into an aqueous solution of the

[1] See Pfeffer, "Uber Aufnahme von Anilinfarben in lebende Zellen," Unters. aus dem bot. Institut, Tübingen, 1886. Also, Strasburger, "Botanisches Practicum," fourth edition.

[2] Strasburger, Bot. Pract., fourth edition.

dahlia. After an immersion of from half an hour to three or four hours, or even much longer, depending on the strength of the solution, it will be found that in many cases the nuclei are more or less deeply colored; and that the cell is not killed is evinced by the continuance of the protoplasmic streaming. It is quite surprising to see how deeply the nucleus is often stained without killing the cell. A nucleus so colored appears perfectly normal, there being no distortion or change beyond the change in color. As yet I have not studied especially what parts of the nucleus are colored, but it appears to be the nucleolus and microsomes only, as in the case of cells that have first been killed and then stained according to the ordinary methods.

Among other objects that have given more or less satisfactory results were the hairs from the base of the perianth of Lilium bulbiferum; stamen-hairs of Aspleodelus albus; leaves of Elodea Canadensis and Vallisneria spiralis; root-hairs of Trianea Bogatensis, Cucurbita Pepo, Tradescantia zebrina; spermatozoids of Chara and a fern (probably Blechnum). In all cases cells were chosen in which there was evident protoplasmic movement, in order that there might be a certain means of determining whether or not the cell was still living.

Similar and usually quite as good results were also obtained with mauvein and methyl-violet, both colors closely resembling dahlia. Usually a .1% solution was made, and this diluted with from 50 to 1,000 parts of water, according to circumstances. Some doubtful results were obtained with other colors, but too uncertain to warrant recording.—DOUGLAS H. CAMPBELL, *Tübingen*.

The absorption of aniline colors by living cells.—About a year ago Pfeffer[1] published the results of a rather extended series of experiments showing that, contrary to the ordinarily accepted idea, various aniline colors can be absorbed in large quantities by living cells. I wish here merely to call attention to some easily made but instructive experiments bearing on the subject. Pfeffer's experiments were mostly made with methylen-blue and methyl-violet, though numerous other colors were also tried. Among colors not employed by him I found that dahlia and mauvein, both very similar to methyl violet, were quite as good and acted much in the same way. The yellow color chrysoidin also gave good results. No very satisfactory results were obtained with red pigments, though in some cases safranin, tropœolin and fuchsin gave tolerably good coloring, but either it was too diffuse, or the cell-wall was more deeply colored than the contents.

With methylen-blue either the cell-sap is colored, often very intensely, e. g., root-hairs of Trianea Bogatensis, or a precipitate is formed in the cell-sap, e. g., Spirogyra. If vesicles of tannic acid are present, as is the case

[1] Untersuchungen aus dem botan. Institut in Tübingen, 1886. "Uber Aufnahme von Anilinfarben in lebende Zellen."

in Zygnema, these are colored dark blue. Methyl-violet, dahlia and mauvein color the protoplasm and nucleus, and are specially valuable in the study of the latter. In some cases they are also precipitated in the cell-sap. Chrysoidin appears to color only the protoplasm. The following are some of the objects that were used: root-hairs of Trianea Bogatensis, Cucurbita, Tradescantia zebrina; stamen-hairs of various species of Tradescantia; Spirogyra spp., Zygnema spp.; roots of Lemna minor; leaves of Elodea (Anacharis) Canadensis, Vallisneria spiralis; pollen-tubes of Hemerocallis spp., Tradescantia Virginica, Scilla spp.; spermatozoids of Chara.

The objects are placed in a solution varying from .002 % to .001 %, varying with the nature of the cell-wall and the time of immersion. Root-hairs are usually especially delicate, and the solution should be very dilute or the immersion very brief.

In most cases objects were selected where there was marked protoplasmic streaming, as this is the best means of determining whether the cell is alive or not. It is surprising how deeply the protoplasm or nucleus may be stained without materially affecting the streaming. For a demonstration of the staining of the protoplasm the root-hairs of Trianea were found to be specially favorable on account of their large size and the rapid streaming, as well as the readiness with which the color is absorbed.—DOUGLAS H. CAMPBELL, *Tübingen.*

H. W. Ravenel.—Henry William Ravenel died at Aiken, S. C., July 17th. This is indeed sad news to all American botanists, for among their number there was none more respected and beloved and few whose scientific work covered so long a period. He was born in the parish of St. John's, Berkley, S. C., May 19, 1814. After receiving the usual high school training he entered the South Carolina College, and graduated with distinction in 1832. He then became a planter, and resided at St. John's for twenty years. In 1835 he was married to Miss Elizabeth Gilliard Snowden, of St. John's. His wife died in 1855, leaving a family of six children, four of whom still survive. In 1858 he married Miss Mary Huger Dawson, of Charleston, who, with five children, all daughters, survives to mourn their irreparable loss. In 1853 he removed to Aiken, S. C., where the remaining years of his life were spent. Although an active worker until the close of his life, when he suffered from a long illness following an attack of apoplexy, he was, unfortunately, for many years, afflicted with a deafness which was, at last, so great that he could hardly converse with strangers.

Mr. Ravenel was born with a fondness for natural history, and he pursued his studies in botany with enthusiasm during the whole of his long life. As a young man he explored minutely the region about St. John's, and he was equally active after his removal to Aiken. There was not a group of plants, no matter how small, which escaped his observation.

It is doubtful whether any other American botanist has ever covered so wide a range of plants. He not only studied critically the phænogams of South Carolina, but he collected and studied, as far as it was possible at that time and in a region remote from large libraries, mosses, lichens, algæ and fungi. But he was not an ordinary collector, heaping up rough material to be exchanged for specimens to be counted rather than studied. He was a most accurate observer, and always noted the habits and peculiarities of what he collected. He discovered a surprisingly large number of new species of cryptogams, besides a few new phænogams. Probably no person had so complete a knowledge of the cryptogamic flora of the southern states as he, and, for a long time, he and his friend, the late Rev. M. A. Curtis, of North Carolina, were practically the only Americans who knew specifically the fungi of the United States. Their interest in fungi brought them into correspondence with Berkeley, Montagne, Fries and other leading mycologists of Europe of that time, and the name of Ravenel became well known abroad as well as at home.

His deafness made it impossible for him to accept any position which involved class instruction, and he was too modest to seek public preferment. The only occasion on which he accepted a government appointment was in 1869, when he was appointed botanist to the commission which, under Prof. Gamgee, was sent to Texas to investigate the cattle disease, and on his return he published a short report on the fungi of that state. At one time he was the agricultural editor of the *Weekly News and Courier*, and at the time of his death he held the position of botanist to the department of agriculture of South Carolina. He was an honorary member of a number of scientific societies of this country and Europe, and in 1886 the degree of LL. D. was conferred on him by the University of North Carolina.

As a writer, he was not voluminous, but the appended list of his works includes several valuable papers. They all show thoroughness and an active mind which went beyond mere descriptions and inquired into causes as well as results. The best known of his works is the "Fungi Caroliniani Exsiccati," in five volumes, the first of which appeared in 1853, and the last in 1860. This is the first published series of named specimens of American fungi of which only thirty copies were issued. Probably he intended to continue the work, but the breaking out of the war and the unsettled state of affairs which followed made it impossible to continue the series. At a later period he issued a second series in connection with the English mycologist, M. C. Cooke, under the title "Fungi Americani Exsiccati," of which eight centuries appeared from 1878 to 1882. The species of this second series were collected principally in South Carolina, Georgia and Texas. Apart from the publications which bear his name, if we would correctly estimate his contributions to American botany, we must also include the very numerous notes and comments furnished by him to other writers, through whose pages they are scattered, a monument to his liberality and freedom from professional jealousy as well as to his industry and acuteness.

The name of Ravenel will be perpetuated in the genus Ravenelia of the Uredineæ, a genus so peculiar in its character that it is not probable that it will ever be reduced to a synonym. There are also many species of cryptogams named in honor of him as their discoverer. To those who have ever known him as a friend or correspondent, nothing is needful to keep his memory ever fresh. A devoted husband and father, a citizen whose life was full of kindness to all about him, a correspondent whose letters, overflowing with friendly feeling as well as information, were always a pleasure, a botanist inspired by a true love of nature and always guided by the spirit of investigation, we might call his loss irreparable had he not bequeathed to us an example of what a botanist should be. He was one of the pioneers of cryptogamic botany in this country. May those who follow be guided by the same spirit.

The following list includes all the works of Mr. Ravenel on botanical subjects as far as at present informed:

An enumeration of some few phænogamous plants, not heretofore published as inhabiting South Carolina, found in the vicinity of the Santee canal. *Charleston Medical Journal and Review*, iv, 32–38, 1849.

Contributions to the cryptogamic botany of South Carolina. *Charleston Med. Jour. and Rev.*, iv, 428–433, July, 1849, Mosses and Hepatics; v, 324–327, May, 1850, Lichens; vi, 190–199, March, 1851, Fungi.

A catalogue of the natural orders of plants inhabiting the vicinity of the Santee canal, S. C., as represented by genera and species, with observations on the meteorological and topographical conditions of that section of country. *Proc. Am. Ass. Adv. Sci.*, 1850, pp. 2–17.

Description of a new Baptisia found near Aiken, S. C. *Proc. Elliott Soc. Nat. Hist.*, i, 38–39, plate 2, 1859.

Notice of some new and rare phænogamous plants found in South Carolina. *Proc. Elliott Soc. Nat. Hist.*, i, 50–53, 1859.

Report on the fungi of Texas. In Report of Commissioner of Agriculture on diseases of cattle in the United States, pp. 171–174. Washington, 1871.

On the seemingly one-ranked leaves of Baptisia perfoliata. *Proc. Am. Ass. Adv. Sci.*, xx, 391–393, 1871; *Ann. Mag. Nat. Hist.*, ix, 174–175; *Jour. Bot.*, i, n. s., 84–85.

On the relation of the tendril to the phyllotaxis in certain cucurbitaceous plants. *Proc. Am. Ass. Adv. Sci.*, xx, 393–397, 1871.

Some rare southern plants. *Torrey Bull.*, vi, 81–82, March, 1876

Some more rare southern plants. *Torrey Bull.*, vi, 93–94, June, 1876.

Abnormal habit of Asclepias amplexicaulis. *Torrey Bull.*, viii, 87–88, Aug., 1881.

Gordonia pubescens. *Am. Nat.*, March, 1882, pp. 235–238.

The migration of weeds. *Torrey Bull.*, ix, 112–114, Sept., 1882.

Morphology in the tuber of Jerusalem artichoke. *Torrey Bull.*, x, 54–55, May, 1883.

Some North American botanists. Stephen Elliott. *Bot. Gaz.*, viii, 249–253, July, 1883.

A list of the more common native and naturalized plants of South Carolina. In South Carolina Resources and Population, Institutions and Industries. Published by the State Board of Agriculture. Pp. 312–359. Charleston, 1883.

Also, short notices in *Torrey Bulletin*, vi, 88; ix, 23, 128 and 140; xi, 132. A paper on edible mushrooms of this country read before the Aiken Vine-growing and Hort. Ass. about 1862–63; was printed in the Charleston newspapers of the day. W. G. FARLOW.

EDITORIAL.

SINCE THE consolidation of the national surveys the government has done nothing for botanical exploration. Millions have been spent in increasing our knowledge of the other riches of our domain, but the plants have been left to private enterprise. It has been claimed that the botanical exploration of this country has been well-nigh completed, but that can only be said by those ignorant of the facts. What botanist does not know that a collector in a single season's work still brings back with him his harvest of new species and increased knowledge of the old? Hundreds of new species are being described yearly in this country. A single contribution, now on our table, describes 160 new species. In the face of all this wealth of undiscovered material, in view of the fact that geology, anthropology, etc., are receiving abundant aid, why does botany lack the fostering care of government appropriation? Money is appropriated for economic botany, but our plea is for the botany of North America. There are many localities not reached by collectors, or reached at such expense of time and labor that but scanty collections are made. The country is settled enough, and botanical interest is so diffused, that exploration could be well parceled out and thoroughly done. The old days of government exploration, when the botanist was compelled to keep pace with a constantly moving pack train, and snatch what he could in his hasty march, are passed, and regions can now be "worked up" in a thoroughly systematic way. The congressional committees on agriculture should be besieged by the botanists of this country to grant an appropriation for botanical exploration, to be under the direction of the already appointed botanical agency, the Department of Agriculture. The herbarium of that department should be enriched by the results of such exploration, until the North American flora is completely represented in our national collection. Such a provision would not only enrich the herbarium of the Department of Agriculture, but all of our larger herbaria, where North American plants are being critically studied. The good feeling of American botanists is such that the possessions of one are the common property of all. Collectors should be sent to unknown or difficult localities to work throughout the season; local botanists in interesting regions should be employed to thoroughly explore their surroundings; specialists should be sent during the summer to study certain problems. In short, a few thousand dollars from an overflowing treasury could be made to yield an ample return in our better knowledge of one of the noblest and (in a public way) most neglected sciences.

OPEN LETTERS.

A Query.

Can any of the readers of the GAZETTE say whether the spores of Marsilia grown in the United States germinate readily? Having made several unsuccessful attempts last winter to grow the spores, I was informed by Professor Pfeffer that it is difficult to germinate spores grown in Germany, and that all accounts hitherto published have been made from spores imported from Australia. It would be interesting to know whether the same difficulty is met in the United States, and if so, what is the cause.

D. H. CAMPBELL.

Tübingen, July, 1887.

NOTES AND NEWS.

IN THE *Journal of Botany* for June Mr. Arthur Bennett presents a revision of the Australian species of Potamogeton, describing one new species.

THE SECOND EDITION of Strasburger's *Botanisches Practicum* has appeared in Germany.

DR. W. ZOPF has been made Professor-extraordinary of Botany in the University of Halle.

DR. G. BERTHOLD has been called to the professorship of Botany in the University of Göttingen.

SCARCELY more than a year has passed since the appearance of de Bary's *Vorlesungen über Bacterien*, yet a second and revised edition has been issued by Engelmann.

MR. ROBERT HESSLER, of Connersville, Ind., finds Gaura coccinea growing along the C., H. & I. R. R. near that place. His plant was very bushy and about fifteen inches high.

THE *West American Scientist* for June has an interesting article on the "Oaks of Southern and Lower California" by the editor. It is accompanied by a photograph of live-oaks.

DR. BYRON D. HALSTED, in *Agricultural Science*, has published a paper on the germination of cucurbitaceous plants.

PROF. L. H. BAILEY, JR., of Michigan Agricultural College, wants specimens from all parts of the country of Carex grisea (especially from the south and west), C. triceps, C. arctata, and C. retrocurva.

THE COLONIAL government of Cochin China has conferred upon Dr. Pierre a life pension of 6,000 francs, to provide for the uninterrupted completion of his *Forst-Flora* of Cochin China.—*Nat. Nov.*

DR. EDWARD R. VON JANCZEWSKY has been made Professor of Anatomy and Physiology of Plants in the University of Krakow.

DR. J. C. ARTHUR has accepted the professorship of Botany in Purdue University, pending the establishment of an experiment station at the university. After Sept. 1 his address will be Lafayette, Indiana.

DR. A. DE BARY, of the Botanical Institute at Strasburg, has been appointed Professor of Botany and Director of the Botanical Institute of the University of Leipzig, to succeed Prof. A. Schenk, who retires.

THE BULLETIN of the Calif. Acad. Sci., vol. ii., No. 6, has just been issued. Of botanical interest it contains E. L. Greene's "Studies in the Botany of California and Parts Adjacent—V.," already noticed on p. 346, vol. xi.

DR. N. S. TOWNSHEND delivered an address before the Columbus Horticultural Society at their meeting on May 28, on "Botany in the olden time." The address is printed in the *Journal* of the society for May.

IN THE proceedings of the Newport Nat. Hist. Society, a lecture by Prof. W. W. Bailey on the "Flora of Rhode Island" is published. It is full of interest, and at the close makes a telling appeal for herbaria and botanic gardens.

IN THE *American Naturalist* for June R. C. Stearns describes and figures Araujia albens (a South American asclepiad) as a moth trap. The moth is caught by its proboscis in searching for nectar, and the more it pulls the tighter the grip, something on the principle of an old-fashioned boot-jack.

REV. FRANCIS WOLLE'S new work on the "Fresh-water Algæ of the United States," which has just been issued, consists of two volumes, one of plates and one of text. It is published by the author, and sold for ten dollars, which is less than half the price of Cooke's "British Fresh water Algæ," a similar but smaller book.

IN HIS SYNOPSIS of Tillandsieæ Mr. J. G. Baker has completed the first five genera, Sodiroa, numbering 3 species (1 new), Caraguata 12 species, Schlumbergeria 3 species, Guzmannia 5 species (1 new), and Catopsis 9 species (4 new). Tillandsia contains 11 sections, and 19 of its species are described in the July *Journal of Botany.*

DR. GEORGE VASEY, botanist to the Department of Agriculture, has published his third bulletin. The subject is, "Grasses of the South," a pamphlet of 63 pages and 16 plates. Dr. Vasey is doing a valuable work in getting at the needs of various regions and disseminating knowledge concerning the cultivation of grasses and forage plants.

W. D. HAYS' books on fungi seem to be arousing not only the indignation but merriment of our English brethren. The following passage from a review in *Gardener's Chronicle* is a sample: "As for the edible species, perhaps the less said of them the better; possibly some of our very remote, flat-headed, palæolithic precursors might have been able (if their jaws were powerful enough) to masticate woody and leathery Polyporei, accompanied by sheets of dry rot peeled from prostrate logs, with a dessert of shivering, cold and loathsome Tremellas."

THE SIXTH EDITION of Dietrich's *Forst-Flora*, "a description of the most important trees and shrubs for the forester," has just been completed by the publication of the sixtieth *lieferung*. It forms two large quarto volumes, with 300 colored plates. Dr. von Thümen, the editor, is to be congratulated upon the completion of so valuable a work for forestry interests.

THE DISCOVERY, at Kew, of a sensitive labellum in Masdevallia, an Australian orchid, adds to the attractions of that already richly dowered group of plants. An insect alighting on the labellum is lifted up at first slowly, then suddenly as if with a click is caught in the box formed when the lip is closed. In about twenty minutes the lip descends and is as irritable as before.

TEACHERS who wish to demonstrate the presence of starch in vessels will find that it occurs abundantly in the vessels of the leaf-stalks of Plantago major, and also in several other species. Fischer finds the quantity to vary from a few grains to sufficient to completely fill the vessel. Schrenk finds starch abundant in the pitted vessels of the root stock of Aristolochia Serpentaria.

SCIENCE has changed its form and price, the former for the sake of the latter, which could be its only excuse. Having become attached to the old dress, we are not yet prepared to say that we like the new. Time may prove that this was a wise step, and publishers understand their needs better than any one else can, but to an outsider the change looks like a step downward from a high plane.

DIE NATURLICHEN PFLANZENFAMILIEN appears with most commendable rapidity, and the work continues of the same high grade, both in the matter of text and illustration. The eighth part, just at hand, continues the discussion of the Gymnospermæ, begun in the third and fourth parts. The Coniferæ are by Eichler, Engler and Prantl; Gnetaceæ by Eichler; Angiospermæ are also begun by Engler.

MR. WATSON writes that Arabis petræa is to be dropped from our N. Am. flora The Willoughby Mt. plant of the Manual is a true Sisymbrium, S. humile of Meyer, an Asiatic species found throughout British America from Anticosti to British Columbia and Alaska. The Vermont locality is the only one known in the United States. On the other hand, the Greenland Sisymbrium humifusum is an Arabis, and is found in Labrador and on the west coast of Hudson's Bay.

THE ADDRESS of Axel Blytt, on "Distribution of Plants," before the botanical section of the Association of Scandinavian Naturalists, is published in the July *Journal of Botany*. His opening sentence is, "The distribution of plants is essentially dependent on climate." His last words are, "I believe the precession of the equinoxes to be a natural cause of such changes in climate, and that the distribution of species is essentially governed by the periodical changes in the earth's orbit."

THE COLUMBUS (O.) HORTICULTURAL SOCIETY held a "strawberry meeting" early in June at Horticultural Hall of Ohio State University, at which papers were read treating of the strawberry from a botanist's stand-point, Prof. W. R. Lazenby; from an originator's stand-point, M. Crawford; from an entomologist's stand-point, W. B. Alwood; from an editor's stand-point, J. J. Jauney; and from a chemist's stand-point, Prof. H. A. Weber. At the close of the meeting the members present considered the strawberries present from the epicure's stand-point, which was no doubt the most delightful stand-point of all.

THE REPORT of the department of botany, British Museum, for 1886, shows 48,111 specimens mounted during the year. The most important collection added was the herbarium of the mycologist C. E. Broome. It consists of a collection of British and foreign fungi, comprising about 40,000 specimens, many of them types. From Edinburgh has been received a collection of plants belonging to Archibald Menzies, who accompanied Vancouver round the world, and whose name is so familiar in our western botany. Our own collectors are well represented among the purchased specimens.

JOS. F. JAMES has a paper in the July number of the *American Naturalist* on "Milkweeds," throughout which he very curiously confounds the latex and the "sap" of these plants. On p. 608 he says: "Yet, not every plant possesses a sap of such service as that of the milkweed. Serving as a vehicle for the conveyance of nourishment from the roots to the leaves, it carries with it at the same time such disagreeable properties that it becomes a better protection to the plant. * * * There are a great many plants which possess a milky sap, only not so well developed as in the milkweed."

THE LAST NUMBER of *Drugs and Medicines of N. A.* (March) contains the conclusion of the account of Lobelia syphilitica, L. cardinalis, Scrophularia nodosa, Lindera Benzoin, Diphylleia cymosa, Cercis Canadensis and Erechthites hieracifolia. The usual excellence characterizes both text and illustrations. An extensive foot-note gives a sketch of Dr. B. S. Barton, one of the early American botanists of note. It would seem that the claims of a plant which is neither a commercial drug nor used in medicine to a place in this work were somewhat tenuous. This is the case with three of the species listed above.

M. F. CRÉPIN has published (Roy. Bot. Soc. Belgique) "Nouvelles remarques sur les Roses Américaines," called out by Mr. Watson's "History and Revision of the Roses of North America." M. Crépin gives directions to collectors concerning collecting and observation, and then follows with critical remarks upon the species as presented by Mr. Watson. The object is to arouse additional investigation with regard to certain species. RR. acicularis, Nutkana, minutifolia, Carolina, humilis, foliolosa, setigera and gymnocarpa are considered well-known and defined species. RR. lucida and nitida need further observation. R. Mexicana is not pronounced upon, as M. Crépin has not sufficient material; while RR. blanda, Arkansana, pisocarpa, Californica, Fendleri and Woodsii are said to be questionable species.

R. W. RAYMOND's paper on "Indicative Plants," read before the St. Louis meeting of the Am. Inst. of Mining Engineers, has been distributed. Referring to the uses made of "signs" by practical miners, prospectors, etc., who neglect nothing, for everything is equally important to them, the author thinks that modern science has neglected them too much. Viola calaminaria, the Westphalian "zinc-violet," is described and figured; also, Amorpha canescens, the "lead-plant." Dr. F. Stapff, of Berlin, also reports, since the presentation of the paper, that at Carceres, Spain, the native prospectors locate with surprising skill, in spite of surface gravel, the underlying outcrops of phosphorite, by means of the growth of Convolvulus althæoides. The author adds a fourth case from Montana, where a plant, regarded by experienced prospectors as an indication of silver ore in the soil, turns out to be Eriogonum ovalifolium, which may be destined to be called the "silver-plant."

J. M. JANSE records[1] a remarkable instance of mimetism in the flowers of Maxillaria Lehmanni, from Central America. On the central region of the labellum is a callosity which is covered by a fine yellow powder, which bears an almost exact resemblance to a layer of detached pollen-grains. The author suggests that they are taken for pollen-grains by bees, which devour them eagerly for the large quantity of starch which they contain. * * * The substance in question appears to be an epidermal structure, consisting of the detached, nearly spheroidal, constituent cells of moniliform hairs. Herr Janse believes that this is the first instance recorded of the occurrence of starch in hairs.—*Jour. Roy. Mic. Soc.*

ONE OF THE most important recent announcements is that of the publication of the "Annals of Botany." It is to be an occasional appearance of original papers, well illustrated, on all subjects pertaining to botanical science. The form will resemble that of the *Quarterly Journal of Microscopical Science*, and the fact that it is to be published by the Oxford University Press is a guarantee of fine typographical work. The editors are Prof. Bayley Balfour (Oxford), Dr. Vines (Cambridge) and Dr. Farlow (Harvard). The most prominent botanists in Britain have promised their support, as well as Dr. Gray and Dr. Farlow in this country. It will appear in parts, and the price for each volume will be one guinea.

THE REPORT of the department of agriculture of the University of Minnesota, a single volume covering a period of several years and recently issued, contains two papers by J. C. Arthur on the supposed poisonous algæ, Glœotrichia Pisum (at first called Rivularia fluitans), being the result of observations made in 1882 and 1884. The first of these papers has been already noticed in this journal (vol. viii., p. 266). They deal with the appearance and geographical distribution of the alga, and especially with its supposed poisonous qualities when swallowed by cattle. Prof. M. Stalker, State Veterinarian of Iowa, also makes a report on the latter inquiry; and both observers conclude that the facts do not sustain the view that the alga is detrimental to the life or health of animals.

PROF. THOS. C. PORTER has issued "A List of the Carices of Pennsylvania," a reprint from Proc. Philad. Acad. The authority of the list, aside from the name of a well-known botanist, is attested in the first sentence: "All the species of Carex contained in this list are represented in the herbarium of Lafayette College by specimens from all the counties named, with the single exception of C. Torreyi." If all our catalogues rested upon such a substantial basis they would mean much more than they do. Prof. Porter has long had Pennsylvania botany within the reach of his hands, and in no group has he taken greater interest than in Carices. A good feature is putting the name of the county first in small caps, followed by particular stations in ordinary print, and then the name of the collector in italics. The list comprises 122 numbers, 98 species and 24 varieties.

WHETHER "for the present and for practical purposes a lichen remains a lichen" or not, the evidence seems to be daily growing stronger that a lichen is nothing but a fungus and an alga in a symbiotic relation. Bonnier has not only succeeded in obtaining by artificial culture in a sterilized atmosphere a well-developed thallus in several species of corticolous and saxicolous lichens, but lately has carried these artificial lichens

[1] Ber. Deutsch. Bot. Gesell., iv (1886), pp. 277-83.

to fructification in several cases. The most successful experiments were conducted at high altitudes in the Alps and Pyrenees. Heretofore one of the chief objections to the cultures of Bonnet, Stahl and others has been that they used gonidia and fungus hyphæ. But in the successful experiments of Bonnier the alga used was a Protococcus or Pleurococcus, while those in which gonidia were used under the same conditions failed.

MR. R. A. ROLFE, in *Gardener's Chronicle* (June 11), describes a bigeneric hybrid between Colax (Lycaste) jugosus as male and Zygopetalum crinitum as female. He gives it a new generic name, compounding the two parent names and calling it Zygocolax. He does not pretend to rank it with natural genera, but considers these hybrids as artificial productions and to be treated accordingly. It is questionable whether they should be dignified with new generic names of any kind, as botanists have not yet grown out of the notion that crossing genera should not be considered distinct. It is still an open question how far the skillful manipulation of cultivators should affect the definition of natural genera. The same writer, in a paper before the Linnean Society on "Bigeneric Orchid Hybrids," presents the following conclusions with regard to orchid hybrids: (1) Hybridization may take place, not only between distinct species, but also between distinct genera, or between plants so structurally different as to be usually regarded as such; (2) these hybrids are generally of artificial origin, or accidentally produced, and can not be treated in the scheme of classification either as varieties, species or genera; (3) the possibility of hybridization taking place between species hitherto considered as distinct does not necessarily prove them to be merely forms of the same species; (4) the occurrence of a hybrid between two structurally different genera does not prove the necessity of uniting them in one, nor can such hybrids be arbitrarily referred to either of the parent genera; (5) species and genera will always have to be dealt with in the scheme of classification according to their structural peculiarities and differences, without reference to the possibility of hybridization taking place between them.

THE TARDY development of the ovules of the Orchidaceæ has long been known. Recent studies of Guignard[1] among plants of this order add to the number and throw much additional light on the subject. So slow is the development of the ovules that in some cases six months elapses between pollination and fecundation. Orchids of temperate climates, however, are quicker, the time varying from one to four weeks. Is this because they are more likely to be exposed to untoward influences than those of the equable tropics? The orchids are not alone, however, in this respect. Maury[2] has recently found that several species of Verbascum have rudimentary ovules at the time of pollination, and other plants are already known. Probably when the subject has been further investigated the list will be greatly increased. It would appear from Van Tieghem's and Guignard's researches that the development of the ovule is a sort of hypertrophy resulting from the formation of an excess of nourishment. It is well known that the pollen tubes live in the tissues of the pistil in a parasitic fashion, and if they develop in their growth a ferment, as certain fungus parasites do, there is no reason why hypertrophy should not be the result in the one case as it so commonly is in the other. Here is an interesting field for some American botanist to work, respecting our native plants.

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[1] Ann. Sci. Nat. (Bot.), iv, 202.

[2] Bull. Soc. Bot. France, viii, 529. Fide *J. R. M. S.*

Dr. Asa Gray has been triply honored abroad this year during the season of degrees. Not that any titles could add to the wealth of his fame, but they are very pleasant acknowldgements of his great services to the science of botany. The degrees come from Cambridge, Oxford and Edinburgh. The D. C. L. of Oxford was accompanied by the following summary of his personal characteristics: *Moribus suavissimis veritatisque semper quam famæ propriæ studiosior.* The LL. D. of Cambridge came with the epithet *Floræ sacerdos venerabilis,* and the following address by Dr. Sandys (we clip a translation from the *Independent*): "And now we are glad to come to the Harvard Professor of Natural History, *facile princeps* of transatlantic botanists. Within the period of fifty years how many books has he written about his fairest science, how rich in learning, how admirable in style! How many times has he crossed the ocean that he might more carefully study European herbaria, and better know the leading men in his own department! In examining, reviewing, and sometimes gracefully correcting, the labors of others, what a shrewd, honest and urbane critic has he proved himself to be! How cheerfully, many years ago, among his own western countrymen, was he the first of all to greet the rising sun of our own great Darwin, believing his theory of the origin of various forms of life demanded some First Cause, and was in harmony with a faith in a Deity who has created and governs all things! God grant that it may be allowed to such a man at length to carry to a happy completion that great work which he long ago began, of more accurately describing the flora of North America. Meanwhile, this man who has so long adorned his fair science by his labors and his life, even unto a hoary age, 'bearing,' as our poet says, 'the white blossom of a blameless life,' him, I say, we gladly crown, at least with these flowerets of praise, with this corolla of honor [*his saltem laudis flosculis, hac saltem honoris corolla, libenter coronamus*]. For many, many years may Asa Gray, the venerable priest of Flora, render more illustrious this academic crown!" To no one has the degree ever come more worthily. May the prayer for added years be answered! It finds an echo in every American botanist's heart.

VOL. XII. NO. 9.—BOTANICAL GAZETTE.—SEPT., 1887.

Æcidium on Juniperus Virginiana.[1]

W. G FARLOW.

During a visit to Bermuda in the winter of 1881 I examined the cedars, *Juniperus Bermudiana* L., which everywhere abound, in order to ascertain whether they were infested by peculiar species of Gymnosporangium. I was unsuccessful in my search and, as far as could be seen with the naked eye, the cedars were free from any species of Uredineæ. The twigs of some trees growing near Paynter Vale on Castle Harbor, however, bore roundish galls attached on one side to the twigs which resembled the distortions caused by Gym. globosum on J. Virginiana in the United States. It was only after an examination with a hand lens that insignificant spots were detected which, seen in section under a higher power, were found to be due to the presence of an æcidium. My specimens were collected in February and, at that date, the peridia hardly protruded beyond the surface of the galls, and in some cases had not opened at all. I hastily assumed that better material could be obtained later in the season and, at my request, Dr. Walter Faxon, who subsequently visited Bermuda in mid-summer, kindly sent me galls collected in July. Contrary to my expectation the fungus was not in so good a condition as in the material collected in February, and a re-examination of my own specimens convinced me that the æcidium on them was past its prime in spite of the fact that a few peridia were not open.

In the spring of the present year I received from Mr. F. S. Earle some twigs of J. Virginiana collected at Ocean Grove, Miss., in January, on which were galls not more than quarter of an inch in diameter, not more than half the size of those on J. Bermudiana and fresher, with the color of mahogany. If the galls on J. Bermudiana looked like old galls of Gym. globosum of several years' standing, those on J. Virginiana looked quite as much like the young first-year's galls of the same species. The specimens collected by Mr. Earle had æcidia essentially the same as those that I have found in Bermuda but in better condition for study, so that it

[1]Read at the meeting of the A. A. A. S., in New York, August 15, 1887.

is probable that the fungus which I consider to be the same in both cases is in perfection in December and January. Compared with other Uredineæ which grow on Coniferæ, the æcidium in question, apart from the galls which indicate its presence, is decidedly less conspicuous, and an excellent observer of plants, Mr. Wm. Peniston, who lives close to the affected trees at Paynter Vale, assured me that he had never noticed any yellow or brown fungi on the galls.

The occurrence of an æcidium on Juniperi, which produces distortions resembling those of a Gymnosporangium, has not hitherto been suspected and, as no similar form is known to me, the species may be described as follows:

ÆCIDIUM BERMUDIANUM n. sp.—Gall perennial, globose or subreniform, when young often distinctly lobed, surface at first mahogany-colored becoming darker with a honey-combed surface, ¼–½ inch in diameter. Æcidia minute, about .20 mm. broad, .20–.25 mm. high when mature. Peridial cells oval or elliptic, .038×.05 mm. average, surface covered with sinuous slightly raised ridges. Spores brownish, usually polygonal in outline, rarely spherical, .019–.023 mm. in diam., surface smooth or only very slightly roughened.

On the smaller branches of *Juniperus Bermudiana* and *J. Virginiana*. Winter. Bermuda *(Farlow)*. Mississippi *(Earle)*.

Whether this æcidium is connected with any Gymnosporangium is very doubtful. No species of that genus is yet known in Bermuda and the æcidia of the Gymnosporangia of the Southern United States, as determined by the cultures of Thaxter and others, are supposed to be well known Rœsteliæ growing on Pomeæ with the exception of Gym. globosum, a species in which cultures have given only negative results as yet. There are two facts, however, which would lead us to hesitate before thinking that there is a connection between Æc. Bermudianum and Gym. globosum. The latter species is very common in the Northern States on J. Virginiana, while Æc. Bermudianum is known only near the sea in the extreme South. Furthermore, in the cases which have been carefully studied, the Gymnosporangia occur in the spring and the æcidia forms come later in the season. Æc. Bermudianum, on the contrary, develops in mid-winter just before the appearance of the Gymnosporangia in the Southern States, and if we believe that the two forms are connected, we must recognize an interval of at least seven months between the disappearance of the teleutosporic form and the apearance of the æcidial form. It is more prob-

ROBERTSON on ASCLEPIADS.

able that the present æcidium has no connection with our known Gymnosporangia, and that its other stages may very likely be traced to other Uredineæ which inhabit warmer regions near the Gulf of Mexico and the Atlantic. The resemblance of the galls in the two fungi is certainly curious.

The relation of Æc. Bermudianum to the Rœsteliæ already known in the United States is not very close. A differential diagnosis is hardly necessary, for the characters above will be recognized as sufficiently marked by those who study this group of plants. The species which in the microscopic characters of the spores and peridial cells comes nearest to the present species is *R. lacerata* Cooke, which grows on Cratægus in the Southern States. In the distortions produced, the absence of ridges on the peridial cell, and several other respects, the differences between the two are decided. It is to be hoped that observers in the field will gather more information about this curious fungus.

Insect relations of certain Asclepiads. I.

CHARLES ROBERTSON.

(WITH PLATE XII.)

Asclepias verticillata.—The gynostegium is very small, the anther wings measuring about one and two-fifths millimetres. It fastens the corpuscula almost exclusively upon the hairs of the legs of insects; and, in this respect, shows a strong contrast even with A. incarnata. While the corpuscula of the latter are sometimes found on the tips of the claws of the largest visitors, Bombus and Sphex, those of this plant are rarely found even on the claws of the smallest, Ceratina dupla, Halictus, and Cerceris compacta (?). Of ninety-two specimens bearing corpuscula, eighty-eight have them on hairs alone, and four on the hairs and claws. That is, one specimen in twenty-three has them on its claws, while about one in three of those bearing corpuscula of A. incarnata has them on its claws. As the wings increase in size in the three following species, corpuscula are attached more frequently to the claws and less often to the hairs. Eight specimens show pollinia on their tongues. There is quite a contrast between this species and A. incarnata, in respect to the formation of combinations of corpuscula. A. verticillata does not form them so readily; and, in fact, does not need to, as it is better adapted to fix its corpuscula directly upon the insect. On account of the shortness of the hoods, the position of the corpuscula on the legs of insects depends on how much the length of the legs exceeds that of the slits. The feet of the smallest visitors reach below the angles of the wings, and corpuscula are found on their tarsi. Large insects, bumble-bees, have pollinia on hairs from the claws to the middle of the tibiæ. I have found no dead insects on the flowers.

Associated with a gynostegium of the character indicated above we find hoods which are very broad and shallow, being not much over half as deep as those of A. incarnata. They open considerably below the level of the style-table, and their tips are turned outward, (fig. 1.)

Compared with A. incarnata, this species shows a marked increase in insects of small size and short tongues, Halictus, Odynerus, Cerceris, Crabro, Pompilus, Priocnemis, Myzine, and fewer long tongues. If it had been observed to the same extent and under as favorable conditions, it would show many more species of Hymenoptera. As the hoods increase in depth from this through A. incarnata, Cornuti, and Sullivantii, long tongued bees increase in number of individuals, while the number of species of Hymenoptera decreases. The number of species of butterflies in the table is quite misleading. The most common were small ones, which seldom remove pollinia of any Asclepias, the large species being represented by only one or two individuals of each.

In color, accessibility of nectar, and, consequently, in the general character of its insect visitors, A. verticillata shows more resemblance to certain Umbelliferæ than to the other species referred to in this paper.

Observations were made in a patch about fifteen feet long and four feet wide, on ten days, between July 20 and August 21.

	Hymenop.	Butterflies.	Other Lepidop.	Diptera.	
With pollinia	31	4	...	4	39
Without pollinia	9	11	1	7	28
	40	15	1	11	67

Asclepias incarnata.—The small anther wings are adapted to fasten the corpuscula upon the legs of large insects from the claws to the middle of the tibiæ, and on the claws and tarsal hairs of the small ones; but they catch the hairs much more frequently. Of 153 specimens bearing corpuscula, 103 have them on the hairs alone, 42 have them on the hairs and claws, and 8 on the claws alone; or, 145 have pollinia on the hairs, and 50 have them on the claws. That is, about one-third of the specimens bearing pollinia have the corpuscula attached to their claws. These processes are not so easily caught, because they are so large. Corpuscula are sometimes found on the tongues also, as I have found in 29 out of 156 specimens, 3 of these bearing them on the tongues alone. Combinations of corpuscula are formed much more readily than in A. verticillata. Sometimes a dead insect is found on the flowers. This occurs only when all or most of the feet are entangled simultaneously, so as to render the insect absolutely helpless. I have found Pelopœus cementarius and a Colletes killed in this way. As the flowers become larger, in the next two species, insects are killed more frequently.

The hoods are comparatively broad and shallow, and their tips do not project beyond the anthers. The visitors are more miscellaneous than those of the other species we have to consider.

The most abundant insects observed by me on the flowers were bumble-bees, especially Bombus separatus, wasps (Sphex and Tachytes) and butterflies (Papilio and Danais). Notes were made in a patch covering two or three acres, on twenty-one days, between July 22 and August 21.

	Hymenoptera.	Butterflies.	Other Leidop.	Diptera.	Coleoptera.	Hemiptera.	
With pollinia	38	15	...	3	3	1	60
Without pollinia	5	5	1	4	3	1	19
	43	20	1	7	6	2	79

Asclepias Cornuti.—The anthers are much larger than in the preceding, and, as a consequence, the corpuscula are fastened to the claws of insects more frequently. The tarsal hairs are not readily caught unless they are long. However, corpuscula are found more frequently on the pulvilli and on the hairs near the claws than on the claws. Even when small and short-legged insects succeed in extracting pollinia and inserting them into the stigmatic chambers they have great difficulty in breaking the retinacula, and often lose their lives in consequence. Hive-bees are frequently killed when most of their feet are entangled. On June 24 I picked thirty dead hive-bees from the flowers.[1] I have also found five species of flies and four species of moths killed on the flowers.

The hoods, although hardly longer than the anthers, are comparatively broad and deep, favoring long-tongued bees, which are the most abundant visitors.

As butterflies have been found on the preceding plants, they would be expected to occur on A. Cornuti. H. Müller gives a list of thirty-one species of insects observed on the flowers in Europe.[2] No butterflies are mentioned, but three species of Lepidoptera of other families, on which pollinia were not found. In Illinois I caught seventeen species on the flowers, six of these showing pollinia.

Notes were made on twenty-two days, between June 21 and July 22.

	Hymenop.	Butterflies.	Other Lepidop.	Diptera.	Coleoptera.	Hemiptera.	
With pollinia	10	6	1	7	1	3	28
Without pollinia	7	11	5	8	4	1	36
	17	17	6	15	5	4	64

ASCLEPIAS SULLIVANTII.—The anther wings are large and strong, the slits being fully one millimetre longer than in A. Cornuti. At the angles, the wings diverge strongly[3] so as to catch the divergent claws; and this is the only Asclepiad I have observed which fastens its corpuscula upon the claws more frequently than upon the other processes. The few small insects which occur on the flowers rarely get their claws caught, and, when they do, rarely escape.

[1] W. H. Leggett found dead hive-bees on some Asclepias, probably Cornuti, but does not mention the species. See *Amer. Naturalist*, iii, 388.

[2] "Fertilization of Flowers," 399, 400; also, "Befruchtung der Blumen," 336, and "Weitere Beobachtungen," iii, 61.

[3] See BOTANICAL GAZETTE, xi, plate viii.

The great number of hive-bees killed on the flowers of this plant and of A. Cornuti, besides being a matter of curiosity, and, indeed, of economic importance, is interesting in the study of the insect relations of the different species. Dead hive-bees are found on the flowers of A. Sullivantii much more frequently than on A. Cornuti. From the flowers of a patch which bore fifty-two follicles, I picked 147 dead hive-bees, from which it seems that the flowers are better adapted to kill hive-bees than to produce fruit through their aid. On seventeen days between July 2 and 27, 1885, I visited a patch to collect the insect visitors, and picked 671 from the flowers. I have often found four, and, in one case, seven dead bees on a single umbel. The intervals between my visit were such that many bees must have escaped my counting by being blown off by the wind, carried away by insects, or by falling with the flowers.

Most of the bees observed on the plants were trying to escape from the flowers. Of those which escape, many leave some of their tarsi between the anther wings, and must often die in consequence. These broken tarsi interfere with the insertion of the pollinia, and stop the claws in their passage through the slits. Many bees which might escape are killed by rain, for I have observed a marked increase in the number of dead bees on days following showers. Many fall a prey to predaceous insects. I have seen them, while still alive, attacked by ants, spiders and Podisus spinosus. I believe the Podisus frequents the flowers to prey upon the insects thus entangled.

There are two ways in which the flowers may bring disaster to hive-bees. It is common to find corpuscula, with their pollinia, fixed to some part of the tongue, and these bodies may interfere with the insertion of the tongue into narrow nectaries. Then, the corpuscula cover the claws so that the feet slip, and pollination is sometimes facilitated in this way. If the bee escape from the flowers with its tarsi, its trouble is not over, for it may lose its life on account of the claws being blunted by the corpuscula.[4]

Besides hive-bees, species of Megachile, Halictus, Astata, Lucilia,[5] Trichius, Pamphila, and Scepsis were found dead on the flowers.

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[4] See R. Bickford, *Am. Naturalist*, ii, 665. J. Kirkpatrick says: "When the claws are thus fettered, the bee can not climb upon the combs nor collect honey, and is soon expelled from the hive and must die. The unfettered bees tumble them out with little ceremony." *Am. Nat.*, iii, 109.

[5] The Diptera mentioned in this paper were kindly determined for me by Dr. S. W. Williston.

The large obovate hoods project half their length beyond the anthers, which increases their depth, and makes small insects less likely to become entangled. The structure of the hoods and the great difficulty smaller insects have in effecting pollination convince me that bumble-bees have had most influence in modifying the flowers, and they are the most common visitors except hive-bees.

It is to be remembered that hive-bees do not belong to our fauna, so that an adaptation to these flowers was not to be expected. By their great abundance, their constant efforts to escape, with the fact that their dead bodies occupy the flowers and give forth a disagreeable odor, they have produced a well marked disturbance of the insect relations of this plant.

	Hymenop.	Butterflies.	Other Lepidop.	Diptera.	Coleoptera.	Hemiptera.	
With pollinia	6	4	...	...	...	...	10
Without pollinia	10	7	2	3	1	1	24
	16	11	2	3	1	1	34

Asclepias tuberosa.—The anther wings are very delicate, as in A. verticillata, and are adapted to catch the tarsal hairs. Of many specimens bearing pollinia, two small bees, Cœlioxys and Augochlora, are the only ones with corpuscula on their claws.

The hoods are long and narrow, and their tips project far beyond the anthers, so that the nectar is only readily accessible to long and thin tongues.

The long tips also hold the bodies of insects so far above the angles of the wings, that only those with long legs easily remove the pollinia. The bright orange-red color of the flowers and the structure of the hoods suggest adaptation to butterflies, and the small anther wings seem to be especially suited to them. The claws of these insects are rather straight, and, when not in use, are held close together and directed in line with the leg; so that they do not often enter the slits. Whenever I have compared them, it has seemed that butterflies have corpuscula on their claws less frequently than do Hymenoptera. Of fifty-three specimens bearing Asclepias pollinia, only eight have them on their claws.

Notes were made on a few scattered plants on eighteen days between June 23 and August 17. This is the only species on which no bumble-bee was seen. By far the most abundant visitors are the butterflies.

	Hymenop.	Butterflies.	Other Lepidop.	Diptera.	
With pollinia	6	7	1	1	15
Without pollinia	3	4	...	...	7
	9	11	1	1	22

Asclepias purpurascens.—The anther wings catch the hairs of the tarsi in all of the cases observed.

The hoods of the reddish purple flowers are long and narrow, their tips being much longer than the anthers (fig. 2). In the back of the hood is a process which projects inward to meet the broad horn, and thus completes the partition between the very narrow honey receptacles.

In my neighborhood A. purpurascens blooms first, when bumble-bee workers and Sphegidæ are least abundant, and shows a greater preponderance of butterflies than in A. tuberosa.

I watched a few plants on seven days between June 2 and 19.

	Hymenop.	Butterflies.	Diptera.	Hemiptera.	
With pollinia	1	5	1	1	8
Without pollinia	5	11	...	...	16
	6	16	1	1	24

Asclepias in general.—The hoods are broad so that the intervals between them are narrow. In order that the legs of insects may be readily caught between them, they project strongly throughout and are open at the summit.

The open mouths are also of advantage in making the flowers more conspicuous, but are to some extent a disadvantage, since they make the nectar more accessible to many insects which are useless. The horn partly offsets this disadvantage. But for its presence small insects could crawl bodily into the hoods of the larger flowers. The horn has also the effect of making the nectar more or less double, notably in A. purpurascens; and I have observed in A. Cornuti and Sullivantii that bumble-bees insert their tongues regularly on each side of it.

Since a small gynostegium can catch more processes on an insect's leg, and so can fasten more corpuscula directly upon the insect, the habit of forming combinations of corpuscula[6] is less important to flowers having it. I have found no combinations of corpuscula of A. tuberosa, and few small ones of verticillata. (1) One advantage of their formation, and a ready explanation of their frequency in certain species, as A. incarnata, is to be found in the fact that the broken retinacula are often more easily caught by the wings than the hairs. Often the hairs are so short that they do not easily enter the slits; but when a corpusculum comes to be fastened to one of them advantage is taken of the circumstance, and a large combination is attached to its retinacula. For example, a specimen of Apathus elatus has six corpuscula on its tongue, all in one combination, illustrating the fact that it is often easier for A. incarnata to fasten a combination to a hair that is once caught than to catch another of the same length. (2) Long combinations are sometimes guided by the hoods over the angles of the wings, when the leg bearing them is not so guided (A. incarnata). I have seen pollinia of A. Sullivantii near the end of a combination drawn into the stigmatic chamber when the foot of the bee did not reach down to the angle. (3) After a corpusculum is fastened to every available process the carrying capacity of the leg is still indefinitely increased. This is so important in the large flowered species that I do not believe they could have been developed until this habit had become fixed in the smaller flowers. On the pulvillus of a hive-bee's foot I found a combination of eighteen corpuscula of A. Cornuti. But for the broken retinacula, it would have required every foot to carry these corpuscula, and then no new ones could have found room for attachment.

[6] For figures of these combinations, see Corry's paper, Trans. Linn. Soc., Ser. 2, Bot., Vol. II, pl. 25.

The frequent occurrence of these combinations spoils the theory that the corpuscula enter the stigmatic chamber. That view can neither explain how they are formed nor how they escape destruction.

While in ordinary flowers an insect may be a useful visitor if it can reach the nectar, in Asclepias many other conditions influence the insect relations. (1) Of visitors whose tongues are suited to the nectaries, many are useless, because they do not light upon the flowers (Sphingidæ, Ægeriadæ and Trochilus).[7] (2) Others because their legs are not long enough to extract pollinia. Megachile is common on A. tuberosa, but never, so far as observed, carries pollinia. (3) Others have legs long enough, but rest their feet so lightly on the flowers that they seldom effect pollination; e. g., Diptera and small butterflies. (4) Still others are not strong enough to free their claws from the slits and break the retinacula; in all, seventeen species were found to be killed on this account.

The table shows the number of species visiting the flowers, with the disposition of the corpuscula on them.[8]

	Hymenop.	Butterflies.	Other Lepidop.	Diptera.	Coleoptera.	Hemiptera.	
Corpuscula on hairs, claws and tongue.......	14	...	...	...	2	...	16
" " hairs and claws	8	7	...	...	...	1	16
" " hairs and tongue.................	5	1	...	3	...	...	9
" " hairs alone........................	26	15	1	7	2	3	54
" " claws alone.........................	3	...	...	...	...	...	3
" " tongue alone	1	...	...	2	...	...	3
" none	13	12	6	13	5	...	49
	70	35	7	25	9	4	150

The most striking peculiarity of Hymenoptera is the frequent occurrence of pollinia on their tongues. Of twenty-eight species with pollinia in that situation, twenty are Hymenoptera. Bembex which resembles certain Syrphidæ[9] in

[7] The ruby-throated humming-bird visits A. incarnata, Sullivantii and purpurascens.

[8] In the table the pulvilli are included under "hairs."

[9] Packard, "Guide to Study of Insects," 164.

colors and manner of flight, also imitates them in resting lightly on the flowers and extracts pollinia less frequently than any wasp I have seen.

EXPLANATION OF PLATE XII.—Fig. 1, Gynostegium of *Asclepias verticillata* L., with one hood removed. Fig. 2, Same, of *Asclepias purpurascens* L. Fig. 3, Gynostegium of *Acerates longifolia* Ell. Fig. 4, Sketch of *Bombus scutellaris* Cress., with pollinia of Acerates longifolia. Fig. 5, Sketch of face of *Cerceris bicornuta* Guér., with pollinia of Acerates longifolia. Fig. 6, Pollinia of *Acerates viridiflora* Ell.; one in stigmatic chamber with tubes emitted. Fig. 7, Corpusculum of same, "spiked" and displaced by caudicle of inserted pollinium.

The "Curl" of Peach Leaves: a study of the abnormal structure induced by Exoascus deformans.[1]

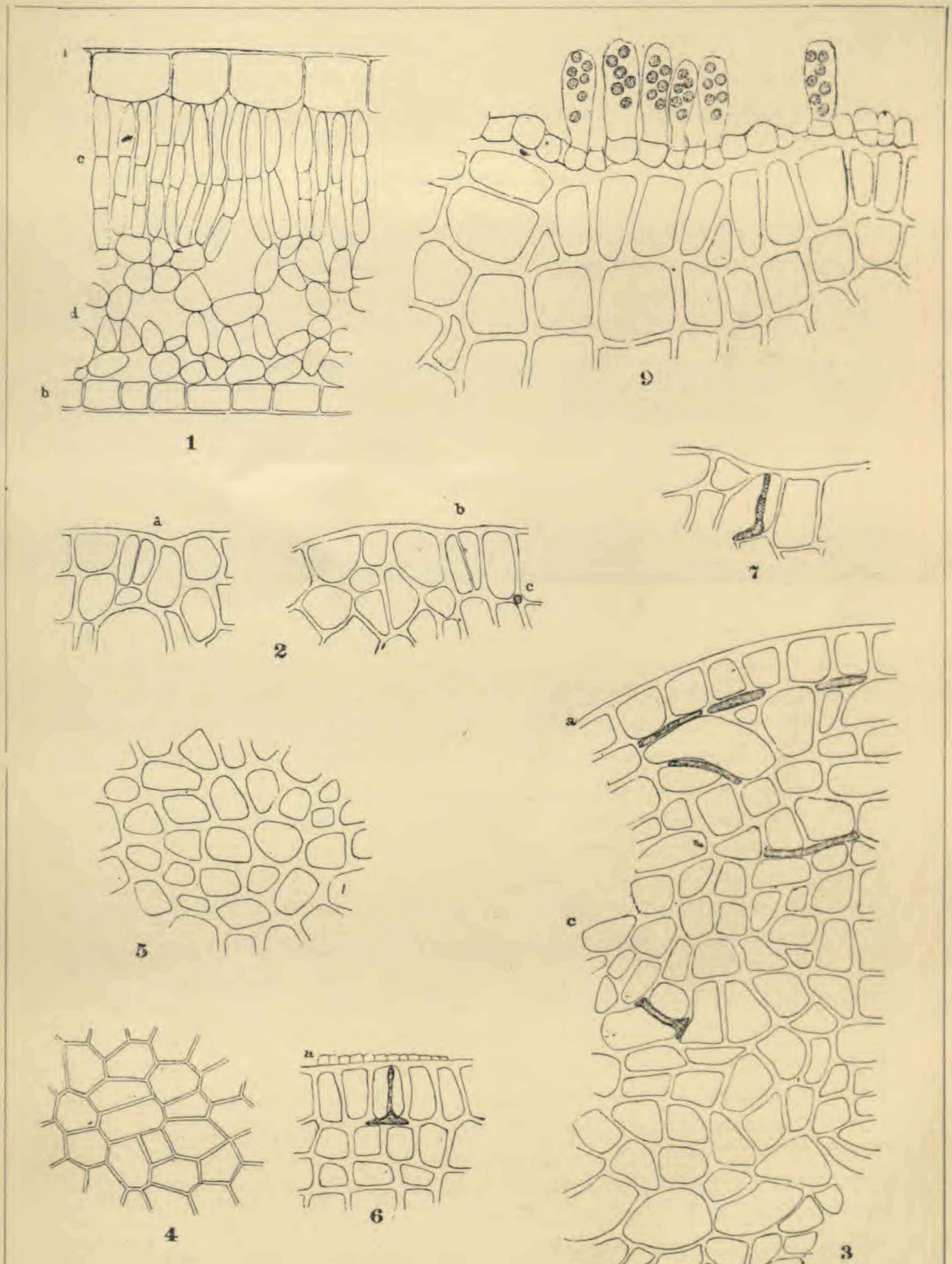
ETTA L. KNOWLES.

(WITH PLATE XIII.)

The fungus which causes the disease of peach leaves, known as "the curl," appears very soon after the leaf unfolds. The following observations were made from alcoholic material gathered May 30, and June 8, 1887. The fungus continued to make its appearance on growing leaves up to the time of concluding this work, at the end of June, but was less abundant at that time than early in the month.

A study of the structure of the normal leaf was first made to serve as a basis of comparison with that of the diseased leaf. The drawings were all made with the camera. Fig. 1 represents a cross section of a healthy peach leaf, *a* being the upper and *b* the lower surface. The epidermis consists of a single layer of cells, the outer walls of which are covered with a very thin, delicate cuticle. The epidermal cells of the two surfaces differ considerably in shape and size, as shown in the figure. Next to the epidermal layer of the lower surface are ordinary parenchymatous cells, thin-walled, irregular in shape and arrangement, and with large intercellular spaces. Beneath the epidermis of the upper surface are from two to three layers of palisade cells, likewise thin-walled, but with smaller intercellular spaces. The cells are filled with granular protoplasm in which are round masses of chlorophyll. On the under surface are numerous stomata. Both

[1] Contributions from the Botanical Laboratory of the University of Michigan, 1887



KNOWLES on PEACH CURL.

epidermal surfaces are smooth, without appendages of any kind. As the fibro-vascular bundles are little affected in the diseased leaf it is not thought necessary to describe their structure.

The fungus was found to be fully matured at the first date of gathering. It makes its appearance very early in the development of the leaf, and in most cases seems to start somewhere in the upper half, as a small puff or swelling in the tissue. This spreads until in many cases it affects nearly the whole leaf. The fungus stimulates the growth of the parenchyma, giving rise to cell-division and thus to a greatly increased area of the surface. Fig. 2 shows two cells, *a* and *b*, in process of division. Attention was called to them by the fact that they were full of protoplasm while the surrounding cells were empty or nearly so. At first glance each looked like a single cell, but on focusing a septum was very plain. The fibro-vascular bundles or veins are acted upon to some extent but do not keep pace with the increased growth of the parenchymatous portion, hence they act as threads on which the other part of the leaf is "gathered," forming the puffs or folds already described. In many cases the leaf is nearly or quite doubled in width and is greatly increased in thickness. The color is a grayish-white when the fungus is mature. Soon after the mature state is reached the leaf becomes shriveled up, turns dark brown and drops off. In the latter part of June the leaves that were infected turned red or orange, looking like leaves in autumn. Taking a cross section of the abnormal leaf the structure was found to be very much altered, as may be seen in fig. 3, in which *a* is the upper and *b* the lower surface, corresponding to *a* and *b* in fig. 1. The epidermal cells have changed in form and their walls are much thicker. The long, narrow palisade cells have swollen and divided until they have the appearance shown in the figure at *c*. The intercellular spaces have disappeared and the cells are nearly or quite empty. The lower part of the leaf is not so much changed, the mycelium being most abundant in the upper portion. The fruiting portion of the fungus is not found on the lower surface of the leaf at all. Winter's statement[2] that the asci break through the lower side of the leaf does not hold good for the peach. Taking thin sections of the normal leaf, parallel to the surface, the epidermal cells were found to be as represented in fig. 4,

[2]Kryptogamen-Flora, Ascomycetes, p. 6.

thin-walled, acutely-angled, polygonal cells. Upon examining a corresponding section taken from an abnormal leaf the change which had taken place was found to be as shown in fig. 5. The acute angles had disappeared in a great measure and the cell walls wêre much thicker.

The mycelium of the fungus, Exoascus deformans, which causes these changes, is septate, variable in thickness, branches irregularly, runs between the cells, and is filled with granular protoplasm in which there is considerable oil. No haustoria were observed. There was some difficulty in finding mycelium running to the surface, but after numerous sections, various cases were observed in which it was seen to pass directly through the epidermal cells, as shown in figs. 6 and 7, or between them as represented in fig. 8. Fig. 8 also shows where mycelium has passed to the surface, and there run for some distance under the cuticle. The same thing was noticed in several sections not figured. Having thus penetrated the cells of the epidermis, the mycelium forms numerous branches, the ends of which enlarge, and after being separated by a septum, form the asci with spores represented in fig. 9. As they grow they push up the cuticle and finally break through it. The protoplasm contained in the asci rounds off into spores, six or seven usually being found and in some cases eight in each ascus.

To sum up briefly the action of the fungus on the leaf:

1. A marked increase in width and thickness accompanied by great distortion.

2. Great multiplication of cells, particularly of the palisade cells and immediately adjacent parenchyma, by cell division.

3. Thickening of the cell walls and disappearance of the intercellular spaces.

4. Diminution of cell contents which often are almost or wholly wanting.

Explanation of Plate XIII.—Fig. 1, Cross section of a healthy leaf, *a* the upper, *b* the lower surface, *c* palisade, *d* spongy parenchyma. Fig. 2, Two sections of the upper surface of an abnormal leaf, *a*, *b* cells in process of division, *c* cross section of a hypha. Fig. 3, Cross section of an abnormal leaf showing mycelium in different forms; *a* upper, *b* lower surface, *c* palisade, *d* spongy parenchyma. Fig. 4, Section of the upper epidermis of a healthy leaf, parallel to the surface. Fig. 5, Corresponding section of an abnormal leaf. Figs. 6, 7, 8 and 9, cross sections of the upper surface of abnormal leaves; *a*, in fig 6, young asci. Figs. 1—8 × 140. Fig. 9 × 200.

An excursion to the Platte.

HARVEY THOMSON.

I have thought an account of a botanical excursion to the Platte river region of Central and Western Nebraska might be of interest to botanists. I had been planning for some time to make a trip from Hastings to the Platte valley, but failed to make arrangements to go until May 21. The excursion was preceded by a preliminary trip May 14 for the purpose of selecting good botanizing grounds; also, another hasty trip was made to a point some three miles further up the river May 24. In all, points extending some four or five miles along the river were visited, and the list of plants may include some found in each or all of the trips.

Sixteen of us started early in the morning of May 21 for a fifteen-mile drive over the prairie to the valley. Keeping directly north along the railroad toward Grand Island, where the land was cultivated, nothing of interest was found, except the occasional appearance of Taraxacum officinale about dwellings. This plant, so common everywhere in the East, was never seen here until within the last two or three years, but from its present growth it promises to become quite a pest to farmers. Six miles north of Hastings we turned to the west, and, going some five miles, found the open, uncultivated prairie, and the typical flora growing upon a sod which had never been disturbed by man, the only sign of civilization being a slightly broken wagon road across the prairie, and at long intervals a small farm-house. Sometimes these were built of sod or were the much talked of "dug-outs." The first settlers in this country took "claims" down in the river valley, thinking this to be the best land, and when railroads were built the second group of settlers felt that they must be within hearing distance of the cars or they were entirely out of the pale of civilization; so that it is still possible to find within a few miles of a city of twelve thousand inhabitants soil owned by speculators which is still covered by the virgin sod. Out upon this prairie we found Viola delphinifolia and Callirrhoe alcæoides. Heretofore C. involucrata has been most abundant here, and has received the name of "Platte Valley rose" from the people living along the Platte. This year I have been unable to find a single specimen, and there has been but one brought in by my students, while C. alcæoides is abundant everywhere.

Oxalis violacea, with its purple flowers, almost covered the ground in places on the prairie. Last year O. corniculata outnumbered O. violacea, while this year it is very scarce, as I have only seen a very few specimens. There were also found in great abundance Amorpha canescens (just beginning to bud nicely), Astragalus caryocarpus, Oxytropis Lamberti, Antennaria plantaginifolia (mostly in fruit), Senecio aureus var. Balsamitæ, and Troximon cuspidatum. Astragalus caryocarpus, with its large, nut-shaped fruit, grows everywhere over the prairies. Its flowers vary in color from dark purple to almost white, not one in twenty of which could be termed "violet." The people call the fruit "buffalo bean," and its great size and beauty is a thing of which they like to boast. Among the rarer plants seen on the prairie were Malvastrum coccineum, Rhus Toxicodendron, Lathyrus polymorphus, Œnothera serrulata, Gaura coccinea, Pentstemon albidus, and Sisyrinchium mucronatum. Lathyrus polymorphus, I believe, has not been reported as being found this far north, at least in the "Flora of the Rocky Mountains," but I have seen it several times in favorable localities.

After some time spent upon the prairie we pushed on to the border-hills of the Platte valley. Here we stopped for another search in the ravines and along hill-sides. In addition to several of the plants already mentioned, we found Ranunculus rhomboideus, Psoralea lanceolata, Aplopappus spinulosus (just beginning to bloom), Lithospermum hirtum, and Veronica peregrina.

The inner man now calling for some new supplies, we drove down into the valley proper and camped out, the ladies of the party spreading lunch upon as beautiful a piece of velvety lawn as one will see anywhere. The Platte valley is here a mile and a half or two miles wide and bordered by low, sandy hills. Next to the Missouri, the Platte river is, perhaps, the muddiest, and changes its bed oftener than any other river in the world. Generally, however, it flows near the middle of the valley, but its banks are always crumbling and falling in and the bed of the river is full of islands and sand-bars. The cause of this changing is found in the very loose, sandy soil and the swiftness of the water. This, in turn, makes it a good transporter of plants, as we saw to our delight.

Lunch being over, part were detailed as drivers, while the rest of us spread out over the valley to take in whatever could be found in the way of plants. In this way we moved up the river. It did not take long to discover that we were in a flora differing from that of the prairie almost as much as if it had been on the other side of a continent. Viola delphinifolia, Callirrhoe alcæoides, Oxytropis Lamberti, and Senecio aureus, var. Balsamitæ occurred occasionally, while Sisyrinchium mucronatum, which was somewhat rare on the prairie, almost covered the river bottom. Everything else was new. In the water of a slough we found Ranunculus multifidus, Erigeron Philadelphicus. Viola palmata, var. cucullata, and Lithospermum angustifolium were occasionally found, while Salix longifolia lined the river bank in places. Among the best "finds" made were Crepis runcinata[1] and Plantago eriopoda, both of which seem to belong farther west, at least they have not been found east of Colorado. Cypripedium parviflorum, which is said to be quite rare in this state, was very abundant in one place.

At one point along the river several acres of the bottom were found very thickly dotted with Cypripedium candidum. Local botanists claim that this is the only place in the state where it is found. Perhaps this is true, as it is no doubt very rare. The plant, however, whose presence here surprised me most, was Lysimachia thyrsiflora. This is, or has always been considered, a distinctly eastern species, although I have a specimen in my herbarium from Iowa, as well as from the east. This is, I think, the first time it was ever found so far west. More abundant than anything else in the valley was Hypoxis erecta, the ground being thickly set all over with its yellow, star-like flowers. Among other things found were Smilacina stellata, Tradescantia Virginica, Eleocharis palustris, Carex tetanica, C. filiformis, var. latifolia, C. stricta, C. straminea, Equisetum arvense, and E. lævigatum.

The study of this flora becomes exceedingly interesting, because, with a large river running almost directly east, we have a natural channel for the distribution of plants, and here we have plants from the extreme east and west. With two large and very swiftly flowing rivers rising in the mountains west of us and flowing to the east, and several lines of railroads entering the state from different directions, one may expect to find a very large and diverse flora and ought not to be surprised if strays from almost any part of the country should be found here.

[[1] This species is reported on the prairies of Iowa and the Red River valley of Minnesota.—EDS.]

BRIEFER ARTICLES.

Botanical Papers before the American Association.—The papers read before the American Association for the Advancement of Science at the New York meeting, which are of interest to botanists, are as follows:

W. J. Beal, Comparison of the epidermal system of different plants.

W. J. Beal and C. E. St. John, Study of the hairs in Silphium perfoliatum and Dipsacus laciniatus in relation to insects.

R. P. Bigelow, On the structure of the frond of Champia parvula.

N. L. Britton, Notes on the flora of the Kittatinny mountains.

J. M. Coulter and J. N. Rose, Development of the Umbellifer fruit.

A. A. Crozier, Methods of branching in the fibro-vascular system of plants.

W. G. Farlow, Apical growth in Fucus; also Æcidium on Juniperus Virginiana.

W. M. Fontaine, The flora of the Potomac formation in Virginia.

W. M McMurtrie, Note on the chemistry of germination; also Note on absorption of nitrogenous nutriment by the roots of plants.

J. S. Newberry, Flora of the Amboy clays.

F S. Pease, Honey plant oil.

Mrs. F. S Pease, The honey plant.

H. H. Rusby, The cultivated Cinchonas of Bolivia.

J. Schrenk, On the histology of the vegetative organs of Brasenia peltata.

A. B. Seymour, Character of the injuries produced by parasitic fungi upon their host plants.

Miss Effie A. Southworth, Notes on Catalpa leaf spot disease.

Sereno Watson, Some notes on American roses.

This list does not contain as many papers as were presented by the zoologists of the Association. It was the plan to have botanical papers read before the Section of Biology in the morning and zoological papers in the afternoon, but the plan was strictly carried out only on Thursday, the first day of the meeting on which papers were read, while on Friday, the second day of reading papers, no botanical subjects were put on the programme. If, however, the botanists did not do their full duty in maintaining an equilibrium between the two sides of the biological body, they at least furnished good material for their portion.

Dr. Beal's paper on the hairs in Silphium and Dipsacus, in which he took the ground that they had no special physiological significance, and that the water of the cups was not excreted by the plant but supplied by rains, was illustrated by charts and specimens, and led to an extended discussion, in which Messrs. Macloskie, Rusby, Schrenk, A. J. Cook, Eccles, and others took part. Some of the speakers were disinclined to agree with the author's conclusions, and the query of what could have caused the development of the hairs in advance of their usefulness to the plant received considerable attention.

The paper by Mr. Bigelow, illustrated by enlarged drawings, cleared up the various conflicting views regarding the apical growth of the sea-weed, *Champia parvula* Harv., and established the interesting fact that there are five cells at the apex of the frond, instead of one as is usual in other plants. The paper will be published in the Proceedings of the American Academy.

Dr. Britton's paper has already appeared in the August number of the *Bulletin of the Torrey Club.* It dealt with the correspondence of the floral and lithological features in certain parts of New Jersey, especially the occurrence on the Kittatinny mountains of plants whose ordinary habitat is in the sandy soil near the sea-shore. The paper was commended by Prof. T. C. Porter, who spoke of his own studies in the same line, which he hoped to publish after a time.

In the absence of Prof. Coulter his paper on Umbellifer fruits was read by Dr. Beal. The paper did not admit of discussion on account of its technical character ; it will be published in this journal.

Dr. Farlow spoke of the confusion which has arisen regarding the apical growth in Fucus, illustrating his remarks with blackboard sketches. Investigators have been inclined to think that the growth proceeded from more than one apical cell. This was shown to be untrue, and what does take place was explained, together with the reasons that led other observers to different views.

The outline of Dr. Newberry's remarks on the flora of the Amboy clays was published some time since in the *Bulletin of the Torrey Club.*

The two papers on the honey plant were read for the authors. The plant, Echinops sphærocephalus, thistle-like in appearance, growing four to five feet high, has been discovered to be of more than usual value for bees. It is hardy at Buffalo, N. Y. The seeds, about the size and form of rye, yield more oil than linseed, being as much as four and a half ounces to the pound when crudely expressed. The residue left after removing the oil is very bitter like quinine, but the active principle has not been examined. Samples of the plant and its products were exhibited. The paper was discussed by Messrs. Morong, Britton, Claypole, and Mrs. Wolcott, especially as to the literature of the subject and the possibility of the plant becoming a troublesome weed if allowed to escape from cultivation.

Dr. Schrenk's paper on the minute structure of Brasenia was a long and able account of an interesting investigation. It was illustrated by growing plants, sections under the microscope, and enlarged drawings.

Proterogyny in Datura meteloides.—I have been cultivating this species for ornament, and by accident discovered the peculiar way in which the stigma is in a position in which it may be fertilized before the pollen of its own flower is shed.

As is well known the corolla, in æstivation, is plicate-convolute or supervolute, and opens in the evening twilight and begins to close and droop shortly after sunrise the following morning. From twenty-four to thirty-six hours before the corolla opens the stigma begins to peep out through the center of the convoluted folds. It gradually protrudes farther until during the last afternoon it is from one-half to three-fourths inch beyond the highest point of the closed corolla. It is thus ready to be fertilized by the pollen of the flowers that are open the evening before its own opens. I have examined the other two species of Datura that grow here, but find no such contrivance for cross-fertilization.

J. SCHNECK, *Mt. Carmel, Ill.*, Aug. 22, 1887.

Entertainment of the Botanists in New York.—Nothing that could reasonably have been done to add to the profitable enjoyment of the botanists of the Association during its August meeting was omitted, and the execution of the carefully devised plans was accomplished without break. This result was brought about by the efforts of the Torrey Botanical Club, and thanks are due to no individuals more than to Dr. and Mrs. Britton.

Upon arrival the botanists found a room set apart for the Club, where they registered, and received their distinctive badges of yellow silk and a programme of the botanical announcements for the week.

A reception by the Torrey Club was given the Club of the Association on Friday evening in the commodious hall of the Columbia Library, which afforded a good opportunity for the exchange of courtesies and the renewal and promotion of acquaintanceship. A rich collation added to the pleasure of the evening.

No feature of the whole meeting was more enjoyable than the excursion to Sandy Hook, which took place Monday afternoon, and in which the entomologists joined with the botanists. Morning showers and a lowering sky threatened to repeat the Point Abino experience of last year; but the sky, the atmosphere and the temperature combined in really producing the most admirable of weather. A trim and cozy harbor steamer, well supplied with refreshments, made the hour's ride especially comfortable.

Sandy Hook is a low stretch of sandy sea-coast, with a rather meager flora of grass and herbaceous plants, with clumps of shrubs and low trees, and still fewer representatives of mosses, algæ, lichens and fungi. The locality was chiefly interesting for its peculiar sea-side character, and was in marked contrast to the rich and varied floras of the localities the club has usually visited. Among the plants which excited the most interest were the beach plum, Prunus pumila, with its black knot fungus; Senecio cineraria, the dusty miller of the gardens, with the habit of a native plant; a broad-jointed Opuntia, and the beautiful flowers of a Sabbatia, among the higher plants. Among lower plants, the abundance of a smut on the inflorescence of Cyperus Grayi attracted attention; a lichen gave a carpet-like growth upon the sandy soil in some places, and a single Geaster stood for the larger fungi.

During the return trip happy and instructive remarks were made upon the events and collections of the day by Mr. Morong, who acted as chairman, Judge Day, Mr. Canby, Dr. Beal, Mr. W. H. Seaman, Prof. Claypole, Dr. Britton, Dr. Arthur, Prof. Spalding, Mr. Jesup, Miss Steele, Mrs. Britton, Mrs. Wolcott, Mr. Fernow, Prof. Lazenby, Prof. Scribner, Dr. Allen and others of the botanical party, and several of the entomologists. The presence of the son and grandson of Dr. Torrey, although neither is a botanist, brought the name of the venerated botanist into stronger association with the place than anything had previously done. Altogether, the club has not had a more delightful and memorable excursion than the one to Sandy Hook.

The Torrey Club added to the pleasure of the visiting botanists by opening their comfortable library and herbarium room, and affording every facility for consulting books and specimens. It was a spot that had many charms, and was much visited. The generosity and forethought of the club toward their guests were also shown in the provision of a set of sixty-three species of the most interesting of the flowering plants of the vicinity, well mounted and labeled, which they were at liberty to take away with them, forming valuable souvenirs of the meeting.

The New York gathering will be remembered as a thoroughly delightful and profitable one.

Dispersion of seeds of Euphorbia marginata Pursh.—This beautiful species of spurge, which has within the last twelve years been first cultivated in this vicinity, under the common name of "Snow on the Mountain," or "Mountain of Snow," proves to be quite interesting as well as ornamental. It has escaped, and has gone a good distance from the flower beds and gardens, and has made itself at home in almost all parts of our country along the roadsides and near farm-houses. During September, 1886, I had a bouquet placed on my office table in which were several sprays of this species. While otherwise engaged I heard a sudden tick, as if some one had thrown a small gravel against the window-pane. This was repeated several times, and I stepped outside the room to look for the rascally urchin, but failed to find him. Afterward I discovered that the sound was caused by the sudden bursting of the seed-pods of the specimens of this plant which were in the bouquet. I kept this species under observation more or less constantly during the remainder of last season, and have learned the following facts about it:

The stiped ovary arises at first above the involucre, but as soon as the stipe is long enough to reach over the involucre it droops down over the outside, and thus remains inverted until the fruit is fully developed, which usually requires nearly one week. As the capsule begins to dry and the seeds to ripen it resumes the erect or vertical position. This last movement of near 180° is generally completed in less than one day. It is now ready to burst and scatter the seed. As it thus stands it consists of a stipe near three-fourths of an inch long, on the top of which is a three-celled, obtusely triangular capsule. Each cell contains a pitted spherical seed, which is a little larger than that of white mustard. The covering of each seed consists of two equal halves, which unite and form a complete cell, except along the inner or central border. Here each half is joined to the neighboring cell in such a manner as to leave a deficiency, thus forming a central cavity which opens into each of the three cells. Passing up through this central cavity is the continuation of the stipe, which is triangular and membranaceous, and so shaped as to fill up the deficiencies where the two halves fail to unite, thus completing each of the three cells. It will thus be seen that the line of dehiscence is much shorter on the inner border of the cell than on the outer, and that the two valves do not touch one another at all at the central part of the inner line of dehiscence.

As the capsule ripens and the stipe assumes the erect position the green color gradually fades and the seams commence to separate. Suddenly all of the six valves contract upon themselves at the same time, thus completely detaching themselves and scattering the three seeds upward and outward. Quite a number of seeds were thrown on to a shelf which was ten inches higher than the top of the bouquet and nearly a foot away from it. The greatest distance which a seed was thrown was nine feet, measured by a line drawn direct from the flower to the spot where the seed struck the ground. The seed had traveled in an upward curve, and had probably made a journey of twelve feet. The sound which was produced at dehiscence was heard sixty-five feet away, in the open air, and nearly one hundred in a room. In looking over such botanical literature as I have at hand, I find that on page 20 of the BOTANICAL GAZETTE for 1880 Prof. W. C. White reports that E. E. White had observed a similar habit in *Euphorbia corollata* L., the report being loud enough to be heard across an ordinary room. J. SCHNECK, *Mt. Carmel, Ill.*

The A. A. A. S. Botanical Club at New York.—The Botanical Club of the A. A. A. S. held its first meeting for this year Thursday, August 11, in the law building of Columbia College. In the absence of the chairman, Mr. M. S. Bebb, the Club was called to order by the secretary, Mrs. E. G. Britton, and Mr. Thomas Morong was elected chairman for the present meeting. About fifty were in attendance, and although the absence of some of the most active members was noted with regret, the Club went promptly to work with its accustomed vigor.

The first paper was read by Dr. W. J. Beal, on "The Root-stocks of Leersia and Muhlenbergia." This was followed by one on the "Dehiscence of the Sporangium of Adiantum pedatum," by Florence May Lyon, read in the author's absence by Prof. V. M. Spalding. Mrs. Britton then presented a list of plants of the vicinity of New York, collected by a committee of the Torrey Botanical Club, specimens of which were placed at the disposal of those present. The list includes a number that are of special interest as regards their distribution, and others, such as Cyperus Torreyi, for example, are new species.

Dr. George Vasey presented a written statement setting forth the claims of the National Herbarium, and a committee was appointed to take the subject under consideration with reference to some action on the part of the Club.

Friday, August 12, about sixty were present. The Club was called to order by the chairman. The committee appointed Thursday was called upon to report through Dr. Vasey, but as the committee had had no formal meeting, and was not ready to report, it was agreed to appoint a committee to consider the subject further, and act in behalf of the Club. This committee as appointed by the chair consists of Messrs. Asa Gray, W. M. Canby, and W. J. Beal.

A communication from Prof. E. S. Bastin, of the Chicago College of Pharmacy, was read, suggesting the desirability of concerted action on the part of botanists, and division of labor with reference to problems still to be worked out.

A letter from Prof. D. S. Kellicott, of Buffalo, was read, raising inquiries concerning the crackling sound of Utricularia vulgaris when taken from the water. Mr. Day, of Buffalo, followed with a few remarks. Prof. C. E. Bessey sent his greetings to the club, with regrets at being obliged to be absent.

A paper was next read by Prof. E. W. Claypole on "Some of the secondary results of pollination," which was followed by rather animated discussions on the part of a number of members.

Mr. A. A. Crozier then brought up the subject of the definition of some common botanical words, and Dr. N. L. Britton called attention to three new species of Cyperus that had come to light since his revision of the North America species of that genus. Mrs. H. L. T. Wolcott exhibited a specimen of yellow-fruited choke cherry, from Massachusetts, near Boston.

Monday, August 15, the Club was called to order by the chairman, Mr. Morong, over fifty being present. Committees on resolutions and nominations were appointed, the former consisting of Messrs. Day, Canby and Crozier, the latter of Messrs. Beal and Britton, and Mrs. Wolcott. The chairman suggested the advisability of securing a special room for the Club next year, to avoid annoying interruptions caused by the same room being used by the biological section.

The first paper was read by Mr. W. M. Canby, on the recently discovered fruit of Darbeya umbellulata, a species first collected at Milledgeville, Ga., and described by Dr. Gray in *Silliman's Journal*, in 1846. The plant belongs to the Santalaceæ, and has been referred by Bentham and Hooker to Buckleya. There are some characters that indicate a very close relationship to Comandra, but the new specimens tend to confirm Dr. Gray's opinion, that it is distinct from either genus.

Mr. A. A. Crozier illustrated a method of drying plants by means of an oven constructed for the purpose.

A letter was read from W. F. Moffat with reference to the proposed location in Lincoln Park, Chicago, of a statue of Linnæus, an exact counterpart of the one recently erected at Stockholm. The estimated cost is $30,000.

Mr. Morong introduced the subject of a national botanical exchange, on the plan of similar exchanges in Europe. A good deal of interest was manifested, and remarks were made by Messrs. Crozier, Beal, Britton, Fernow, Rusby and others. A committee consisting of Messrs. Vasey, Britton, Watson, Morong and Halsted was appointed with power to act for the Club, and report through the botanical magazines.

Mr. F. L. Scribner reported an interesting observation upon the ejection of the ascospores of Physalospora Bidwellii. Grapes affected with the black rot were gathered at Vineland, N. J., last year, and placed in a damp atmosphere, when after eighteen to forty-eight hours it was found that the ascospores had been ejected with some force and thrown against the walls of the chamber. Mr. Scribner also reported the spread of the black rot in France. The disease appeared there two years ago, and is now rapidly extending through the southwestern part of that country.

Tuesday, August 16. The nominating committee reported David F. Day as chairman, and Volney M. Spalding as secretary for the ensuing year. The committee on resolutions then reported resolutions expressing the great obligations of the Club to the members of the Torrey Botanical Club.

Prof. George Macloskie spoke of the hairs of watermelon seed as packed transversely, and when moistened extending and showing zigzag branching. Lists of the desiderata of the herbarium of the Department of Agriculture were distributed. Mrs. E. G. Britton spoke of the second blooming of Wistaria this year on Staten Island. The first flowers are seldom fertilized owing to the visits of the bumblebees, while the late flowers are visited in the normal way by another bee.

Mr. Morong asked if Typha angustifolia is always confined to the vicinity of the seashore, and T. latifolia inland. He invited observations on the distinguishing characters of these two species. He also asked for observations on Sparganium.

Mr. Sereno Watson said that Arabis petræa of the Manual must be dropped, as it is *Sisymbrium humile* Meyer (BOT. GAZETTE, xii. 200).

Mrs. M. L. Moody read a paper describing the discovery of Epipactis latifolia near Buffalo.

Mr. F. L. Scribner spoke of the remarkable abundance of Cercospora viticola at Fayetteville, N. C.

The Club then adjourned to meet next August at Cleveland.

OPEN LETTERS.

Relation of moisture to plant diseases.

The object of this note is that of inquiry, especially as to the value of the following opinions and observations:

It is the prevailing opinion that wet weather is favorable to the growth of parasitic fungi, and this is no doubt true in some cases at least. The spring of 1882 was a rainy one in Illinois, and a large number of Peronosporæ were collected. This year a large amount of rain has fallen in New England during July and August, and Uredineæ and Erysipheæ are less abundant than in dryer seasons. In dry autumns like that of 1886 in Central Illinois, fungi of these two groups are exceedingly plentiful. Water plants have few parasites, and plants of wet places less than those growing upon common soil. A. B. SEYMOUR.

Cambridge, Mass.

Bees mutilating flowers.

In the May number of the GAZETTE, in a note on Mertensia, Dr. J. Schneck suggests that the habits of bees to mutilate the corollas of flowers, in order to get at the honey, may be general. Appended are some notes on the subject.

Aquilegia vulgaris L. is mutilated by humblebees. The insects puncture the spur a little above the bulb at the end.

Lonicera parviflora Lam. is punctured just above the calyx.

Weigela (Diervilla, cult. specs.), punctured by humblebees. Honey bees enter the tube.

Orchis spectabilis L. Slits made in lower end of spur.

Aquilegia Canadensis L. Spurs punctured just above bulb.

Mertensia Virginica DC. In May number of BOTANICAL GAZETTE Mr. Schneck mentions Mertensia as being mutilated. A few days after seeing the note I happened to find a patch of that plant and watched the bees at work. They generally punctured the tube, but occasionally a bee would light on the mouth of a tube, insert his head, and then by a sudden movement of the wings cause the honey to drop down upon his head and then suck it up through his proboscis.

Lonicera grata Ait. Reported by Nathan Banks from Roslyn, L. I.

Tropæolum major. Reported by Nathan Banks. "Often 2-5 punctures in the same spur."

Impatiens fulva Nutt. Sometimes the end of the spur is bitten off.

Linaria vulgaris Mill. Slits are made in the spur.

Poughkeepsie, N. Y. GILBERT VAN INGEN.

CURRENT LITERATURE.

Revision of North American Linaceæ. By William Trelease. From Trans. St. Louis Acad Sci., Vol. v., no. 1, pp. 1-20, with 2 plates.

Twenty-one species are described, the two plates representing the fruit of the genus and the petals and filaments of the section Hesperolinon. L. perenne of American botanists becomes *L. Lewisii* Pursh. L. Floridanum is brought to specific rank from a variety of L. Virginianum.

Our species are all clearly endemic with one exception, L. Lewisii. The European forms of L. perenne are heterogone-dimorphic and self-sterile, while the American representative is not heterogone. "It appears, therefore, that forms of a single species, originally distributed over the northern portion of both continents, have in the course of time differentiated so far as to acquire heterogeny in the Old World, or lose it in the New—the latter appearing more probable."

Contributions to American Botany, XIV. By Sereno Watson. From Proc. Am. Acad., xxii., pp. 396–481.

Most of this contribution is given to the enumeration of plants collected by Dr. E. Palmer in Mexico in 1886. It contains the usual percentage of new species that always rewards the labors of the diligent collector in Mexico. This collection was made about Guadalajara, state of Jalisco, as a center, and of all the localities, Tequila, a deep volcanic depression twenty miles northwest of Guadalajara, yielded the most novelties. Of the 675 species enumerated 120 are new, 40 new Polypetalæ by Watson, 45 Gamopetalæ by Gray, 30 Apetalæ and Monocotyledons by Watson, 2 Grasses by Vasey, and 3 Ferns by Eaton. A new genus of Asclepiadaceæ is Mellichampia, dedicated to our well-known southern botanist; Corythea is a new genus of Euphorbiaceæ, and Prochnyanthes a new genus of Agaveæ. In the second part of the contribution are descriptions of 44 new species from various localities, chiefly western. Arabis Drummondii of the Atlantic region all becomes the new species *A. confinis* Watson. True A. Drummondii is confined to the western mountains. In recasting this genus Mr. Watson has found it necessary to propose 6 new species of Arabis, all belonging to the section Turritis, and all western. Podistera is proposed as a new genus of Umbelliferæ, nearly related to Pimpinella, its type being Cymopterus (?) Nevadensis. Peucedanum graveolens of Bot. King's Exp. becomes P. Kingii, owing to prior publication of the former name in the Genera Plantarum. It is also *Seseli Nuttallii* Gray, in large part. *Quercus Sadleriana* R. Brown finds a place among the western oaks, and *Q. Breweri* Eng. is replaced by the earlier name of *Q. Œrstedtiana* R. Brown.

Fresh-water Algæ of the United States (exclusive of the Diatomaceæ), complemental to "Desmids of the United States." By Rev. Francis Wolle. Bethlehem, 1887. Roy. 8°. 2 vol., pp. 364, 151 plates.

This work has been long expected, and meets with a warm welcome. No part of the American flora is so much in need of careful systematic treatment as the algæ. The work of Dr. Wood, long since out of print, was unhandy in form and confessedly incomplete, but has been the only work to do service as a manual up to the present time.

The excellent volume on the "Desmids of the United States," issued some time ago by the same author, has led to the expectation of an equally satisfactory treatment of the remaining non-siliceous fresh-water algæ. In the matter of characterization of species, illustrations, which are abundant and excellent, and general typographical features, the expectation is realized; but in the discussion of imperfectly understood forms and in classification and arrangement, the work is disappointing. The preface, the introduction, and paragraphs here and there through the work, altogether forming many pages, are devoted to elucidating the author's views of polymorphism among algæ, and the consequent unreliability of descriptions of many so-called species as representing specific and stable forms. The theme is evidently a hobby, and so thoroughly permeates the work as to leave an uncomfortable feeling in the mind of the student that there is great and discouraging uncertainty regarding the stability and limits of species among fresh-water algæ, especially of the simpler forms. We regard the discussion as in the main foreign to the purposes of the work and as interfering with its usefulness.

The classification used does not commend itself for either philosophical arrangement or serviceableness. It is not explained; and there is no general key or analytical table to guide the student. A few genera are provided with an outline or key to the species adapted from other writers, notably of Œdogonium and Bulbochæte from Wittrock, Spirogyra from Petit, and Nostoc from Bornet and Thuret.

The volume closes with a good glossary and index, the latter inconveniently divided into two parts, one containing the names used and the other the synonyms.

Aside from imperfections, students will welcome these volumes as giving in connected and handy form the descriptions of our inland algæ, with copious and well drawn illustrations.

Practical Forestry, A treatise on the propagation, planting and cultivation, with a description and the botanical and common names of all the indigenous trees of the United States, both evergreen and deciduous, with notes on a large number of the most valuable exotic species. By Andrew S. Fuller. 12mo., pp. 300. New York: Orange Judd Co.

The above rather elaborate title-page sufficiently describes the scope of this book. The description of the species occupies the larger part (about 200 pages) and should be the most valuable part. But by reason of the faulty arrangement and the uneven descriptions its usefulness will be greatly lessened. The chief value of collected botanical descriptions of the arboreous plants of any region must be to enable one to determine the name of an unknown specimen. It is much more rarely that one knowing the name wants a description. How can the descriptive part of this book help any one while the genera are arranged *alphabetically* and without keys of any kind?

The author is evidently not a botanist, and when he unnecessarily undertakes to discuss synonymy he flounders in the mire of preference and convenience rather than stand upon the sometimes uncomfortable rock of priority. "The novice who desires to find an authority at once unimpeachable and so thoroughly trustworthy that it may in all cases be quoted without fear" is warned that "even in such a simple matter [*sic*] as names of the different species of conifers, authors disagree!" Verily, they do. In the first part of the descriptive chapter the authorities for the names used are not given, though they appear in the index. Synonyms are given only in the index, and there *only below the accepted name.*

A queer set of chapter headings appear in the descriptive part. Thus chapter xv is headed "forest trees;' chapter xvi treats of "evergreen trees," including only Taxus, Torreya, Podocarpus, Dacridium and "Salisbury;" while chapter xvii is entitled "Coniferæ, or cone-bearing trees." What have the conifers done that they must be excluded from the forest trees, and not be allowed to associate with the evergreens?

Of course, the descriptive part is largely a compilation. The first eighty pages, containing chapters on raising trees from seed, budding and grafting, propagating by cutting, pruning, etc., has much useful information, though little that is new. With the author's plea for the preservation of our forests and the systematic establishment of new ones by the state or general government we are in hearty accord, and we sincerely hope that his book may do good in interesting farmers in such work, as it may come to their hands. But we can not get rid of the impression that the book before us was gotten up chiefly *to sell.* We do not therefore feel, as the author avows regarding Henderson's *Evergreens,* that we "can confidentially recommend it."

Vergleichende Anatomie der submersen Gewächse, by Dr. Heinrich Schenck. (Bibliotheca botanica, Heft 1.) Quarto, pp. 67, plates x. Cassel: Theodor Fischer. 1886.

This, the first memoir of a series under the general title "Bibliotheca botanica, Abhandlungen aus dem Gesammtgebiete der Botanik, herausgegeben von Dr. Oscar Uhlworm und Dr. F. H. Haenlein," is in every way worthy to lead the van. A publisher in this country who should undertake to put out such a collection of monographs would be thought mad by his fellows. Botanists are to be congratulated that there is one country and at least one publisher to do such work. Those who know Fischer's work need not be assured that both text and plates are worthy the *imprimatur.*

The memoir before us is a continuation of the author's earlier work, *Die Biologie der Wassergewächse,* and in it he traces the modifications of structure due to the different medium of growth and the consequent functional differences in various organs. The structure of leaves, stems and roots of over thirty species is compared in detail. Many observers have studied submerged plants but no one has ever before brought together the results into a complete comparative study. Some of the generalizations are highly interesting.

The leaves of most submerged plants show a tendency to become slender and hair-like or grass-like, and show little differentiation in the parenchyma, which consists usually of very few layers. The epidermis generally contains chlorophyll bodies and lacks stomata. The vascular bundle is either single or accompanied by two other weakly developed strands. In the stem the vascular system is either reduced, as in Zannichellia, to a single bundle in which only the sieve-cells can be definitely distinguished, or it consists of several well developed bundles coalescent, as in Potamogeton nitens. Between the two extremes there is every gradation. In the bundles one or more lysigenous passages occur which occupy the position of the large vessels, and at the nodes, where the stretching has been too small to destroy them, are fragments of these spiral or annular vessels.

As would be expected, the mechanical elements are but scantily developed. Hairs, crystal and tannin reservoirs are rare, while oil-glands, latex vessels and resin ducts are always wanting. The root system may be entirely suppressed as in Utricularia or fairly developed in more amphibious species.

This series of monographs, by reason of the elaborate work and the elegant illustrations which accompany it, should be in every working laboratory in this country.

Über die Gerbstoff- und Anthocyan-Behälter der Fumariaceen und einiger anderen Pflanzen. By Dr. W. Zopf, Privat-docent, University of Halle. (Bibliotheca botanica, Heft 2.) Quarto, pp. 40, 3 double colored plates. Cassel: Theodor Fischer. 1886.

This is the second paper of the same series. The colored plates are exquisitely done. We can not do better service to our readers than to give a brief abstract of Dr. Zopf's very careful work.

The relation of the Fumariaceæ to the Papaveraceæ suggested to the author that he examine them to discover, if possible, the structures corresponding to the latex vessels of the Poppy family. The analogous cells, which he designates as idioblasts, occur in all organs in the primary parenchyma, and also in those tissues which arise in the secondary thickening of the organs. The primary idioblasts arising from the primary meristem are elongated cells (2–10 mm.) without branches; the secondary, arising in the cambium of the vascular bundles, are at first of the same size as the cambium elements, but afterward elongate. In each at least one nucleus was found, and large quantities of tannic acid, commonly in the form of a clear, homogeneous and highly refractive solution, which may be colorless or dyed by a yellow or red anthocyan. Colorless or yellow idioblasts quickly become red when the organs containing them are exposed to light. Micro- and macro-chemical experiments indicate that the yellow pigment is converted into the red by acids, and it seems probable that the same action occurs in the living plant under the influence of light by the formation of organic acids. The yellow anthocyan appears to develop from a colorless chromogen. These pigments have a definite relation to the tannin; but whether part of the tannin is converted into chromogen or whether the latter is formed new in the presence of the tannin is undetermined.

The plants investigated were Corydalis cava, C. pumila, C. Halleri, C. ochroleuca, C. lutea, Diclytra spectabilis, D. formosa, Adlumia cirrhosa; Fumaria officinalis, F. muralis, Parnassia palustris and Parietaria diffusa.

NOTES AND NEWS.

PROFESSOR C. E. BESSEY made a collecting trip to the Bad Lands and Black Hills of Dakota during vacation.

PROFESSOR L. M. UNDERWOOD, of Syracuse University, is making a two months' collecting trip through the Southern States.

THE FIFTH VOLUME of Saccardo's *Sylloge Fungorum*, devoted to the Agaricineæ, has been issued. It is a thick octavo of 1146 pages, price 72 francs.

DR. A. DE BARY has declined the call to Leipsic as Dr. Schenk's successor, and the professorship has been tendered to Dr. W. Pfeffer, of Tübingen.

DR. GEORG WINTER, editor of *Hedwigia*, and known to many American botanists by correspondence, died at Connewitz, near Leipzig, Germany, August 16, after a long and severe illness.

IN Dr. Farlow's address, printed in the August GAZETTE, an error occurs on page 180, which should be corrected. In the 13th line from the bottom the "not" should be stricken out, which materially alters the sense.

CHARLES S. PLUMB, of the New York Agricultural Experiment Station, and editor of *Agricultural Science*, has accepted the professorship of Agriculture, Botany and Entomology in the University of Tennessee, situated at Knoxville.

THE FIRST FASCIDE of volume 5 of the bulletin of the *Sociedade Broteriana*, bearing date of 1887, is chiefly devoted to a systematic description of the native orchids of Portugal by José d'A. Guimaraes. Thirty-nine species and nine genera are included.

TWELVE NEW SPECIES of North American mosses have recently been described by Dr. Karl Müller (Halle) in *Flora*, No. 14, pp. 219-225. They were collected in Alaska, Colorado, California, Tennessee and Florida. A new species from Labrador is described by Philibert in *Rev. Bryologique*, 1887, p. 55.

BABYHOOD for August has a timely article on poisonous plants, illustrated by accurate wood-cuts. Mothers and nurses are thereby warned against Rhus Toxicodendron, R. venenata, Phytolacca decandra, Conium maculatum, Solanum Dulcamara, Veratrum viride, Datura Stramonium and Hyoscyamus niger. The author should have specified more particularly the poisonous parts of these plants and whether they are poisonous by contact or when eaten.

A CORRESPONDENT, W. L. Morris, of Des Moines, Iowa, sends to the *Gardeners' Monthly* specimens of Aphyllon fasciculatum growing upon zonale geraniums. The geraniums were raised in pots and from cuttings since October last. The parasites were attached to the roots, and one to the buried stem of the cutting. They probably started from seeds in the potting soil taken from the woods.

THE *Journal of the New York Microscopical Society* is now issued quarterly, instead of in nine numbers a year as heretofore. The price remains unchanged. The two numbers, which form half of the present yearly installment, have been received, and together contain twenty-six pages, seven of which are devoted to original articles and the remainder to the minutes of the society and lists of the publications received.

THE COMMITTEE of the A. A. A. S. to secure more favorable ruling from the U. S. postal officials for the transmission of botanical specimens through the mails made no report at the New York meeting, and the committee was discontinued. The subject was agitated and a committee appointed at the earliest meetings of the Botanical Club, immediately after its organization, and strong efforts in various directions have been made to secure the object in view, but to no purpose. It is to be hoped that some means may yet be found for its accomplishment.

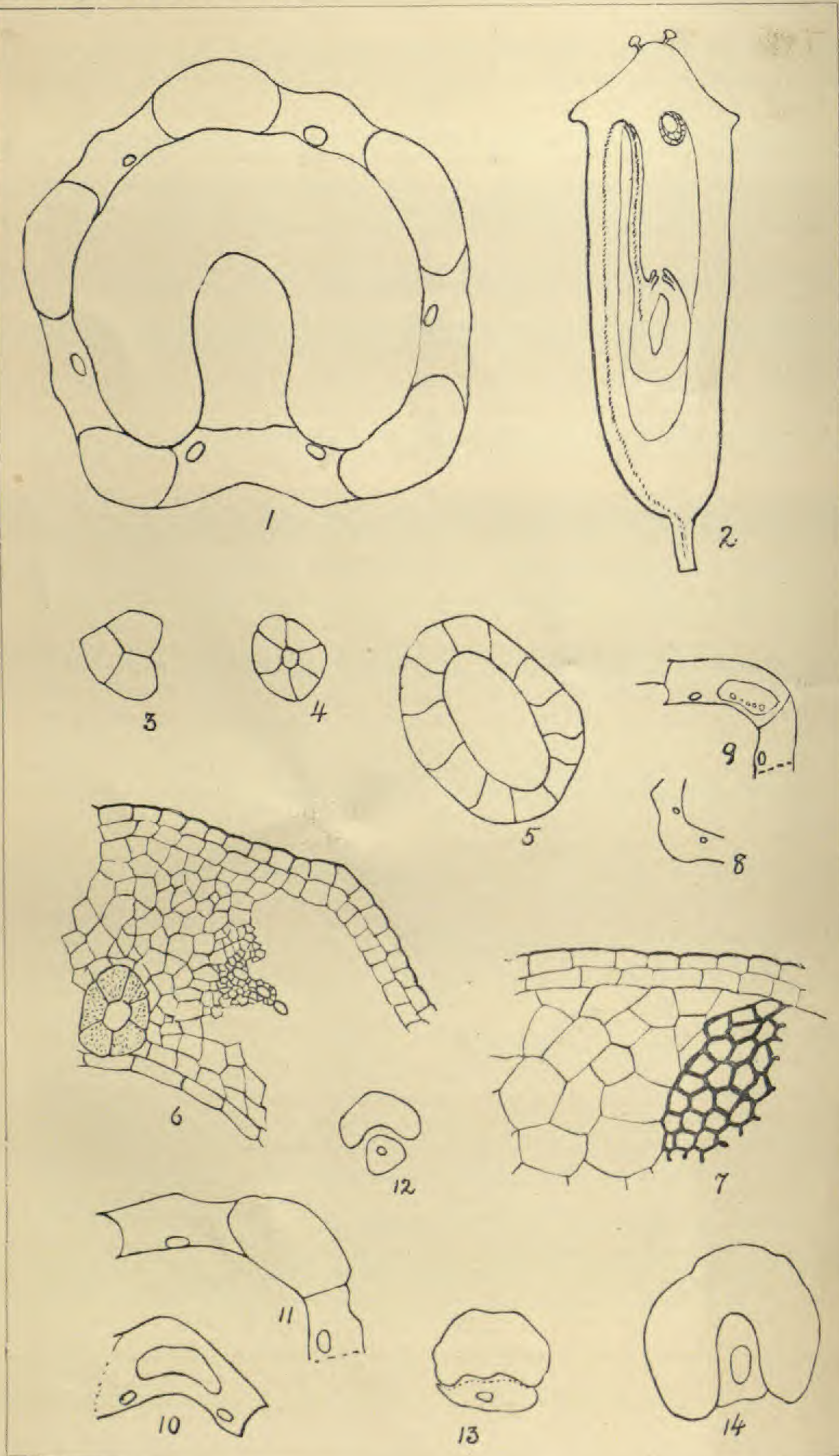
PROFESSOR L. F. WARD and Mr. F. H. Knowlton are collecting fossil plants in the Yellowstone National Park. The latter is giving particular attention to fossil woods, and already has nearly 300 specimens, each representing a separate tree. He writes: "Yesterday I noticed the largest fossil forest that I have yet seen. The largest tree measured twenty-six feet in circumference, and was about twelve feet high. Numerous others still standing ranged from two to seven feet in diameter and five to twenty feet in height, while the ground was literally covered with fallen logs and debris."

OUR READERS very well know the wide divergence of opinion as to the tubercules on roots of Leguminosæ. On June 16 Prof. H. Marshall Ward read a paper before the Royal Society, London, "On the tubercular swellings on the roots of Vicia Faba." Prof. Ward finds a definite fungus, whose affinities are with the Ustilagineæ, living in the tissues of the tubercle and producing by budding at the ends of the hyphæ the minute, germ-like bodies which have been mistaken for bacteria. He has succeeded in infecting the roots of Vicia growing in sterilized soil and in water with this fungus, and has watched its development. The hyphæ enter the root-hairs, cross the cortex and break up into fine branches.

THE REPORT of the Department of Agriculture for 1886, recently issued, contains interesting botanical matter. The botanist's report deals with the history of the division, an account of its work, descriptions of native clovers of economic interest, with five plates, and an article on the weeds of agriculture, by A. A. Crozier, with sixteen plates. The mycologist's report treats of diseases of the grape, celery-leaf blight, orange-leaf scab and potato rot, with seven plates, two maps showing distribution of mildew and black rot of the grape, and diagram showing loss from potato rot, together with an article by J. C. Arthur on pear blight, with a map, and one by W. Trelease on a spot disease of grass, with plate. The report of the forestry division is especially devoted to the practical work of forestry. The report of the bureau of animal industry contains considerable matter relating to bacteria, with several plates showing different forms and colored illustrations of cultures.

ABOUT TWO YEARS ago Mr. Charles Aldrich, of Webster City, Iowa, while making a collection of autographs, wrote to Grant Allen, of England, well known to our readers by his entertaining books on botanical subjects, and received a letter in reply which has recently been published in the *Critic*. The letter contains a statement of what is apparently one of Mr. Allen's inmost grievances; we take from it the following sentences: "For ten years I have been fighting a hard battle against poverty, in writing scientific works; and now I am just being compelled to retire from the hopeless contest and take to penny-a lining for a livelihood at vulgar stories." He ascribes this in some measure to the lack of an international copyright, and says, "While there is only a very small and non paying audience in England for popular scientific books, there is a very large and paying audience in America," the latter buying pirated editions of his works from which he receives no profit. He adds: "I feel it all the harder because I was myself born in America, brought up on one of the Thousand Islands, and taught my first rudiments of higher education beneath the shadow of the elms at Yale College, New Haven."

THE SOCIETY for the Promotion of Agricultural Science held its annual meeting in New York August 8 and 9. The attendance was good and the programme an interesting one. The following is a summary of the papers containing items of botanical interest: "Some suggestions as to experimenting with grasses," by W. J. Beal, formulated the methods by which the best tests of the economic value of grasses can be obtained. "The peg in germinating cucurbitaceous plants," by B. D. Halsted, gives the origin, development and service of this temporary organ. "A hint as to nitrogen appropriation in clovers," by B. D. Halsted, in which the author suggests that the bacteria, which he finds in a slimy envelope about the root-tips of clover, assist in nitrification, and thus render this crop so superior as an accumulator of nitrogen over timothy, which does not possess this special feature. He also thinks that the tubercles on roots of the Leguminosæ aid in the same manner by the active particles within them, which he determines by staining tests to be bacteria. "Hog cholera and swine plague," by D. E. Salmon, contains further data and observations relating to the two distinct germs which severally produce these diseases. "On a new fungus disease of the vine—Greeneria fuliginea," by F. L. Scribner and Pierre Viala, describes an "imperfect" fungus found on the fruit and pedicels of cultivated grapes in North Carolina; both the genus and species are new. "Sorghum as a sugar producing plant," by Harvey W. Wiley. "The absence of certain native plants in soils containing a large percentage of lime," by W. R. Lazenby, is an attempt to explain the distribution of the American chestnut, and of blueberry, huckleberry, trailing arbutus, and other members of the heath family by the amount of lime in the soil. "Old English vegetables," by E. L. Sturtevant, is an enumeration of the plants mentioned in a cookbook intended for the nobility of the time of Richard II, published in England about 1390. "The relative times of germination, leafing, blossoming, and size of fruit of species of American grapes," by T. V. Munson, gives important data in tabulated form of twenty-one species of Vitis in the United States, including one inedited species—V. Texana.



COULTER and ROSE on DEVELOPMENT OF THE UMBELLIFER FRUIT.

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Development of the Umbellifer Fruit.[1]

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE XIV.)

In no family of plants does the fruit furnish more certain diagnostic characters than in the Umbelliferæ. So definite are they that the fruit alone can be made to determine the genus, and in most cases the species, while in every case it is an essential part of the description. This indicates at once an unusual amount of differentiation in the fruit structures, and a great diversity in its display. During the past year we have been making a critical examination of all our Umbelliferæ east of the 100th meridian, and this has directed our special attention to the minute structure of the fruit of all our species. This study has shown that while the grouping of these structures is very diverse, and hence available for diagnostic purposes, the structures themselves are simple and few in number.

It was a matter of interest to study the development of these peculiar structures, and for this purpose the common Chærophyllum procumbens was selected as a type, as its fruit contains all the structures found in the family. Beginning with ovary wall composed of undifferentiated parenchyma, supported by simple fibro-vascular elements, the changes wrought in the maturing ovary and then in the ripening fruit were traced.

A description of the structure of the mature fruit of Umbellifers in general will make plainer the questions to be answered by a study of its development. The two carpels face each other, and are in contact at first by their commissural or ventral faces, but eventually separate. The fruit is compressed laterally (at right angles to the plane of the commissural faces) or dorsally (parallel with the commissural plane), or not at all. As the two carpels are but repetitions of each other, a description of structure may be confined to a single one. The surface of the carpel is usually marked by five ribs or wings longitudinally placed. The two nearest the commissure are the laterals; a single dorsal one occurs on

[1]Read at the meeting of the A. A. A. S., New York, August, 1887.

the back of the carpel, while the pair between the dorsal and the laterals are the intermediates. In addition to these five primary ribs or wings secondary ones may appear (as in Hydrocotyle Asiatica), and even become more prominent than the primary ones (as in Daucus and Trepocarpus); or occasionally even all external indications of ribs may be lacking (as in Sanicula). The presence of these ribs or wings, their varying size and structure, furnish good diagnostic characters. At the summit of each carpel a stylopodium may be developed, of various appearance, from prominently thick conical to a flat or depressed cushion.

The general structure of the pericarp wall well represents the typical leaf structure, with under and upper (that is, outer and inner) epidermal layers bounding a more or less developed mesophyll (figs. 6, 7). It is in the mesophyll region that the characteristic fruit structures are developed. The constant occurrence in the outer epidermal region of the two distinct layers of epidermal cells suggests that the outer layer represents the connate calyx, while the inner is the true epidermis of the pericarp. The mesophyll region of the pericarp is naturally separated into three structures: (1) oil-ducts, (2) strengthening cells, and (3) undifferentiated parenchyma.

I. Oil-ducts.—These occur in varying number, size and position in the different genera, and are of such constancy as to furnish most valuable characters. By far the most common position for oil-ducts is in the intervals between the ribs, where they occur singly or in groups. In this position they may occur close against the inner epidermal layer, or centrally in the pericarp section, while in Cryptotænia and Erigenia they seem to be developed in the inner epidermal layer itself. In Æthusa, Cœlopleurum and Cryptotænia oil-ducts occur both in the intervals and beneath the ribs. In some cases, as in Polytænia, there are two sets of oil-ducts, one forming almost a continuous layer about the seed-cavity, the other composed of smaller ducts, and scattered through the very thick pericarp. In Zizia there are also smaller accessory ducts in the ribs. In Conium there is no development of oil-ducts, but the whole inner epidermal layer of the pericarp becomes a secreting layer. In Hydrocotyle, on the other hand, in the absence of oil-ducts groups of secreting cells occur just beneath the outer epidermis of the pericarp, and in some species eventually break through it, forming superficial oil vesicles. Anthriscus and some Bupleurums have neither oil-ducts nor secreting cells. In Osmorhiza the mature fruit usually gives no trace of oil-ducts, while the immature fruit may show groups of four to six oil-ducts in the intervals and one to three in the ribs themselves. The obliteration of oil-ducts on approach to maturity would seem to make them represent aborted organs in this case, and may account for the discrepancy of opinion concerning the oil-ducts of certain genera. It is an interesting fact that this suppression of oil-ducts seems to involve the formation of an oily layer. In Osmorhiza the mature fruit has an oily layer about the seed, a region occupied in the immature fruit by a distinct line of oil-ducts. In Hydrocotyle, however, the isolated groups of secreting cells are such as always precede the formation of oil-ducts. In Hydrocotyle, therefore, the oil-ducts could be called rudimentary; in most Umbellifers they are oil-ducts proper; in Conium a secreting layer has been developed; while the development of the Osmorhiza fruit gives us distinctly all three phases. Hence, to summarize: (1) most genera have distinctly developed oil-ducts, variously placed, (2) a few have a layer of secreting cells, (3) some have groups of secreting cells, and (4) others have neither oil-ducts nor secreting cells, in fact, without any representation of this one of the three structures of the mesophyll.

II. Strengthening cells.—Under this name we would define certain groups of cells, which are unlike enough in structure, but seem to serve the common purpose of strengthening the pericarp wall or its ribs. They usually occur beneath each rib, and are normally developed about the simple fibro-vascular elements of the pericarp wall (fig. 6). These fibro-vascular elements may eventually become obliterated. The group of strengthening cells may consist of fibrous tissue, sclerenchyma, sclerenchymatous parenchyma, or small-celled parenchyma. It may be well marked off from the surrounding tissues, as in the distinct thick-walled groups of Osmorhiza, Cryptotænia, Conium and Chærophyllum (figs. 1 and 7); or it may gradually merge into the surrounding tissue, as in Angelica, Thaspium, etc. In Hydrocotyle, Pastinaca and Heracleum the strengthening cells are developed in a broad continuous band about the seed-cavity; while in Sanicula, Conioselinum and Æthusa they seem to be entirely wanting. In the last named genus they may be found in the very tips of the prominent ribs, the position usually held by strengthening cells being occupied by large and loose parenchyma, the other structures remaining normal. Strengthening cells are thus unlike in elements and position, are in groups of varying size and distinctness, or in bands, or may be wanting entirely. From these facts important characters may be obtained for generic grouping.

III. UNDIFFERENTIATED PARENCHYMA.—This has merely the negative character of not being transformed into either strengthening or secreting cells. Its abundance is dependent upon the development of the strengthening cells. It will be seen, however, that although it furnishes no diagnostic characters, it is probably most concerned in the growth of the pericarp.

Each carpel primarily contains two ovules, one of which soon becomes aborted (fig. 2), although it is developed sufficiently to display its nucellus and integuments, as well as its anatropous character. The other ovule eventually occupies the whole space of the ovarian cavity.

The fibro-vascular connection of the ovules with the plant axis is as follows: A fibro-vascular bundle enters each carpel at its base, thus making it a lateral out-growth from the axis, while the axis itself continues its growth in the carpophore. The carpellary bundle almost at once subdivides into five branches, and these branches ascend the carpellary wall beneath the five primary ribs.

The two lateral bundles (that is, those beneath the lateral ribs) are the largest, as they contain the fibro-vascular elements to be distributed to the ovules. These lateral bundles pass in the carpellary wall to the very summit of the carpel, and then send a branch inwards and downwards into the funiculus of the anatropous ovule (fig. 2). The remaining elements of the fibro-vascular bundle pass on to the floral organs and stylopodium. It will be seen that in this case, as in Compositæ, the ovules are lateral outgrowths. A point or two in the development of the ovule may be mentioned in this connection. At first both ovules lie at the summit of the ovarian cavity, but soon, by the development of the funiculus, one is thrust toward the bottom, with the micropyle near the center of the cavity (fig. 2). It is in this position that the pollen tubes are seen to enter the micropyle, and subsequently the ovule develops so as to fill the ovarian cavity. The aborted ovule is retained at the summit of the cavity, its funiculus never developing, and its micropyle out of reach of the pollen-tubes, even if its nucellar structures were developed to receive them.

To recur now to the mature seed, it will be found to consist mainly of a much developed embryo-sac, filled with endosperm and a small embryo. The embryo-sac never entirely replaces the nucellus, more or less of the nucellar tissues being found on the commissural side, either pressed against the flat or concave face of the embryo-sac or embraced in its infolding (figs. 12, 13, 14). Important characters have been obtained from the commissural face of the seed, based upon the fact that it may be convex, plane, concave, or more or less involute. Great care should be exercised, however, to obtain seed of perfect maturity, or a comparison on this basis will amount to nothing. All seeds at first have a convex or plane face, and the amount of concavity or infolding will depend upon the development of the embryo-sac. In some cases the embryo-sac, instead of developing uniformly, develops strongly towards the commissure on the two sides, resulting in a concave or involute seed-face. This variation may occur in the mature fruits of a single species (as in Eulophus), so that there may be found plane or concave seed-faces in one and the same plant.

Having described the structures to be found in the mature fruit in general, it remains to describe the method of their development in Chærophyllum procumbens.

I. Development of oil-ducts.—In very young buds groups of 3 or 4 parenchyma cells of the pericarp, next the inner epidermis, begin to be set apart for the formation of oil-ducts (fig. 3). The first indication of this is in the fact that they become secreting cells, and are discolored by the characteristic oily contents, and also become larger than the surrounding parenchyma cells. The 3 or 4 secreting cells then begin to divide radially, so that, at about the time of anthesis, the resulting intercellular space becomes an oil-duct of small caliber, with 6 to 8 secreting cells (fig. 4).

This radial division continues as the fruit matures, thus gradually enlarging the caliber of the duct, until it reaches its full size, with a dozen or so secreting cells (fig. 5). The ducts are thus enlarged intercellular spaces, developed by the radial division of the surrounding secreting cells, and simply act as reservoirs.

In Hydrocotyle (in which there are only groups of secreting cells and no ducts developed) the absence of ducts seems to be explained by the lack of power of radial division in the secreting cells. In Osmorhiza this power is also poorly developed, so that while the ducts are at first outlined, they are presently encroached upon and obliterated by the development of contiguous cells, thus forming a continuous oily layer composed of obliterated ducts and intervening secreting cells. In Conium no ducts are developed, because groups of cells are not set apart as secreting cells, but only a single layer of cells, and there can thus be no development of intercellular spaces, although the power of radial division is retained. Hence Hydrocotyle has no oil-ducts because its secreting cells lack the power of radial division; Conium has none because its secreting cells are in a plane instead of in groups; while most Umbellifers have oil-ducts because their secreting cells are in groups, and also have the power of radial division. The only other phase is the entire absence of secreting cells, as in Anthriscus and certain Bupleurums.

II. Development of strengthening cells.—In young buds there is no setting apart of this region from the ordinary parenchyma of the pericarp wall (fig. 8). Upon approaching anthesis, however, the parenchyma cells surrounding each fibro-vascular bundle sub-divide (fig. 9), and at anthesis quite a distinct group of small parenchyma cells is discovered beneath each rib (fig. 10). This comparatively small size is due not only to cell division and moderate growth but also to the strong growth of the surrounding undifferentiated parenchyma. While the region is indicated before anthesis it does not become really a region of strengthening cells until the development of the fruit. It is then that the walls begin to thicken, until at maturity a group of strengthening cells is composed of firm, heavy-walled tissue (fig. 7). The contained fibro-vascular elements are encroached upon, and for the most part obliterated, as they are really functionless after anthesis. This differentiation proceeds centrifugally from the fibro-vascular elements as a center, at first a comparatively small area being included. The surrounding parenchyma is gradually invaded, until in some cases the whole thickness of the pericarp wall is concerned (figs. 1 and 11). The amount of primary parenchyma transformed into strengthening cells varies widely. In Chærophyllum this structure reaches probably its maximum development, occupying the whole thickness of the pericarp wall, separating the undifferentiated parenchyma into isolated patches, and also being very thick-walled. In certain genera the strengthening-cell groups of the mature fruit are in the same condition as those of Chærophyllum at anthesis, viz.: differing from the surrounding parenchyma only in smaller size, and never becoming thick-walled, as in Angelica. Continuous bands of strengthening cells, as in Hydrocotyle, are always developed next to the seed cavity, in the same position as the continuous secreting layers. Hence we find strengthening-cell structures developing in bands or groups, and when in groups they may become thick-walled or not. In certain genera this kind of differentiation is entirely lacking, while in Æthusa we find the anomalous feature of the strengthening-cell regions developing a large-celled and loose parenchyma.

III. DEVELOPMENT OF UNDIFFERENTIATED PARENCHYMA.—This region, lying between the strengthening-cell groups, is chiefly concerned in the development of the pericarp wall in size. After anthesis there seems to be but little increase in the thickness of the pericarp wall, the growth being chiefly extension. This extension is effected by the radial division of the undifferentiated parenchyma cells, the amount of tangential cell division being comparatively small. The exception to this is found in ribs and wings, which represent regions of strong tangential cell division in the undifferentiated parenchyma.

In this way the three structures of the pericarp wall are built up, and in their endless, but simple and constant variations, we find a clew to the classification of a group of plants otherwise hopelessly confused.

EXPLANATION OF PLATE XIV.—All the figures are from Chærophyllum procumbens Fig. 1, Cross section of mature carpel, showing large strengthening-cell areas; small solitary oil-ducts in the intervals, two on the commissural side; and a deeply sulcate seed-face. Fig. 2, Longitudinal section of carpel at anthesis, showing abortive ovule; developing ovule thrust down into ovary cavity ready to receive pollen-tubes seen at summit of stylopodium, and which should have been represented as passing through the ovary cavity and entering the micropyle; and fibro-vascular connections of ovule. Figs. 3, 4 and 5, Development of the oil-duct. Fig. 6, Section of ovary wall at anthesis, showing beginning of a strengthening cell group about the simple fibro-vascular elements; a developing oil-duct; and inner and outer epidermal layers, the latter of two layers, probably indicating a connate calyx. Fig. 7, Mature strengthening cells, sharply marked off from surrounding parenchyma. Figs. 8, 9, 10 and 11, Development of strengthening cell area, fig. 10 being taken at anthesis. Figs. 12, 13 and 14, Cross sections of developing seed.

Insect relations of certain Asclepiads. II.

CHARLES ROBERTSON.

On the ground of usefulness to Asclepias, butterflies may be thrown into three divisions. The Papilios are the most useful, and pollinia were found on all of our species except Ajax. They suck with their wings in motion. Using their legs to offset the motion of the wings, they rapidly repeat those movements which are necessary to draw the pollinia from the anther cells and insert them into the stigmatic chambers. Other large butterflies, like Danais, hold their wings still in sucking, spending more time on an umbel, but generally carrying pollinia. Small butterflies are worse than useless. They remain long on the umbels, sucking, but resting their feet superficially on the flowers, and seldom effecting pollination. Of twenty-three species bearing pollinia, only three are smaller than Chrysophanus Hypophleas; while of twelve species on which no pollinia were found, with the exception of Eudamus Tityrus, which was not caught, the Chrysophanus is the largest. As stated before, butterflies have corpuscula on their claws less frequently than Hymenoptera.

Since several moths were found entrapped on the flowers, pollination must often be brought about by night-flying Lepidoptera.

As a rule, Diptera either do not transfer pollinia at all, or become hopelessly entangled when they do. I have specimens of Eristalis, Trichopoda and Sarcophaga with several pollinia. In contrast with Bembex, mentioned above, certain flies, which resemble wasps in form and colors, also imitate them in their movements on the flowers and extract pollinia more readily than other flies. These are Physocephala, Conops and Midas. The legs of Midas clavatus sometimes bristle with pollinia of A. verticillata and incarnata. Corpuscula were found on the pulvilli, hairs and tongues of flies, never on their claws.

Beetles which visit the flowers to gnaw, as Tetraopes, are injurious, while those visiting them for nectar, Trichius, Euphoria and Chauliognathus, are quite as useful as any flies.

Among Hemiptera, Podisus, which frequents the flowers to prey upon insects, and Lygaeus, which sucks the hoods regularly, both transfer pollinia.

It is evident that the flowers of Asclepias are adapted to fasten corpuscula upon the legs of insects, and that they catch the tongues only accidentally. However, I have found corpuscula on the tongues of one species of butterfly, two species of beetles, five flies, and twenty Hymenoptera.[10] Bees and wasps move about with their tongues partly extended, and it is natural, especially on the smaller flowers, that some of the appendages which they bear should be caught by the wings. Moreover, combinations of corpuscula are found on the tongues showing that pollination has been effected repeatedly in this way. I have a specimen of Bombus vagans with five corpuscula on tongue, one of B. Virginicus, with a combination of four corpuscula and one single corpusculum, and a Sphex with a combination of five corpuscula. In general, however, extraction of pollinia by the tongue appears to be of little or no use.

ACERATES LONGIFOLIA.—If we compare a flower of this plant with one of Asclepias, it will be apparent that the flowers are not particularly adapted to fasten their corpuscula on the legs of insects (fig. 3).[11] The hoods have no horn, and their tips are pressed against the gynostegium so as to close them. The angles of the wings, instead of being set between the bases of the hoods, are above them. The hoods, therefore, have the sole function of nectaries, and do not serve, as in Asclepias, to guide the legs over the slits.

The anther wings, from the corpusculum to the angle, measure hardly one millimetre, and are adapted to catch fine hairs, not the coarser processes.

Bumble-bees insert their tongues into the closed nectaries with great facility. They are the most common visitors, and the flowers seem to be especially adapted to them. A bumble-bee clasps several flowers between its legs, and, as it moves over the umbel, the abundant hairs on the under side of the thorax, abdomen and basal joints of the legs enter the slits and draw out the pollinia; so that the ventral surface of the bee fairly bristles with them. Fig. 4 is a sketch of Bombus scutellaris, showing the positions of attachment of the corpuscula. The specimen from which it was drawn has more than one hundred pollinia, with many corpuscula which have lost their pollinia, and is not an uncommon case. Hive-bees sometimes visit the flowers. On one I found thirty-three pol-

[10] Hildebrand found pollinia of A. Cornuti on tongues of bees. Bot. Zeit., 1866, No. 48.
[11] The figure references are to plate xii, issued with the September number.

linia, on another fifty-four. I have also found a pair of pollinia on a hair of the abdominal brush of Megachile. Next in abundance to bumble-bees, is Bembex nubillipennis, which rests so lightly on the flowers and has such short hairs that I have failed to find pollinia upon it, except in one case, mentioned below. One beetle, Trichius piger, caught on a Pycnanthemum, has eight corpuscula and eight pollinia on ventral surface. Butterflies rarely force their thin tongues into the nectaries, but do not extract the pollinia. Flies were not seen sucking.

In Acerates viridiflora, the tips of the hoods rise to the level of the style-table, while in this species they hardly reach to the angles of the wings, and it is interesting to observe the effect. In sucking, the insect's head is brought down so close to the tips of the hoods that the hairs on its face and tongue are often caught by the wings; indeed, it seems more natural for visitors of this Acerates to have pollinia on their tongues than for those of Aclepias. Pollinia were found on the hairs of the labrum and tongue of Bombus separatus, and on the labrum of Bembex nubillipennis. Fig. 5, a sketch of the face of Cerceris bicornuta, indicates the positions of attachment of three corpuscula with five pollinia. The specimen also has pollinia on the tongue, and five corpuscula with eight pollinia on ventral surface.

I have seen no combinations of pollinia of this plant, and it does not seem to need them, as it can attach an abundance of corpuscula directly to the hairs.

The pollinia turn with their blades parallel in about a minute after extraction. When the bee moves over the flowers a retinaculum with its pollinium is caught as the hair was before. When the pollinium has entered the stigmatic chamber and will go no further, the retinaculum is broken, leaving the pollinium in the cavity, and escapes from the slit without withdrawing the corpusculum at the top. That the corpusculum does not enter the chamber, but that each pollinium is inserted singly, I am satisfied is true in this plant as well as in Asclepias. It is hardly possible to see pollination effected, as in Asclepias Sullivantii, but I have found pollinia under conditions which indicate that they are introduced in the same manner. A pollinium is sometimes found in the stigmatic chamber with pollen tubes emitted, with its retinaculum projecting through the slit, and the corpusculum and the other pollinium hanging outside. Broken hairs in the cleft of the corpusculum show that it has lost its hold on the insect, instead of the retinaculum breaking and leaving the pollinium behind. Mansel Weale found pollinia of *Xysmalobium linguæforme* Harv., attached to the long hairs of the sternum and coxæ of a Pallasoma, but they gain this position accidentally, the flower being adapted to fasten pollinia to some part of the insect's head.[12]

Insects with short hairs sometimes suck without drawing out the pollinia, which shows the importance of those with long hairs (bumble-bees).

In all fifteen species of the following genera were caught on the flowers, those bearing pollinia having been mentioned:

Hymenoptera: Apis, Bombus (2), Megachile (2), Polistes, Odynerus, Cerceris (2), Bembex, Myzine. *Coleoptera:* Trichius. *Lepidoptera:* Thecla, Chrysophanus, Scepsis.

ACERATES VIRIDIFLORA.—The flowers are much larger than in the preceding. The wings measure about one and three-fifths millimetres from the angle to the top, and are adapted to catch the hairs of the legs of insects, not the claws or ventral hairs.

The hoods extend from the bases of the petals to the tips of the anthers, are pressed close to the gynostegium, and are about five millimetres deep.

The pollinia are two and three-fifths millimetres long, and are narrowed above for about half their length into a slender stock. From above the stock is devoid of pollen grains for about one millimetre. The retinacula are very short, serving mainly to keep the pollinia apart, so that both may not be drawn into the same fissure. The stock of the pollinium serves the place of a retinaculum, and lets the granular part of the mass down below the angle of the wings. When drawn up this slender part is caught by the wings, as the hair bearing the corpusculum was before. The base of the mass is drawn into the chamber, and is wedged fast. Then the retinaculum separates from the pollinium, leaving it behind with the long caudicle projecting beyond the anthers. After insects have visited the flowers the presence of a pollinium in the chamber is indicated by this stalk. Sometimes the corpusculum loses its hold on the insect, when we find the pollinia in the condition shown in fig. 6, one with its base emitting tubes, and the corpusculum and other pollinium outside. While the stalk seems to be very useful in effecting pollination, it seems to act injuriously in every case in which a corpus-

[12] "Observations on the mode in which certain species of Asclepiadeæ are fertilized." *Jour. Linn. Soc.*, xiii, 52.

culum is present at the top of the slit, for it enters the cleft and carries the corpusculum up out of its proper position, as shown in fig. 7 (plate xii). Such cases may be found on flowers which insects have visited. Combinations of pollinia can hardly be formed.

Compared with other Asclepiads we have studied, this shows a few peculiarities which we may sum up: (1) The upper part of the pollinium serves the purpose of a retinaculum and is without pollen grains. (2) The pollinium does not fit the stigmatic chamber, but, when in a position to emit tubes has its upper end projecting above the style-table. (3) The retention of the pollinium is effected by its own thickness, and not by a rigid part of the retinaculum which remains attached to it.

I have five specimens of Bombus separatus and three of B. scutellaris, all with pollinia on hairs of legs.

While the hoods of the species of Acerates do not enable them to catch the hairs and pollinia with the same precision as in Asclepias, they compensate for this by restricting the visitors to the most diligent bees, which are provided with an abundance of long hairs.

There are some peculiarities in the adaptations of Asclepiads, which may be brought out by comparing them with ordinary flowers, or with the orchids. If an insect inserts its tongue into the nectary of a Habenaria, it is fairly certain that it will draw out one or both pollinia, and, when sucking another flower, will bring the pollen in contact with the stigma. In the case of Asclepias the most efficient visitor may suck the hoods without drawing out a pollinium, and, then, the chances of a particular pollinium being inserted are not many. Pollination is only fairly certain when the leg is provided with many pollinia. The accidental nature of pollination is to a certain extent conducive to cross fertilization. If we suppose that an insect visits a number of plants, a given pollinium will be more likely to be carried to a distinct plant.

One act of pollination supplies enough pollen to produce good fruit. Mr. Corry has observed that one pollinium is sufficient to fertilize a flower of Asclepias Cornuti.[13]

There are two ways bees have of treating loose pollen, to which the pollinia of Asclepiads are not liable: (1) It is

[13]Trans. Linn. Soc., Lond., Bot 2d. Ser., II, 196. This bears directly on what I have insisted upon, that the pollinia are inserted singly by the knees, and not in pairs by their corpuscula.

well known that they wipe loose pollen from the hairy surface of their bodies to apply it to their pollen collecting apparatus. (2) I have seen Bombus vagans, after visiting several flowers of Triosteum perfoliatum, stop and brush the pollen from her face and tongue without placing it in her corbicula. Bombus Pennsylvanicus was seen to insert her tongue between the introrse anthers of Dodecatheon Meadia, and then hang with her four posterior feet fixed to the flowers and wipe off the pollen with her front legs simply to get rid of it. In contrast with this I have seen bumble-bees trying in vain to free themselves of the pollinia of Acerates longifolia, by which they were evidently annoyed.

As far as the mere application of pollen to an insect is concerned, a flower with loose pollen has the advantage. But the advantage is on the side of Asclepias after the insect is loaded with it. It is only a general rule that insects keep to flowers of a particular species, on their honey and pollen-gathering expeditions. If a bee dusted with loose pollen visits flowers of another species, it will not long retain pollen in sufficient quantity to effectually fertilize flowers of the original species. On the other hand, if an insect returns at any time during the day, or even after a few days,[14] to the species of Asclepias from which it got a load of pollinia, it may bring with it all or most of the pollinia which it has carried from the first plants. The firmness with which the pollinia keep their hold on the insect is one of the best adaptations for cross-fertilization.

Since different species are in bloom at the same time, it is necessary to be very certain that the pollinia on an insect belong to the plant on which it is found. A Scolia caught on Asclepias verticillata had pollinia of this plant and of A. Cornuti on its tarsal hairs. A Papilio found on A. Cornuti had only pollinia of A. tuberosa. A specimen of Bombus scutellaris shows how insects change flowers and emphasizes the advantage in the structure of the pollen-masses of Asclepiads. Its pollen baskets show the yellow pollen of the Petalostemon on which it was caught, and dark pollen from some other plant; and it has, besides, pollinia of Acerates longifolia on ventral surface and of A. viridiflora on hairs of tibiæ. It is interesting to observe that, while the loose pollen was packed in the corbicula to be carried away and left in the

[14] Pollinia of Asclepias Sullivantii, which were extracted and exposed to the air on June 23, were inserted into the stigmatic chambers on July 7, two weeks after extraction, and emitted pollen tubes.

nest, the pollinia of the two Acerates kept their proper position. Now, when such insects visit flowers of the species to which the pollinia belong, full fertilization may take place—cross-fertilization, too, since they have wandered so far from the original plants.

The modifications of the floral structure of different species enable the plants to avoid competition for the same insects, or for the same parts of the same insects. Thus, bumble-bees have pollinia of Asclepias Sullivantii on their claws, of A. verticillata on their tarsal hairs, and of Acerates longifolia on the hairs of the ventral surface.

As an interesting peculiarity of Asclepiads may be mentioned, the occurrence of pollinia in positions in which the flowers are not specially adapted to place them. It has been observed that Asclepias sometimes fastens pollinia on the tongues of insects. Acerates longifolia accidentally catches the hairs of the face and tongue. In contrast with the Acerates, is Xysmalobium linguæforme, whose pollinia, according to Mansel Weale,[15] are found regularly on the insect's head, but only accidentally on the hairs of the tarsi and ventral surface.

BRIEFER ARTICLES.

"Indicative" Eriogonums.—The mountains of Montana are not very high, but they are numerous, extending over a large portion of the territory. Almost wherever prospected they yield precious metals, in some form or other, to the eager searcher after wealth. Even the plains have been found to hide within their vast expanses valuable iron ores and coal.

In the August GAZETTE certain "indicative plants" were spoken of. Eriogonum ovalifolium was considered indicative of silver ore in the soil. We have at least three species of the genus in northern Montana, and I am prepared to state that none of them are indicative of anything of the kind. In 1885, Dr. Frank Pottle, in company with the writer, found a large vein of magnetic iron ore in the Belt mountains. The ore also contained small per cents. of copper and silver. Thickly covering the surface soil of this "lead" were large beds of Eriogonum umbellatum in an unusual degree of luxuriance. It was towards the end of June, and the many creamy-flowered umbels were at their best. It is highly probable that had some knowing old prospector hunting "signs" as well as gold

[15] Loc. cit., p. 52.

discovered this vein, he would have set Eriogonum umbellatum down as a good sign. But it is no sign at all, for it is profuse almost everywhere in the mountains, where there is quartz or other ore, or where there is none. This species appears to confine itself to the mountains, and is common in the Belts and Birdtails, and the ranges about Helena. E. flavum is also common, and certainly is a pretty plant. We find it mainly on the plains and in the foot-hills. While E. umbellatum seems equally partial to rocky and loamy soil, E. flavum is found in rocky or gravelly ground almost exclusively. Like so many of our western plants it has wonderfully long, tough roots, considering its size, which penetrate the soil to a considerable depth, nothing daunted by the stones or other impediments in their downward course. The roots of this plant are covered by a loose, papery bark, brown or blackish in color, beneath which the surface is reddish. I have found them nearly two feet in length, and about an inch thick just below the crown of dead leaves which characterize this and E. ovalifolium alike. I have never found the latter growing so abundantly in the mountains as E. umbellatum, but it is extremely plentiful on the plains, growing with E. flavum. Generally speaking, it is a smaller plant than the two preceding, although the peduncle often exceeds that of E. flavum. It may be readily distinguished from the latter by its white appearance, smaller and denser umbels, and small roundish leaves. Often it is remarkably cespitose, forming small hillocks through the accumulation of dead leaves and the earthy substances lodging amongst them. It has been said that reliable Montana prospectors regarded this plant as a good indicator of silver in the soil. It may be so regarded by some, although none of that persuasion have crossed my path; but I am convinced that the growth of this plant is no sign. If it were, then all northern Montana would rest upon a bed of silver. In this vicinity carbonate iron stones underlie the surface, and below them are huge deposits of coal. In some places coal veins eighteen feet thick have been disclosed. A professional assayer, who has assayed many samples of these irons, told me, upon special inquiry, that they averaged from 40 to 60 per cent. in iron. In some instances he found small per cents or mere traces of silver, but in the majority of cases he found none.

This portion of Montana has been prospected over for years, plains as well as mountains, and if silver were as plentiful as the abundance of Eriogonum ovalifolium seem to indicate, it would have been brought to light long ago. So far as prospecting is concerned, it is largely a game of chance. It is, in fact, mere gambling. I have heard of cases where professional geologists from Washington have examined a portion of country with a hammer; tapping here, chipping there, and with that and their scientific knowledge of formation combined, have concluded no precious metals were there; while shortly afterward a weather-beaten prospector, with pack horse, pick, shovel and gold pan, would traverse the same ground and "strike it rich." But it is also well understood that the average professional geologist very much underrates the practical experience and "signs" of the prospector, and vice versa. If each would condescend to grasp and use the knowledge of the other in conjunction with his own, then better results would be obtained and mutual respect would exist between geologists and prospectors, which it can not be said to do to-day.

And although I am sure the abundance or sparsity of Eriogonum ovalifolium is no sign as to the presence or the absence of silver or other metal in the soil (for it grows in any formation, lime, sandstone, etc.), I would not presume to say the same of other "indicating plants," individually unknown to me.—F. W. ANDERSON, *Great Falls, Montana.*

Some western plants.—In examining some western collections recently, an interesting fact or two with respect to the range of certain plants has been brought to light. *Phlox Richardsonii* Hook., of the Arctic sea-coast, was found by Mr. F. W. Anderson, in May of this year, growing in great abundance upon Mt. Helena, Montana. It had previously been discovered by Scribner in the Belt Mountains, Montana. Mr. W. M. Canby's corps, on their northern transcontinental survey, discovered a form of Trautvetteria palmata, and now it turns up from Idaho, collected by J. B. Leiberg. *Pentstemon Lyallii* Gray, of British Columbia, and extending into the borders of Montana, has been sent in by Mr. J. B. Leiberg from Kootenai county, Idaho, growing on rocky banks, 3,000 to 6,000 feet altitude.—JOHN M. COULTER.

EDITORIAL.

A FEW writers are inclined to scatter their thoughts before the public with a too lavish hand. Facts of interest secured in an investigation are arranged to be presentable and ushered into the presence of the public through the medium of some society or journal. Without adding materially to the number of facts the language with which they are clothed is readjusted and another society or journal receives them. This shifting may be repeated several times, and the facts turn up in various places. Each time the reader, if not on his guard, will naturally suppose he is perusing the first and only statement of the kind, there being nothing to indicate that the author has already published other versions of the same matter. We do not have in mind the case where a paper read before a society is printed in a magazine to secure earlier publication, reference being made to the time and place of its first presentation; or to the case where an article is reprinted in one or more journals, due credit being given; or the case where an author writes up a part of a subject, and subsequently presents another part; or the case where new facts are first published in a scientific journal and then worked over into popular form for the weekly press or any ephemeral publication. We are not thinking of these, but of the presentation of scientific facts in different journals, society reports, etc., under various guises, without adequately stating where and how they previously appeared. The neglect to take this precaution, when publication through one medium is not deemed sufficient, as usually ought to be the case, leads to much confusion and annoyance when another investigator goes over the same ground, and also has the effect of lowering the standard of appreciation with which thoughtful persons regard the author's writings. It suggests the idea that the author must be deficient in solid facts, or he would not require so much service of those he brings forward; and unpleasant suggestions also present themselves regarding the author's motives in thus using his material over and over. It may be supposed that scientific men of eminence would never fall into such practices, and yet conspicuous examples are not wanting.

OPEN LETTERS.

Vitality of seeds.

About twenty years ago, when "White Hall," upon the grounds of the Maine State College was built, the excavated dirt was used to make a fill, covering the surface of the ground four or five feet. This year, to lay some sewer pipes, a ditch was cut through the old fill, and along the side of the ditch, four feet below the present surface, seeds in considerable numbers germinated.

The plants did not develop sufficiently before the ditch was filled to determine the species. F. L. HARVEY.

Orono, Maine.

The old and new botany.

In the April number of your magazine, the editorial on the methods of teaching botany attracted my attention. While heartily agreeing with the general sentiment expressed, I wish to offer some criticism, or call attention to that aspect of the new method which is considered, in some quarters at least, as the only true biological method.

You close the article with the sentence, "The botanical teaching of the future will consider these, not as two opposing methods, but as complementary, both essential to the rounding out of a botanical course." This implies that at the present time these two methods, the old and the new, may be considered as opposing each other. It seems to me we do not need to wait for the future to teach us that there can be no real opposition between them, for according to their definition in the editorial they refer simply to different departments of the same science. By the old method is meant the teaching of systematic botany, by the new, the teaching of types and the grounding in biological (physiological?) principles. But biological work appears sometimes to be regarded as a science distinct from both botany and zoology, so that one not unfrequently hears of courses being planned in botany, zoology *and* biology, as though botany and zoology failed to recognize plants and animals as living things! Now this is what I do not believe, and it is this monopoly of vital phenomena set up by biologists for biology to which I object.

Now the new method, which is often referred to as the biological one, is supposed to include what is left out in the old, since they complement each other.

While I am unwilling to call it a *method* of teaching, it seems particularly unfortunate to call it the biological method. This word, as I understand it, belongs to the science by virtue of the objects considered being living things, therefore it is illogical to consider any department of botany as entirely unconnected with biology. To explain more fully, classification is based on morphology, or the doctrine of forms, the forms of the organs by which the plant is able to carry on its own existence and to reproduce its kind. It is as idle to consider the vital processes independently of the organs which exhibit them as it would be to ignore the functions of organs by dealing alone with their forms.

The opposition supposed to exist between the old and the new methods is the result of this misuse of the term biological, and it works harm in two ways: First, those wishing to take up the study of botany are deceived by supposing that there is a short, easy, new method, by which they are going to be led straight to the heart of the science without the tedious circumlocution of learning the names of things. It is natural that they should reject and oppose what they consider the old fashioned way. Secondly, this use of the term, biological method, is apt to lead to misunderstanding on the part of students, well educated in other respects, who are not especially interested in the biological sciences. To such the word protoplasm is destined to call up ideas of life-manifestations in which animals and plants either have no part or are inextricably confused.

As long as botanists are willing to suffer the most important part of botanical teaching to be referred to in such vague terms as to effectually disguise its real nature and even mislead educated people into supposing it can only be taught in connection with the science of animal life, so long will they find it difficult to give to botany the rank which it deserves. In France and Germany the study of the vegetable kingdom has been recognized, for some years, as a distinct science, including several departments; the terms, physiological, anatomical, morphological (which includes systematic botany), being used in a similar manner as in connection with zoology. In my judgment, if we were to follow their example and use these or similar terms when speaking of the different departments of botany it would do much toward obviating the two evils referred to. It would certainly help to place the science on a level with other natural sciences in the minds of those not especially interested, and would have some influence, perhaps, in rescuing botany from the general disfavor into which it appears to be falling. When the different parts of botany are not only referred to but taught in the way suggested, so that a general course will include a knowledge of all its departments, and an advanced course, continued study in any one or more of them, there will be no possibility of opposition, except the natural and healthful one of competition between those striving to do their best in their chosen fields.

EMILY L. GREGORY.

Bryn Mawr College.

CURRENT LITERATURE.

Pittonia, Vol. i, part 2. A series of botanical papers by Edward L. Greene, July, 1887, pp. 51–93.

When the first part of *Pittonia* appeared the question as to the meaning of the name was raised. This has called forth an explanation in the part before us, which explains that an easy name was sought, to be used in quoting, and so the family name of Tournefort was chosen. Two new genera of Borraginaceæ are proposed, *Oreocarya*, to include Krynitzkia § Pseudokrynitzkia and part of § Pterygium in Gray's Syn. Fl. Suppl.; and *Eremocarya*, to include Krynitzkia micrantha of Gray, and the var. lepida. The § Piptocalyx of Krynitzkia is restored to generic rank. Among miscellaneous species, new or rare, about twenty new ones are described. The part closes with an account of an excursion to the island of San Miguel, and a catalogue of its flowering plants.

Untersuchungen über Bau und Lebensgeschichte der Hirschtrüffel, Elaphomyces, von Dr. Max Rees und Dr. C. Fisch. Bibliotheca Botanica, Heft 7, quarto, pp. 24, pl. 1. Cassel, Theodor Fischer, 1887.

The obscure life history of truffles has received additional treatment by the authors, who corroborate the constant limitation of species of *Elaphomyces* to soil permeated by the roots of trees—according to their observation, pines—that are closely invested and parasitically attacked by the growing mycelium, which matures its fruit only when in the most intimate connection with the abnormally branched rootlets. The connection between mycelium and roots appears to be simply that of a parasite with its host, and not a case of true symbiosis. Although plants were examined in large numbers, and in all stages of development, no trace of fertilization was observed, so that the fruit appears to be strictly non-sexual, as in the pileate fungi; but this retrogression has progressed further than in the latter, for many of the fruits fail to mature, and, though produced in myriads, the spores seem to have entirely lost the power of germination, and propagation is only known to be effected by the spreading of mycelial fibers from root to root. —W. T.

Lectures on the Physiology of Plants. By Julius von Sachs; translated by H. Marshall Ward, M. A., F. L. S. Roy. 8°, pp. xv, 836; wood cuts 455. Clarendon Press, Oxford, 1887. (New York: Macmillan & Co.)

Again we are indebted to the Clarendon Press for an important aid to English speaking students of plant physiology. Sachs' admirable "Vorlesungen über Pflanzen-physiologie," issued in 1882, has been turned into excellent English by Prof. Ward, and thus added to the list of books essential to the working library of our laboratories. However much it is to be regretted, it is a fact that our American students can not make ready use of German books, and a translation is always welcome; particularly such a book as this, in which, in lecture form, the author sets forth his own special views on physiology. Sometimes this personal treatment runs almost into egotism, though much is to be forgiven to one who has made such extensive and profound additions to our knowledge as Dr. Sachs. There is hardly an important topic upon which his researches have not cast much light, and for a large number of principles he justly claims priority.

But this work appeals not alone to the special student of plant physiology. It can be read by any person fairly well informed as to plant structure and the principles of chemistry and physics, and deserves as wide a circle of readers in its English form as it has had in Europe in its original German. To this the most admirable work of the translator commends it. We have him to thank also for the greatly extended index, an important part of a book, to which our German friends would do well to take better heed. We say nothing of the treatment of the work, taking it for granted that most teachers are already familiar with it, and that all who are not will at once obtain the new edition. The *imprimatur* of the Clarendon Press is a guarantee of the excellence of the typography. The volume is uniform with the recently issued Goebel's "Outlines of Classification," which is supplementary to it. With Goodale's, Vines' and Sachs' physiologies, English students have for the present a pretty full epitome of the functions of plants.

List of Works on North American Fungi, with the exception of Schizomycetes, published before 1887. By W. G. Farlow and William Trelease. Library of Harvard Univ.; Cambridge, 1887. 8°, pp. 36.

This reference catalogue, in its complete form, makes No. 25 of the Bibliographical Contributions of the Harvard library. It comes as a great boon to all students working upon the American fungal flora. Much of its value lies in the remarkable completeness and accuracy with which references to all independent works, articles, or incidental mention of American fungi, having scientific value, have been collated. Yet it is not supposed the list is perfect, and botanists will do their fellows, as well as the authors, good service by reporting omissions and corrections. A most difficult feature of the work has been to justly discriminate between articles having a modicum of scientifie value and those which are simply popular, which would on the one hand make the list imperfect if omitted, and on the other lumber it with useless references if included. We think the judgment of the compilers in this regard will not often be called in question.

The list includes about 650 numbers, some dozen of which are titles of journals, government reports, etc., and the remainder are titles of papers by 110 American and 73 foreign authors. Many of these works possess value in this connection by reason of a few paragraphs, subordinate statements, or mention of a few species—important matters to the investigator, and except for such an index most difficult to find. The list serves to correct a very prevalent misconception—an idea that the literature pertaining to American fungi is small and easily collected, and will also tend to set on their guard those who, with imperfect knowledge, rush into print with descriptions of supposed new species.

Over half the entries are the writings of fifteen authors, each of whom has contributed ten or more entries each. Two-fifths of these are foreigners, viz.: Fries 11 entries, Von Thümen 11, Winter 12, Saccardo 13, Berkeley 30 and Cooke 71, total 148 entries; while three-fifths are Americans, viz.: Arthur 10 entries, Bessey 11, Leidy 11 (all pertaining to fungi parasitic on animals), Gerard and Trelease 12 each, Burrill 17, Farlow 31, Peck 40 and Ellis 50, total 194 entries.

The slight biographical item of dates of birth, and in some cases of death appended to each author's name (with 43 exceptions) has its value. It brings out the interesting fact that over one-fourth of the American writers enumerated (excluding the twenty-four names without data) were born either during or since 1850, and constitute 35 per cent. of those living at the beginning of the present year. They are also represented in the list of chief writers mentioned above. The large percentage of young investigators obviously promises an accelerated development of this field of science. Only four foreign writers occur whose births do not antedate 1850, of whom Bagnis, now dead, Pirotta and Voglino are Italians, and Rostafinski a Pole.

Other interesting statistics might be gleaned from this list, but space forbids. A supplement gives an account of ten exsiccati, three American and the others containing American specimens.

Every student of fungi will feel that he is indebted to the compilers for a valuable service, and one no other botanists were in position to perform so acceptably.

NOTES AND NEWS.

PROF. G. C. WITTSTEIN died at Munich on June 1, in his seventy-eighth year.

A CORRESPONDENT of the *Revue Horticole* reports the growth of mistleto on an old peach tree.

IN THE *Journal of Botany*, for September, R. Miller Christy has a paper entitled "Notes on the botany of Manitoba."

DR. H. MAYR, of the Forestry Institute of the University of Munich, has accepted a professorship in the University of Tokio.

DR. H. VÖCHTING, author of numerous important botanical works, has been made professor of botany at the University of Tübingen.

MR. TOKATURO ITO gives an interesting account, in *Journal of Botany*, of the history of botany in Japan. It is accompanied by a portrait of Ito Keisuke.

M. Pierre Viala, of Montpelier, France, an investigator of eminence, is visiting this country to study the diseases of the grape and of other cultivated plants.

Copies of the desiderata (Ranunculaceæ to Rosaceæ incl.) of the herbarium of the Department of Agriculture, can be had on application to the Commissioner of Agriculture.

Dr. V. F. Kosteletzky, professor of botany at Prague, died August 18, aged 87. It will be remembered that our malvaceous genus Kosteletzkya was named in his honor by Presl.

At the recent meeting of the British Association Count Solms-Laubach described a genus of fossil plants (Bennettites), the type of a new group between Angiosperms and Gymnosperms.

The finding of Grindelia squarrosa at Evanston, Ill., is recorded by L. N. Johnson in *Science* for September 23. It is a common plant in western Iowa and Minnesota, and especially on the plains of Dakota.

Mr. James E. Humphrey, Dr. Goodale's assistant in the summer school of botany at Cambridge last summer, has been appointed instructor in botany at the State University, Bloomington, Ind., and has entered upon his duties there.

At the recent Manchester meeting of the British Association the following grants were made for botanical work: Botany (and zoology) of the West Indies, £100; flora of China, £75; flora of Bahamas, £100; Peradenyia botanical station, £50.

The lecture of Miss Helen C. De S. Abbott, on "Plant chemistry as illustrated in the production of sugar from sorghum," has been distributed as a reprint from the proceedings of the alumni association of the Philadelphia College of Pharmacy.

The first number of the *Annals of Botany* contains papers by Prof. Marshall Ward, Mr. Walter Gardiner and Mr. Tokaturo Ito, Miss Calvert and Mr. L. A. Boodle, Messrs. Gregg, F. W. Oliver, Reynolds, Blake and Prof. Bayley Balfour. Prof. Ward's paper is on the histology and fruits of Rhamnus.

Millspaugh's American Medicinal Plants is completed with the appearance of the sixth fascicle. The work is a valuable one, has been well done, and should be a great help to homœopathic physicians. It contains 188 colored illustrations, and complete text, of all the plants indigenous and naturalized in the United States, which have been proven and incorporated in the Homœopathic Materia Medica.

A new periodical devoted to botany has just been issued at St. Petersburg. It is published in connection with the botanical garden of St. Petersburg University, the editors being Profs. Beketoff and Gobi. The title is *Scripta Botanica Horti Universitatis Petropolitanæ*, which in reference will be abreviated to *Scripta Botanica*. A welcome feature is that papers in Russian are followed by abstracts in French or German.

The source of nitrogen in Leguminosæ has long been an interesting question. M. Hellriegel has attributed it to bacteria found abundantly in the well-known tubercles on the roots of this family. His experiments showed that plants deprived of bacteria were starved, while those which had the benefit of them flourished, and the tubercles were highly developed. It will be remembered that Prof. H. Marshall Ward (BOT. GAZ. xii. 235) refers these so-called bacter a to the germs of a fungus related to Ustilago. In either case the tubercles seem to have to do with the nitrogen supply.

DR. GEORGE VOLKENS has published a series of observations on the plants of the Egyptian and Arabian desert. According to *Gardener's Chronicle* the physiological history of the plants is given in relation to the absorption and transpiration of water, the assimilation or digestion of food, the mechanical frame-work, etc. All these phenomena are more or less modified to suit the remarkable climatal conditions that prevail.

IN HIS synopsis of Tillandsieæ, in the *Journal of Botany*, Mr. J. G. Baker has completed eighty-eight species of Tillandsia, of which twenty-four are new. Of these new species six come from Mex co, one of which bears the familiar name T. Parryi, having been discovered in Central Mexico by Parry and Palmer. The *T. juncea* Le Conte, and *T. Bartramii* Ell., of Chapman's Flora, become *T. setacea* Sw., while *T. bracteata* Chapm. is *T. fasciculata* Sw.

THE RED PATCHES on the leaves of Chenopodium album, the common pig weed, is found by Prof. H. Osborn, of the Iowa Agricultural College (*Science* for September 30), to be associated with larvæ of the same color, belonging to the leaf-hopper, *Thamnotettix seminudus* Say. Although the insect is quite common, it seems to have heretofore escaped observation in its larval form. The conjecture is hazarded that it is the cause of the change of color in the leaves.

THE ASTONISHING ACTIVITY of our friends of the Pacific coast does not abate, and parts of Pittonia and Bulletins of the California Academy of Science appear with unexpected frequency. The sixth contribution of Prof. E. L. Greene, entitled "Studies in the botany of California and parts adjacent," has now come to hand, containing (1) notes on the botany of Santa Cruz Island, (2) a catalogue of the flowering plants and ferns of the Island of Santa Cruz, (3) three new species.

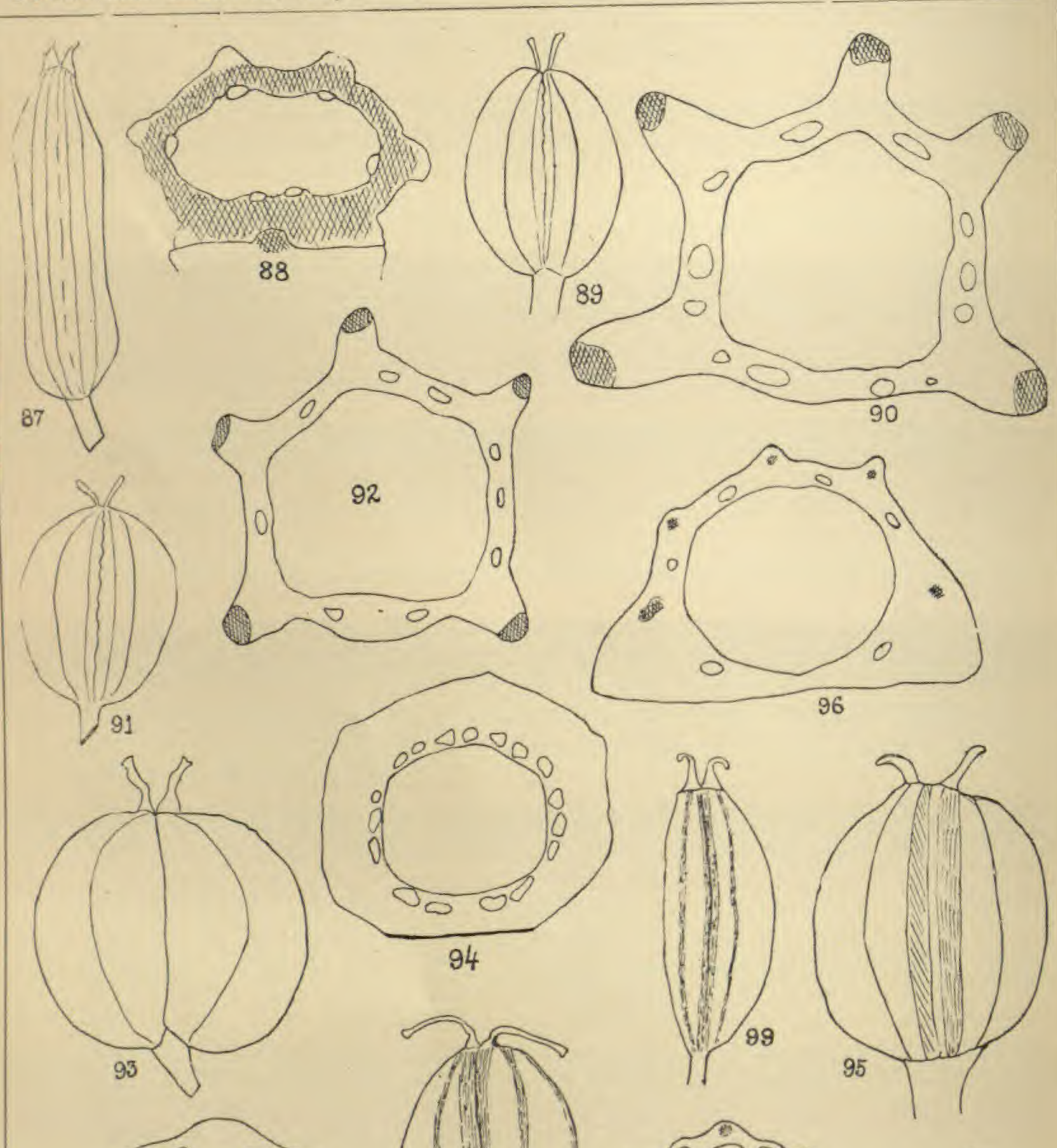
THE *Bulletin of Miscellaneous Information*, begun to be issued in monthly parts from Kew Gardens, has now reached its ninth, or September number. The object is to give notes on economic products and plants to which attention has been drawn in the correspondence or work at Kew. The last number contains two parts, xvii—Annotto (*Bixa Orellana* L.), and xviii—Notes on articles contributed to the museum of the Royal Gardens, Kew, from the Colonial and Indian Exhibition, 1886. Only cranberries and buffalo berries were received from Canada.

DR. C. C. PARRY has just distributed a partial revision of the *Uva-ursi* section of Arctostaphylos, as represented on the Pacific coast. In it A. pungens of various authors (not HBK.) becomes *A. Manzanita* Parry; A. glauca, in part, of various authors (not Lindl.) becomes *A. viscida* Parry; *A. Standfordiana* Parry is a new species heretofore confounded with A. glauca; *A. insularis* Greene, in herb., is a new species from the island of Santa Cruz; and *A. Pringlei* Parry is from Lower California. *A. pungens* HBK. is Mexican.

SOME RECENT researches of Molisch on the fall of leaves, as summarized in the *Bot. Zeitung* for July 29, are of interest. Molisch finds the formation of the separating layer to be chiefly dependent upon unusual variations in the amount of transpiration, or to the diminution of the water-content of the leaf, produced by injury or disease of the roots or stem. The direct influence of absence of light is comparatively slight, and the relation between temperature and defoliation was not fully enough tested to be established. Of two series of experiments the higher temperature (17°–22°C.) promoted the fall of the leaves. The presence of oxygen is necessary to the development of the separating layer. The author holds that the separation of the cells of the separating layer is due to a solution of the middle lamella, by action of a ferment rather than by resorption of the wall.

George Massee, in *Journal of Botany*, has a paper on causes influencing the direction of growth, and the origin of multicellular plants. His conclusions are that, as experimentally proved in the case of Œdogonium, the normal method of cell-formation is due to the unyielding nature of the external sheath. "The influence of the sheath is not to be considered as the only factor in determining the direction of growth or habit of a plant, but rather that the initial idea of direction and multicellular structure were due to it, and in the simplest as also the unbranched filamentous forms, its influence predominated, but in the latter is modified by the increased power manifested by the protoplasm in softening or completely dissolving certain portions of the sheath for various purposes connected with reproduction," as in the beak of Vaucheria and the conjugating tube of Spirogyra.

Dr. J. von Sachs gives in *Arbeit. Bot. Inst. Würzburg* (iii. 372-388), the details of the experiments from which he concludes that the invisible ultra-violet rays of the solar spectrum are especially efficacious in the development of flowers. The experiments were all made on Tropæolum majus. If the rays of the sun are made to pass through a solution of sulphate of quinine the ultra-violet rays are entirely absorbed or transformed into rays of less refrangibility which are visible and of a light blue color. If a plant is made to grow behind a screen of sulphate of quinine the vegetative organs are normally and luxuriantly developed, but the flowers are almost entirely suppressed. Twenty-six plants thus grown produced only a single feeble flower, while twenty plants grown under similar conditions behind a screen of water of the same thickness produced fifty six flowers. * * * It may be assumed then that there are three distinct regions of the solar spectrum differing in their physiological action—the yellow rays and those near them cause the decomposition of carbon dioxide, and are active in assimilation; the blue and the visible violet rays are the agents in the movements of irritation; the ultra-violet rays are those which produce in green leaves the substances out of which flowers are developed.—*Jour. Roy. Mic. Soc.*, Aug.



COULTER and ROSE on UMBELLIFERÆ.

VOL. XII. NO. 11.—BOTANICAL GAZETTE.—NOV., 1887.

Notes on Umbelliferæ of E. United States. VII.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE XV.)

TREPOCARPUS Nutt.—Fruit linear-oblong, flattened laterally: carpel somewhat dorsally flattened, with the 5 primary ribs filiform or obsolete, the 4 secondary ones prominent: oil-ducts solitary under secondary ribs, two on commissural side: stylopodium conical, with very short style (figs. 87, 88).—Glabrous annuals, with thin pinnately decompound leaves and linear segments, lateral few-rayed umbels opposite the leaves, white flowers, and prominent calyx-teeth.

1. **T. Æthusæ** Nutt. DC. Mem. Umbel. 56, t. 14. From a few inches to three feet high: umbels 2 to 5-rayed; umbellets few-flowered: involucre and involucels of few linear bracts, entire or divided: fruit 4 to 5 lines long; pericarp wall thick and mostly made up of strengthening cells: secondary ribs corky.—From Arkansas to Louisiana, Indian Territory and Texas. Fl. July.

SIUM Linn.—Fruit ovate to oblong, flattened laterally: carpel with 5 corky primary ribs (each with a well-developed group of strengthening cells at tip): oil-ducts 1 to 3 in the intervals (never solitary in all the intervals), 2 to 6 on commissural side, near center of pericarp: seed-section roundish or sub-angular: stylopodium depressed or wanting, with short style (figs. 89–92).—Smooth perennials growing in water or wet places, with pinnate leaves and serrate or pinnatifid leaflets, involucre and involucels of several bracts, and white flowers, in summer.

Bentham and Hooker refer our two species of Sium to Apium, but to us they seem abundantly distinct, as also indicated by Watson, Bot. Calif. i. 261. The oil-ducts are never solitary in all the intervals, and the prominent group of strengthening cells in the outer edge of each rib still further emphasizes the distinction. There is no better defined generic group in Umbelliferæ than that formed by our two species of Sium, being so nearly identical in fruit and so easily separated from all other genera.

1. **S. cicutæfolium** Gmelin, Syst. 2. 482. Stout, 2 to 6 feet high: leaflets 3 to 8 pairs, linear to lanceolate, sharply serrate and acuminate, 2 to 5 inches long: fruit larger in section and with more prominent ribs than in the next; oil-ducts 2 to 6 on commissural side (figs. 89, 90). *S. lineare* Michx. *Apium lineare* Benth. & Hook.—Throughout our range, and west to the Pacific.

2. **S. Carsoni** Durand, Gray's Man. 196. Weak, 1 to 2 feet high: leaflets 1 to 3 pairs, linear, sharply serrate, 1 to 2 inches long; when submersed or floating, very thin, ovate to oblong, usually lacinate-toothed or dissected, the leaf sometimes reduced to the terminal leaflet: oil-ducts 2 to 4 on commissural side (figs. 91, 92). *Apium Carsoni* Benth. & Hook.—Pennsylvania, Connecticut, Rhode Island, and Massachusetts.

BERULA Koch.—Fruit nearly globose, somewhat flattened laterally, emarginate at base: carpel with 5 filiform primary ribs: pericarp thick and corky, with no strengthening cells: oil-ducts numerous and contiguous, closely surrounding the seed cavity: seed-section round: stylopodium conical (figs. 93, 94).—Smooth aquatic perennial, with pinnate leaves and variously cut leaflets, and white flowers, in summer.

1. **B. angustifolia** Koch, Deutsch. Fl. 2.455. Stout, ½ to 3 feet high: leaflets 5 to 8 pairs, linear to oblong or ovate, serrate to cut-toothed, sometimes crenate: fruit ¾ line long. *Sium angustifolium* L.—Throughout our range and westward.

CRANTZIA Nutt.—Fruit globose, slightly flattened laterally: carpel with 5 primary ribs, each subtended by a small group of strengthening cells; the laterals thick and corky: the others filiform: oil-ducts solitary in the intervals, two on the commissural side: seed-section round (figs. 95, 96).—Small perennials, creeping and rooting in the mud, with hollow cylindrical or awl-shaped nodose petioles in place of leaves, simple few-flowered umbels, and white flowers. July.

1. **C. lineata** Nutt. Genera, 1. 178. Leaves very obtuse, 1 to 3 inches long, 1 to 2 lines broad: fruit a line long, the thick lateral wings forming a corky margin.—In brackish marshes along the coast, from Massachusetts to Mississippi.

CICUTA Linn.—Fruit ovoid to oblong, slightly flattened laterally: carpel with 5 strong flattish corky primary ribs (laterals somewhat larger): oil-ducts solitary in the intervals, two on the commissural side: stylopodium conical or depressed (figs. 97–100).—Smooth poisonous marsh perennials, with pinnately or ternately compound leaves, and white flowers, in summer.

Bentham and Hooker, in Gen. Plant. i. 889, say "stylopodia crassiuscula, depressa, integra;" and Sereno Watson, in Bot. Calif. 1.260, says "stylopodium depressed." While this is apparently true in most specimens of mature fruit, in many younger specimens, and some mature ones, the stylopodium will be found to be conical. In any event it is large and prominent, and may or may not become conical. When depressed, we have not found it entire.

1. **C. maculata** L. Spec. 256. Stout, 2 to 6 feet high, stem streaked with purple: leaflets oblong-lanceolate (narrower above), coarsely serrate: fruit oval, 2 lines long, with no strengthening cells and large oil-ducts; seed-section roundish (figs. 97, 98).—Throughout our range and westward.

2. **C. bulbifera** L. Spec. 255. More slender, 1 to 3 feet high: leaflets linear, sparsely toothed; upper axils bearing clustered bulblets: fruit (seldom matured) oblong, 2 lines long, with groups of strengthening cells beneath the ribs and smaller oil-ducts; seed-section somewhat dorsally flattened. —Common northward.

CYNOSCIADIUM DC.—Fruit ovoid, not flattened either way: carpel with 5 strong primary ribs, lateral ones much the larger, forming a broad corky margin, a large group of strengthening cells in each rib: oil-ducts solitary in the intervals, two on the commissural side: seed-section somewhat flattened dorsally: stylopodium conical (figs. 101–104). —Glabrous annuals, with pinnately divided cauline leaves (leaflets linear), mostly undivided lower and radical leaves, white flowers, and persistent calyx-teeth.

1. **C. digitatum** DC. Mem. Umbel. 44 t. 11. Slender, 1 to 2 feet high: radical leaves linear-lanceolate, entire; cauline leaves palmately 3 to 5-parted: fruit a line long, contracted into a neck at summit, with very prominent ribs and minute calyx-teeth (figs. 101, 102).—Wet ground, Arkansas, Alabama, Louisiana and Texas. Fl. May, June.

2. **C. pinnatum** DC. l. c. Smaller (in var. *pumilum* Eng. sometimes becoming cespitose): cauline leaves pinnately

divided into few distant segments, terminal one much the largest; radical leaves similar or often entire: fruit $1\frac{1}{2}$ lines long, not beaked at summit, with less prominent ribs and very prominent calyx-teeth (figs. 103, 104).—Wet ground, Arkansas, Indian Territory and Texas. Fl. April.

DAUCUS Linn.—Fruit oblong, flattened dorsally: carpel with 5 slender bristly primary ribs and 4 winged secondary ones, each bearing a single row of prominent barbed prickles: oil-ducts solitary in the intervals (that is, under the secondary ribs), two on the commissural side: seed-section dorsally flattened, the face somewhat concave or almost plane (figs. 105, 106).—Bristly annuals or biennials, with pinnately decompound leaves, foliaceous and cleft involucral bracts, concave umbels (connivent in fruit), and white flowers.

1. **D. Carota** L. Stem bristly: ultimate segments of the leaf lanceolate and cuspidate: rays more numerous and elongated than in the next (figs. 105, 106).—Naturalized everywhere.

2. **D. pusillus** Michx. Fl. 1.164. Stems retrosely papillate-hispid: leaves more finely divided, the ultimate segments narrowly linear: umbels smaller, with fewer and shorter rays.—Throughout the southern states and westward.

The varieties microphyllus and scaber simply depend upon the varying character of the hairs, a character not to be relied upon. This species is a very close American representative of the European D. Carota, and it is really questionable whether they should be kept specifically apart. The fruit is so exactly similar in both species that it can not be distinguished, and hence our figures 105 and 106 represent D. pusillus just as well as D. Carota.

EXPLANATION OF PLATE XV.—Fig. 87, fruit of Trepocarpus Æthusæ; fig. 88, section of carpel of same; fig. 89, fruit of Sium cicutæfolium; fig. 90, section of carpel of same; fig. 91, fruit of S. Carsoni; fig. 92, section of carpel of same; fig. 93, fruit of Berula angustifolia; fig. 94, section of carpel of same; fig. 95, fruit of Crantzia lineata; fig. 96, section of carpel of same; fig. 97, fruit of Cicuta maculata; fig. 98, section of carpel of same; fig. 99, fruit of C. bulbifera; fig. 100, section of carpel of same; fig. 101, fruit of Cynosciadium digitatum; fig. 102, section of carpel of same; fig. 103, fruit of C. pinnatum; fig. 104, section of carpel of same; fig. 105, fruit of Daucus Carota; fig. 106, section of carpel of same. Fig. 87, is $\times 5$; figs. 89, 91, 97, 99, 101, 103, 105 are $\times 8$; figs. 88, 93, 95, 98, 100, 102, 104, 106 are $\times 25$; figs. 90, 92, 94, 96 are $\times 40$.

Plant Odors.

ARTHUR J. STACE.

In furnishing descriptions of plants to aid the learner in identifying them, the odor is an important element, but we often find it neglected. The cause of this neglect is manifold; the poverty of our language in affording names to distinctions of odor, and the difficulty of determining what are the elementary odors, contributing to it, among other sources of embarrassment. The writer's object is to offer a theory by which elementary odors may be detected in their almost innumerable compounds in a way which will lead to the formation of a systematic nomenclature.

His theory is this: that, owing to the sympathetic connection of the olfactory nerve with the nerves controlling the organs of secretion and excretion, each elementary odor produces a specific effect on some one of these organs and may be recognized by this effect.

Thus, it is not only true that the alliaceous odor stimulates the lachrymal glands, producing in sensitive persons an actual flow of tears, but conversely, if we find any odor that so stimulates the lachrymal glands it is a proof that it contains the alliaceous element.

It may be said that the odor of wood-smoke excites the lachrymals, although it is not alliaceous; but it is not the odor of the smoke; it is the impact of particles of the smoke upon the eyeball that does it. Protect the eyes effectually against the smoke and no such effect will be perceived from the mere odor.

Again, it may be said that the lachrymals may be excited by any odor that brings pathetic incidents to mind. The odor of sweet basil, for instance, recalling the affecting tale of "a pot of sweet basil," may make some sentimental young lady weep. But we are not concerned with the effects of association, where the nervous system is reached through the mind, but speak only of the direct, physical effect of odors. No one ever attributed pathos to an onion.

For another example, the odor which excites the salivary glands is the parsley odor, an element common to the whole order Umbelliferæ. It may be said that anything good to eat will excite the salivary glands; that a hungry man's are excited by the smell of roast beef and a child's by the mere sight of candy. But that is because the man wants to eat the beef, and the child to eat the candy. Now, when the smell of parsley excites the salivary glands, one does not necessarily want to eat the parsley.

There are other appetizing odors, for instance, that of oak sap, which hangs around a saw-mill, but it does not excite the saliva. It stirs some of the deeper digestive fluids, probably the gastric juice.

Opposed to this last is the nauseating odor which belongs to the order Solanaceæ. Lifting up tomato vines on a dewy summer morning one will get the full benefit of it. It will enable us to understand the difficulty found in introducing the use of the potato as an article of diet into Europe, and to appreciate the fallibility of the human nose as a guide to wholesome food.

As there are many organs concerned in the functions of alimentation, so there may be as many different appetizing odors. It is not always easy to decide on the organ acted upon by each odor. The perfume of spice, for instance, the element common to nutmeg, allspice, mace and cloves, is appetizing, but whether through the stimulus it gives to the liver, the pancreas, or the intestinal juices, it would be rash for me to say. Combined with a weedy element in Lindera Benzoin, it still retains its appetizing quality; but we do not so readily recognize it as appetizing when in combination with the delicious but cloying fragrance of the pink, sweet-william and carnation. Sweet odors are destructive of appetite, though they are not nauseating. They must, therefore, have an effect the reverse of stimulating on the hypogastric fluids.

The well-known odor of turpentine, found in various combinations among the Coniferæ, and in the genus Silphium, acts as an irritant upon the kidneys, as every one confined to the atmosphere of a paint-shop will corroborate.

The odor of musk, represented in the vegetable world by Mimulus moschatus and some other species of the same genus, is a notorious aphrodisiac; while an element in the fragrance of camphor, frankincense and cedarwood has the opposite effect. Scarcely anybody will acknowledge that he likes the smell of musk, but nevertheless the perfumers regard it as a principal source of profit.

There is a delightful fragrance belonging to flowers of widely different species which agree in having a waxy texture, a white color, and a disposition to open, or to keep open, during the night. Such is the perfume of the tuberose, jessamine, white lily (L. candidum), night-blooming cereus and many others. Delightful as it is, its physiological effect is undesirable. It enervates the system, and sometimes even causes headache. Opposed to this is the bracing odor of the hop, found also in hemp, although in a less pleasant combination. The hop aroma restores the balance of the nervous system, allays headache, and promotes a healthy, refreshing sleep. The absinthine odor of wormwood, chamomile, chrysanthemum and many other plants stimulates the skin to healthy action, relieves fever and promotes perspiration.

And now, to test the practical value of the theory, take a plant, hitherto unknown, with a labiate corolla and didynamous stamens. Its appearance indicates that it may belong to one of several orders, Scrophulariaceæ, Acanthaceæ, Verbenaceæ, or Labiatæ. The first impulse is to smell it, and the presence of a peculiar element in the odor will determine the search for it among the Labiatæ. Do the Labiatæ all smell alike, then? Far from it, for an educated nose would never mistake peppermint for spearmint, much less for thyme, sage, catnip or lavender. Then, are the other orders mentioned devoid of odorous species? Linaria is decidedly odorous, though by no means fragrant; Veronica, in some of its species, has a faint but agreeable smell, and Lippia citriodora a delightful fragrance What common element is there, then, in the various odors of the Labiatæ by which the species of that order may be generally identified? The epithet "aromatic," applied to them, will not help us, for the same epithet is applied to absinthine, spicy, balsamic, lupuline and many other distinct odors. We must recognize it by a peculiar physiological effect produced by it. On some sultry August day, one is walking, tired, thirsty and faint, when the foot accidentally strikes a patch of mint, and the atmosphere is filled with the perfume. It will be agreed that a refreshing sensation is the immediate result. How the sensation is produced I do not pretend to say; but am inclined to describe it as a cooling of the mucous membrane lining the nose, pharynx and mouth. This peculiar sensation is the effect of an odor common to all the Labiatæ. I have noticed it in Monarda fistulosa, a plant with a smell distinct from that of mint, owing to the presence of a citric element which mint lacks. I have detected it beneath the honeyed sweetness of thyme and lavender, as well as under the absinthine element in sage, and the scarcely agreeable geranium element in ground ivy. In some of the

Labiatæ, Teucrium for instance, it is scarcely perceptible, but there are exceptional cases.

I would like to show that the characteristic element in the Cruciferæ has an opposite or thirst-exciting effect, and to point out the effects of citric, amygdaline, malic, nutty and other odors, but enough has been said to illustrate my meaning.

BRIEFER ARTICLES.

A Study of Silphium perfoliatum and Dipsacus laciniatus in regard to insects.[1]—The upper surface of the leaf of Silphium perfoliatum near the axis is thickly set with small hairs. Their length is on the average about .17 mm. They are composed of four cells each having a distinct nucleus; the upper one is somewhat enlarged. Some of the hairs are colorless, while in some a peculiar brown substance was seen which was variously distributed, sometimes in masses at the top of the upper cell or diffused through the upper cell, and sometimes through the lower ones as well. These hairs point toward the tip of the leaf. Similar hairs were found all along the mid vein, side veins and veinlets of the upper surface of the leaf, and also on similar portions of the under surface. No difference was seen between these hairs and those near the axis, except that they were much more thickly set along a surface about an inch in length at the base of the leaf. The leaf examined was about 20 cm. long and was typical.

The brown material does not seem peculiar to the hairs. Upon the upper surface of the leaves were found some more very small prickles composed of two cells, the upper very pointed, the lower one globular and containing an onion-shaped mass of brown matter similar in appearance to that in the hairs. In the epidermal cells of the stalk were found similar masses, and some cells were completely filled with it.

The cavities formed by the perfoliate leaves are very small and hold but a few cubic centimeters of water. They are full after any rain or heavy dew, but are often dry before noon. If cups are dry at night they will be filled in the morning when there is a heavy dew; otherwise they will be dry.

These cups do not appear to serve any purpose as insect catchers. No insects were seen in any of the cups. This plant is not native here,[2] and perhaps it does not show its full development with us.

Is Dipsacus laciniatus insectivorous? To answer this question was the purpose of the following observations:

It is well known the connate leaves of this plant form cups sur-

[1] Read at meeting of A. A. A. S., New York, August, 1887.
[2] Lansing, Michigan.

rounding the stalks, which most of the time contain more or less water. It has been suggested that the purpose of this arrangement is to catch insects for the nutrition of the plant.

A microscopical examination of the leaf surface was made, to discover, if possible, any peculiar organs of absorption. Especially was that portion of the leaf explored that is much of the time beneath the water in the cups. On this portion of the leaf were found two forms of hairs. The more numerous were about .09 mm. long, with a club shaped upper portion upon a pedicel composed of a single cell. The upper part was composed of about five nucleated cells; it was broader than thick, and seemed to be divided by a partition across the narrow way. These hairs were all inclined toward the tip of the leaf with the broad side toward the leaf surface, and were not very numerous. The rarer form of hairs had a rounded head upon a pedicel of a single cell. The head was divided into a number of cells which contained no visible nuclei, but were generally filled with brownish-green masses of granular matter.

Other portions of the leaf were also examined, and upon the whole upper surface along the mid vein, side veins and veinlets, were found hairs similar in form to these and equally numerous. They were also found on the corresponding portions of the under surface of the leaf. So far as *special* organs of absorption are concerned, that part of the leaf below the surface of the water shows no advantage over any other part.

Twenty plants were watched carefully for two weeks, and during that time but few insects were caught, and those were mainly bees; the nutrition from the insects caught could be but little.

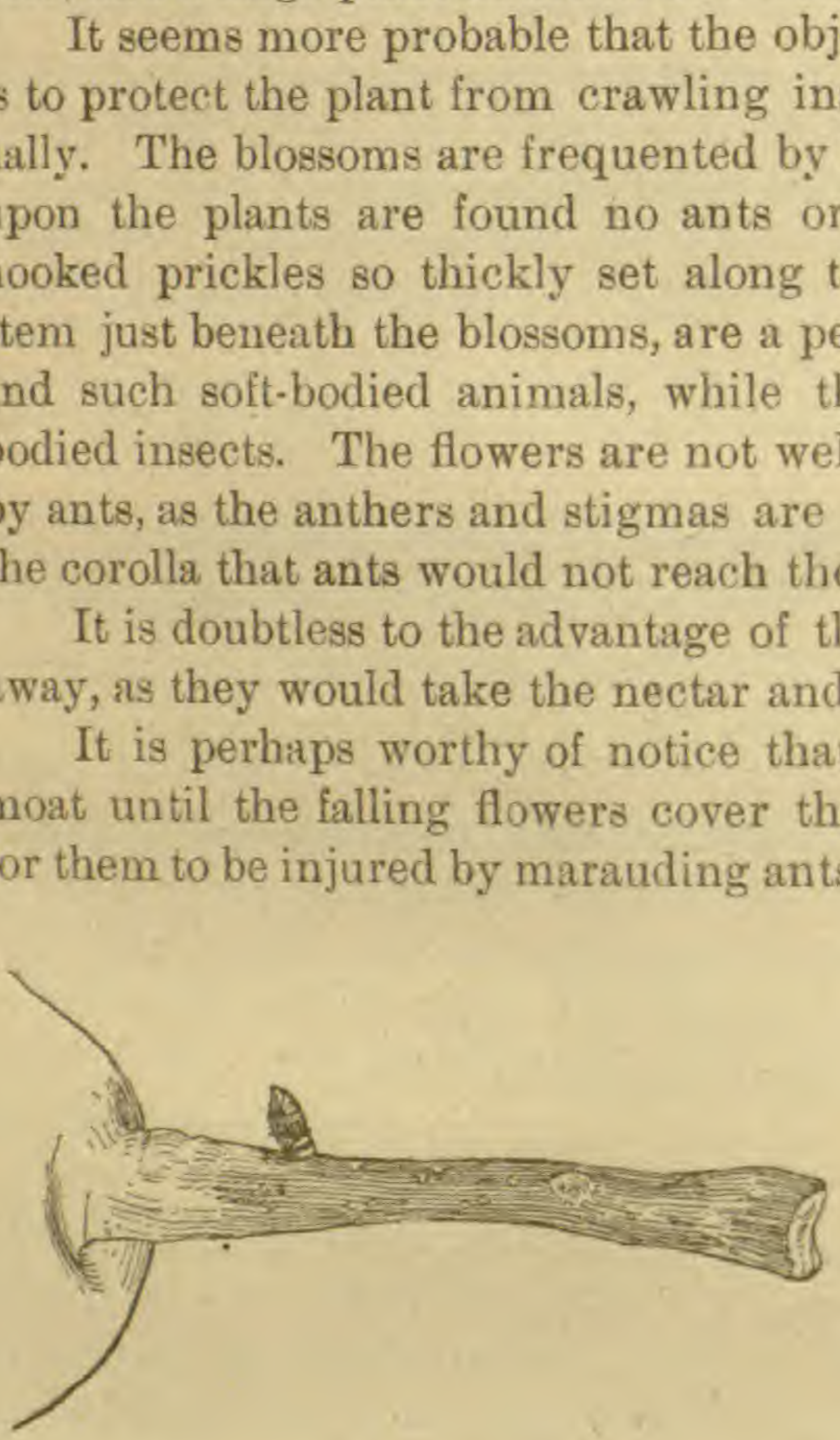
Water was gathered from several plants ten days after a rain, when it had evaporated largely and must have been concentrated. The water was filtered from suspended matter, mainly algæ and flower petals, and the starch-iodine test applied, first for nitrites and then for nitrates, and no indication was obtained of the presence of either. If present at all, they were in extremely small amounts. Nessler's test for ammonia gave a marked reaction, showing the presence of from one to two parts of ammonia in 1,000,000. To take advantage of so small an amount of ammonia hardly seems sufficient cause for such a modification of the leaves, with no *special* organs for absorption. It would seem that the plant might get some good from the ammonia in the water, and perhaps these hairs may absorb the nitrogen compounds from air or water. But this supposition would include all similar hairs on both surfaces of the leaves, and would not account for the cups; it can only be an incidental advantage, therefore, and not the prime use of the water-gathering cups.

Dipsacus depends mainly on the rain for its water supply, and very little upon the dew. Some cups were thoroughly emptied, and it was found that after a heavy dew there would be a little water in the cups. This would tend to replace that lost by evaporation, but this loss is slight because the water is so well shaded from the sun. Upon July 20, there was a copious rain that filled all the cups, and it was five days before any marked diminution of the water was noticed. At the end of fourteen days many of the lower cups still contained water. The cups were found to contain from 300 to 600 cc. An average plant would hold about a liter, and a large plant as much as a liter and a half.

It seems more probable that the object of the cups with their water is to protect the plant from crawling insects, which it does most effectually. The blossoms are frequented by bees and other flying insects, but upon the plants are found no ants or other crawling animals. The hooked prickles so thickly set along the stems, and especially on the stem just beneath the blossoms, are a perfect barrier against snails, slugs and such soft-bodied animals, while the water keeps away the hard-bodied insects. The flowers are not well arranged for cross-fertilization by ants, as the anthers and stigmas are raised so far above the throat of the corolla that ants would not reach them easily and naturally.

It is doubtless to the advantage of the plant that such insects be kept away, as they would take the nectar and yield nothing in return.

It is perhaps worthy of notice that no bridge is thrown across this moat until the falling flowers cover the surface, and then it is too late for them to be injured by marauding ants.—W. J. BEAL and C. E. ST. JOHN.



Bud on a pear stem.—The Howell pear often presents a curious anomaly in bearing a well-developed bud upon its fruit stem. The accompanying cut shows such a bud borne a half inch below the base of the fruit. This singular disposition is additional proof, if any were needed, that the fruit stalk is essentially a true stem, bearing a transformed cluster of leaves.—L. H. BAILEY, JR., *Agricultural College, Mich.*

Cultivation of saccharomycetes.—Some fermentation experiments with which I was engaged during the past summer required the application of pure yeast, free from other organisms capable of producing fermentation. The methods of separation and cultivation employed were very successful, and may suggest something of value here.

A few drops of fresh beer-yeast were shaken in a test tube with sterilized gelatine, which had been melted and cooled again until it was barely fluid. This, flowed upon sterilized plates, gave in twenty-four hours, at ordinary room temperature, a great number of colonies of schizomycetes and saccharomycetes, from which, with the aid of an ordinary dissecting microscope, it was easy to inoculate new cultures. The gelatine was of the ordinary composition in daily use in the laboratory, viz.: ten per cent. gelatine, ten per cent. grape sugar, Liebig's "Fleisch Extract" added to give a yellowish brown color, and neutralized with sodium carbonate. Such a mixture is solid at 25° C.

For further culture the isolated gelatine plate colonies were inoculated into sterilized solutions consisting of an extract made by boiling 200 grams of yeast in a liter of water, filtering, and adding ten per cent. of grape sugar. In such a solution an inoculation of a few yeast cells usually increased in from twenty-four to forty-eight hours sufficiently to cover the sides and bottom of an ordinary 200 cc. flask with a thick white sediment. The cultures were most strong and active at the end of forty-eight hours. The supernatant fluid was then poured off, leaving the yeast deposit comparatively dry, twenty cc. of sterilized water added, and in this condition transfer to the sugar solution undergoing observation was easy, by means of a pipette. By this method, and the use of the extract of yeast as a nutritive solution, pure cultures were repeatedly obtained which excited as active fermentation as the fresh yeast from the breweries, a result not always obtained by the use of artificial nutritive solutions. The original gelatine plate cultures, on account of their rapid growth, were useless after thirty-six hours, and to avoid a constant renewal of the process, as well as the introduction of different species of saccharomycetes, inoculations were made into gelatine tubes. The cultures thus obtained produced characteristic, elegant, ivory-white colonies of 3-6 mm. in diameter, and then further development ceased. In this state they retained their vitality, and were constantly referred to as a source of inoculating material for two months. Probably they remained vigorous much longer, as saccharomycetes are well known to do, but at this time my need of them came to an end.

Such a dormant vegetative state might be favorable to the production of spores, which, according to the prescribed methods, I have had difficulty in obtaining. At least, for the object desired, the method given was found very convenient and successful.—W. E. STONE, *Göttingen*.

The preparation of agarics for the herbarium.—It will be generally admitted that the wretched condition of most specimens of fleshy fungi in herbaria and published exsiccatæ makes them practically worthless for purposes of comparison and identification. The purpose of this note is to call attention to a practicable process for greatly improving the quality of such specimens and so rendering them really valuable.

In 1880, G. Herpell, of St. Goar, Germany, published an account[1] of his method for the preparation of herbarium specimens of fleshy fungi, and from 1881 to 1884 issued illustrations of his method in the form of four small fascicles of Agaricini, under the title, "*Sammlung präparirter Hut-*

[1] Das Präpariren und Einlegen der Hutpilze. Bonn, 1880.

pilze," certainly by far the finest exsiccatæ of this group ever distributed. A partial translation of his article was given by W. R. Gerard, in the *Bull. Torrey Bot. Club* for March and May, 1881.

The writer has succeeded in simplifying Herpell's process without much sacrifice of efficiency, and offers the following abstract of the method, as modified: The whole fungus is split vertically with a sharp knife into halves. From one half a thin slice is taken by a careful cut parallel to the first, and laid aside as No. 1. From the other half the stipe is cut off close to the pileus, and gills and flesh are removed as completely as possible from both pileus and stipe, so as to leave only their outer surfaces intact. These shells of pileus and stipe are Nos. 2 and 3, respectively.

The three preparations thus made are now laid, right side up, on a prepared adhesive paper, covered with unsized muslin, and placed between driers of heavy felt paper, under a moderate pressure.

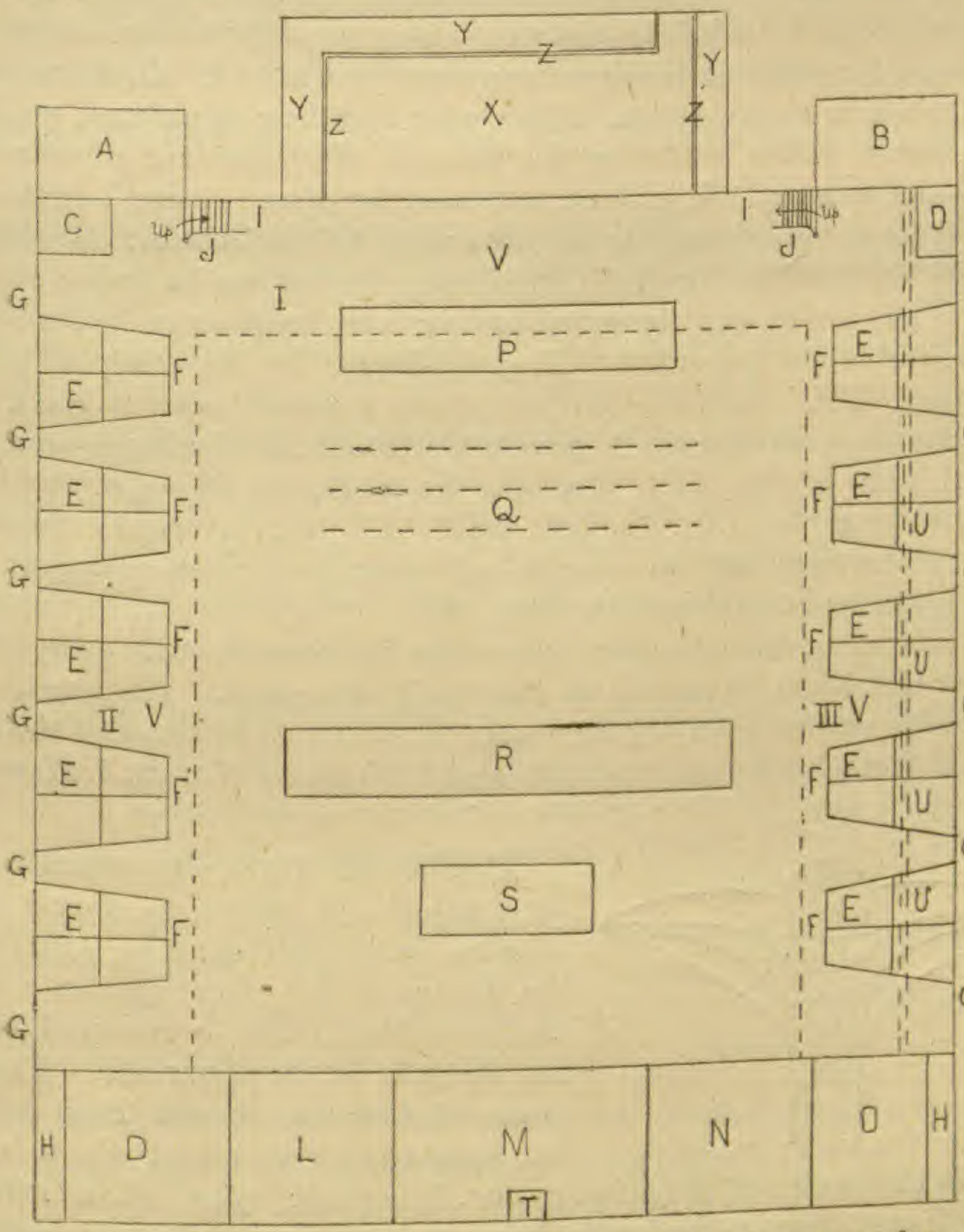
Great care should be taken not to destroy any delicate portions of veil or volva which may be present in making the various preparations, which should show (1) attachment of gills and nature of interior of stipe, (2) nature of top of pileus, (3) nature of surface of stipe and presence or absence and nature of veil and volva. Either of the adhesive papers in use for strapping plants to the herbarium sheet serves excellently for this purpose, viz.: Dennison's gummed paper or photographers' albumen paper. The latter, perhaps, gives rather better results. Driers should be frequently changed, and pressure should be secured by *weights*, not by screws. When the specimens are partly dried the muslin may be carefully removed; and when wholly dried they will be found to be firmly attached to the paper, their adhesion to which has prevented the shrinking so prominent in the common method of drying these fungi.

The paper is now to be cut away with knife or scissors close to the edge of each preparation, which is then ready for mounting. No. 1 is first glued to the mounting paper; then No. 3; lastly No. 2 is put on, overlapping No. 3 in such a way that the two together give a profile view of the living fungus.

Spore preparations made in the usual way on adhesive paper are permanent, since almost any pileus has sufficient moisure to soften the gum or albumen, which dries when the pileus is removed and holds the spores fast. This can then be mounted with the other preparation to complete the specimen.

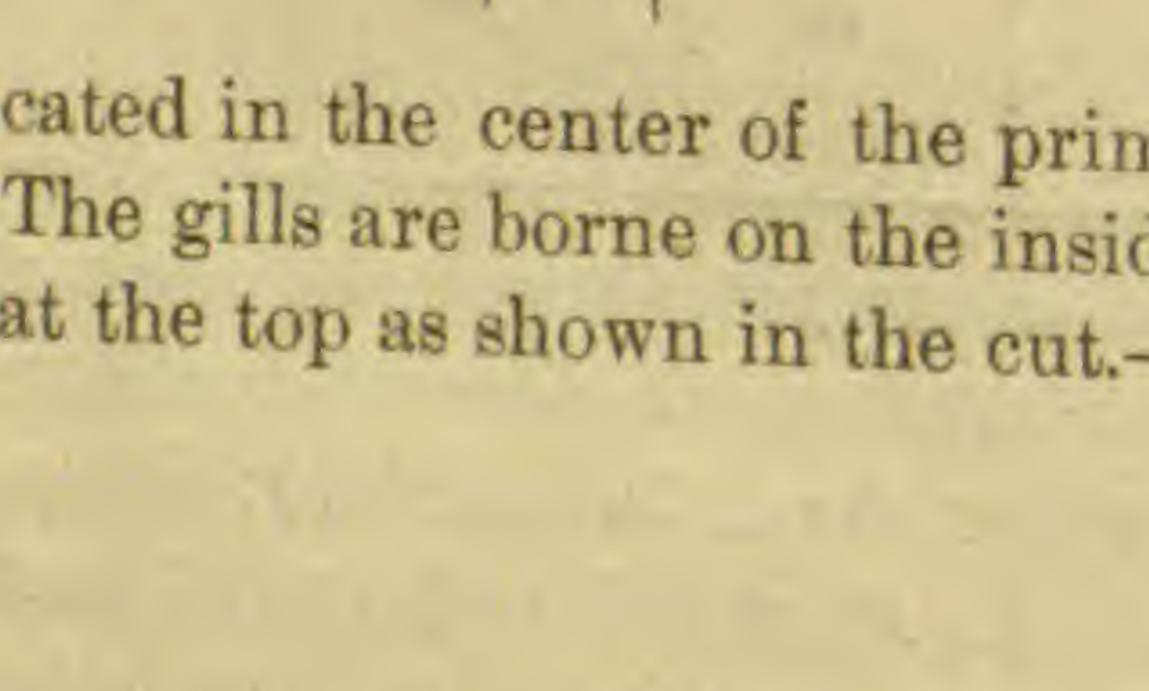
Many little points will suggest themselves in carrying the process through, but the above is an outline of its essential features. It does not wholly obviate the necessity for colored drawings of the fresh fungus, but renders them less indispensable and makes the preparation alone really useful. The time required to make a good specimen is, of course, much longer than is needed to dry and press an agaric in the old way, but is less than that required for a good specimen of a flowering plant, and the difference in time consumed by the two processes is not at all commensurate with the difference in value of the results.—JAS. E. HUMPHREY, *Bloomington, Ind.*

Plan for botanical laboratory.—The BOTANICAL GAZETTE for July, 1885, published an outline course in plant chemistry. A laboratory desk arranged for such work was figured in the same journal for the following November.. It is believed that the laboratory sketched below will be found convenient for the study of plant anatomy as well as of plant chemistry.



A, teacher's private laboratory. *B*, small laboratory for special work. *C*, large spectroscope. *D*, balances; shelves above hold measuring dishes. *E*, students' working desks (BOT. GAZ., July, 1885); above each set are spaces for charts and pictures. At *F*, end of each set of four desks, is a writing-desk and book-shelf. *G*, windows; brackets are to be placed alongside for holding pots of the plants that are being studied. *H*, entrances to laboratory. *I*, doors to botanical garden. *J*, stairs to gallery above. *L*, drying oven; the water is also distilled here. *M*, instruments for taking melting and solidifying points. *N*, combustion furnace. *O*, closet for supplying the chemicals on the students' desks; one side has the following for organic work: petroleum spirit, ether, absolute alcohol, chloroform, carbon bisulphide, benzole, Meyer's solution, gold chloride, Fehling's solution, gelatine, milk of lime, carmine, mounting material; the other side holds the usual re-agents for qualitative and quantitative analysis. *O*, hood for generating H_2S and chlorine. *P*, lecture table; behind is a blackboard which may be pushed down and leave white walls for receiving pictures from stereopticon at *T*. *Q*, chairs with desks for taking lecture notes. *R*, table for distilling apparatus; pulleys to be attached to the condenser for purpose of convenient adjustment. *S*, mills and mortars. *V*, gallery, indicated by dotted lines; I is the library, II for storing chemicals and apparatus, III herbarium; one side is for dried, the other for alcoholic, specimens; shelves can be drawn out to support specimens during examination; the cupboards below hold presses, herbarium paper, etc. *X*, green-house for the study of plant physiology. *YYY*, shelf for growing plants, a certain portion being set aside for each student's use. A pneumatic trough, *ZZZ*, runs around the exposed edge of this shelf. Gases to be employed in experimenting upon the living plants are brought from the main laboratory through tubes. The trough may be covered and made to furnish a support for plants while applying electricity, heat, etc.

In arranging this laboratory, the object has been to bring everything together that could be needed in the study of a plant. Too much can not be said against teaching any natural science so as to make the student feel that science cuts a natural object into parts.—LILLIE J. MARTIN, *Indianapolis, Ind.*



Proliferous fungi.—My attention has been called this season to several proliferous fungi belonging to Agaricini. On the top of the pileus appears a secondary pileus, which is reversed, bearing the gills on the upper side. A specimen of *Lactarius cinereus* Peck before me has a secondary pileus which is located in the center of the primary one. It is nearly spherical and sessile. The gills are borne on the inside, being exposed only by a small opening at the top as shown in the cut.—F. L. HARVEY, *Orono, Me.*

EDITORIAL.

IT IS customary to speak of the botanical work constantly issuing from the German laboratories as representing the highest attainment in botanical activity and accuracy. In a contrast with German botanists, American workers are placed in an inferior position in the estimation of the botanical world. The first statement is undoubtedly true, while the second is no discredit to American botanists, as we desire to show. Botanical activity and botanical ability were never greater in this country than at the present writing. The older botanists add to long lives filled with most enduring work an abiding zeal that associates them with the youngest workers, while an abundance of strong new blood gives promise of a most vigorous development. It is no lack of ability among American botanists that ranks them below their transatlantic brethren, but lack of opportunity, and lack of opportunity comes from lack of equipment. Money-givers and boards of control in this country have no appreciation of the conditions necessary for good botanical work. They think their duty is done when they have employed a man, who is then expected to make bricks without straw. The Botanical Garden at Cambridge, and the noble gift to American botany made by Mr. Shaw of St. Louis, are illustrations of what should become more general. One of the most essential things, and one of the very great advantages of German botanists, is the establishment of a botanical garden. This should be considered the necessary foundation for every botanical position from which original investigation is expected. In fact, the investigator, with his lecture room and laboratories should be considered as a part of the equipment of a botanical garden. It seems to us that this is the imperative need of American botany. It need hardly be said that such an equipment includes the element of time which will make investigation the chief thing and teaching incidental. Our appeal, then, is for friends of American botany to establish botanical gardens, and so endow them that they will not only become seats of botanical investigation, but also inciting causes of similar institutions everywhere.

A CORRESPONDENT of *Science* asks if the trumpet-creeper is poisonous. Such a query might be raised about many plants generally regarded as innocuous. Rhus poisoning is taken as the standard of comparison, in which the virulent effluence is potent enough to affect specially susceptible persons through considerable distance, and a far larger percentage of persons by contact. The most unexpected and harmless plants may be brought into the category. An instance within the writer's knowledge was that of a clear-minded lady of a botany class, who found the large white lady's-slipper (Cypripedium spectabile) a plant to be avoided; and the absurdity of the notion in the opinion of the other members of the class did not in the least change her positive assertion of its poisonous qualities. It would be a curious and, withal, an interesting inquiry to trace up and catalogue such experiences and to investigate the nature of the poisoning, if such it be. The subject has considerable of the indefiniteness and evasiveness of the ghost, haunted-house and mesmeric questions now being investigated by the society for psychical research, and it may be doubted by some if the results of the inquiry would be any more valuable. There is, however, the substantial question of rhus poisoning, whose etiology has not yet been settled, to afford a *point de résistance*, and when that is fully elucidated the more obscure cases may, to some extent, fall easily into place. Even a knowledge of the extent of the subject would have a value.

OPEN LETTERS.

Organized botanical work.

It seems to me no more important suggestion looking to the promotion of the progress of botany in this country has been made than that of Prof. Farlow, in his paper entitled, "The Task of American Botanists," in which he urges that the amateur botanists of America be organized and their work directed. There are hundreds of educated young men and women in this country who are capable of doing something to promote botanical knowledge, some in one branch, some in another, and who are also eager to do it, but they need to be told what to do, what subjects to investigate. They are desirous of working, but do not know where to begin; or, perhaps, in many cases, they are industriously studying a subject which is too large for them, or one which has already been satisfactorily wrought out, so that their work profits none but themselves. In this way the science suffers an immense loss.

Now, it seems to me, a practical scheme might be devised whereby most of this wasted or misapplied talent might be turned into useful channels. Astronomers are organizing for the systematic study of the heavens; why should not the botanical talent of the country be similarly organized for the purpose of furthering botanical research in a systematic manner? E. S. BASTIN.

Chicago, Ill.

Crackling sound of Utricularia.

I write to ask an explanation of the distinct crackling sound produced by Utricularia vulgaris when it is disturbed. I had for some time supposed it was to be heard only from fronds removed from the water and beginning to dry, but I find the same phenomenon when the plants, old ones filled with sacks, still in the water, are disturbed. On shaking such a stem the rattle is distinct, the separate clicks being as loud as those made by slowly winding a watch. After the first series of clicks the plant must rest some time before a second disturbance will produce a second fusillade. D. S. KELLICOTT.

Buffalo, N. Y.

Bees mutilating flowers.

The note on bees mutilating flowers, in "Open Letters," was interesting to me, having been interested in the same subject myself. I believe it is considered safe to plant two colors of balsams (Impatiens balsamina) in adjacent rows without their mixing. Not being satisfied to take it for granted, I sought the reason. Upon examination I found the anthers were closely pressed to the stigma, thus insuring self-fertilization without any outside help. Also, as the flower became double, the opening to the spur was entirely closed by petals. Humble-bees, in seeking for honey, were obliged to visit the "back" of the flower and puncture the spur. I never saw one visit the inside of the flower nor puncture a spur that had been visited before, though it did not seem to learn that fact until it visited each flower.

Humble-bees, in getting the honey from Salvia splendens, enter the calyx and slit the corolla. This is a very interesting subject, and any one observing anything bearing on the subject would do well to make notes and send them for publication. E. S. MILLER.

Wading River, N. Y.

CURRENT LITERATURE.

Fossile Pflanzen aus der Albourskette, von Dr. A. Schenk. Bibliotheca Botanica, Heft 6, 4to, pp. 14; pl. ix. Cassel: Theodor Fischer, 1887.

The Albourskette, the locality from which the fossil plants herein described were obtained, is a mountain chain on the southern and western sides of the Caspian sea in Northern Persia. It is a locality difficult of access, and consequently has been rarely visited by collectors of fossil plants. The first to explore these plant deposits was Dr. Göbel, of Asterabad, who submittted a small collection to Dr. H. R. Göppert for examination. From this material Dr. Göppert identified (Schles. Gesell., 1860, p. 19, 20) six species, of which four were ferns and two were cycads. From the resemblance between these plants and those obtained in the vicinity of Baireuth, and also from geological considerations, Dr. Göppert concluded these plant-bearing beds to be of Liassic age. Later Eichwald collected from the same locality the species mentioned by Göppert, as well as several additional ones, and ventured the opinion that the strata showed oölitic as well as liassic characters. The material placed at the disposal of Dr. Schenk was collected chiefly by Herr Tietze, from the vicinity of Hif, near Kaswin; from Tasch, which is between Sahachrud and Asterabad; and from Mt. Siodshur, near Ah. This material was much more copious than any that had previously been examined, and from it he was able to identify 28 species, of which number 4 proved to be new to science. No dicotyledons are of course represented, the species being distributed among the various divisions as follows: *Equisetaceæ*, 2; *Filices*, 8; *Cycadaceæ*, 12; *Coniferæ*, 6. The most valuable part of the paper is the interesting comparison made between this flora and that of Franconia, Scandinavia, and Tong-King, India. Of the 28 species found in the vicinity of Hif and Tasch only 7 are peculiar. Of this number 10 are found in Franconia, 12 in Scandinavia, and 6 in Tong King. This shows that the flora of these localities, widely separated as they are geographically, was nearly or quite synchronous, another argument pointing to the wide geographical distribution of the early floras. The American plant-beds which furnish a flora most nearly related to that of the famous Franconian beds are the older mesozoic of Virginia and the so-called triassic of Emmons, in North Carolina. From these considerations Dr. Schenk decides the age of these beds to be rhetic, placing them lower, it will be seen, than any of the previous investigators. The abundance of ferns and cycads argues for this flora a tropical temperature. Each species is carefully described and discussed, and in most cases fully illustrated.—F. H. KNOWLTON.

Sylloge Fungorum omnium hucusque cognitorum. Digessit P. A. Saccardo. Vol. v; Agaricineæ. Patavii, sumptibus auctoris; 1887. 8°. pp. 1146.

The fifth volume of Prof. Saccardo's great work, Sylloge Fungorum, will be gladly welcomed by all students of the department of mycology to which it pertains. Though devoted to a single family, Agaricineæ, it is the most voluminous one of the series yet issued. Its 1146 pages contain descriptions of 69 genera and 4639 species. The original design of the work, as the author remarks in the preface, being to collect and systematically arrange published descriptions, no attempt has been made to elucidate synonymy or to suppress invalid species. Here is a vast and difficult work for some one yet to undertake. It is gratifying to note that the spore characters have been so generally introduced with the descriptions. While the main features of the Friesian system of arrangement have been followed, some notable changes have been made.

The sections of the family are still based on spore coloration, but in an amplified sense. The section Leucosporæ has been made to include Hygrophorus, Lactarius, Russula, etc.; also, such genera of tough marcescent species as Marasmius, Lenzites, Lentinus, etc., though these are still retained in a subsection *Tenaces*. The third section, Ochrosporæ, equals Dermini of Fries with Cortinarius and Paxillus added; and the fourth, Melanosporæ, includes the Friesian Pratelli and Coprinarii with Coprinus and Bolbitius, thus reducing by one the old sections.

The subgenera of the vast genus Agaricus have been raised to the rank of genera, and Agaricus includes only those species formerly placed in the subgenus Psalliota. Whatever may be said of the characters on which these genera are founded, this arrangement is certainly more convenient.

The exannulate species of Amanita, corresponding to section B of Fries, constitute the genus Amanitopsis, and in like manner the annulate species of Panæolus become a genus Anellaria. The same distinction, however, has not yet been accorded to the annulate and volvate species of Coprinus, though logically it would seem to be required.

Of course, there are a few omissions, but these can easily be excused in a work so vast. Students of this branch of mycology will find the volume a most useful, convenient, and even indispensable one, and will be very grateful to Prof. Saccardo for giving them such a vast amount of solid mycological literature in such a compact, systematic form, at the comparatively low price of 72 francs.—CHAS. H. PECK.

A Course of Practical Instruction in Botany: Part II, Bryophyta–Thallophyta. By F. O. Bower, D. Sc., F. L. S., and Sydney H. Vines, D. Sc., F. R. S., F. L. S. Macmillan & Co.: London, 1887. 12°, pp. 144.

The first part of this work, embracing the flowering plants and vascular cryptogams, was issued over two years ago, and noticed in this journal for May, 1885. The present part, entirely from the pen of Dr. Bowers, as we learn from the preface, completes the work with the same admirable features displayed in the first part. It is unnecessary to repeat here the general comments and criticisms made upon Part I in the earlier review, as they hold equally good for all portions of the completed work.

For mosses and liverworts under Bryophyta three types are used, Polytrichum, Sphagnum and Marchantia. The Thallophyta are divided into algæ and fungi. Sixteen types are used for the algæ, of which the first three are salt water forms representing the red and olive-green seaweeds, and the others are fresh water forms, the number permitting quite a range of well selected types. The fungi are illustrated with ten types, beginning with the common mushroom, Agaricus campestris, and continuing with the wheat rust, Puccinia graminis in its various stages, the cup fungus, Peziza, a lichen, Parmelia parietina, ergot, several molds, the white rust on Capsella, and Pythium DeBaryanum.

The selection is to be commended, and the treatment also, with some slight reservations. This stricture refers chiefly to the occasional lack of sufficiently explicit directions, in order that the learner may not go astray or become hopelessly lost in demonstrating difficult points of structure, or in attempting to find the more obscure parts referred to. Much is left to the ingenuity of the pupil, or the help to be obtained from a master.

For advanced pupils, especially those under good supervision, the work will prove most serviceable. The directions for studying the lifecycle of the lower forms, in the cases where it can be done to advantage, is a valuable feature.

Comparative Morphology and Biology of the Fungi, Mycetozoa and Bacteria. By A. DeBary. Translated by Henry E F. Garnsey, M. A.; revised by Isaac Bayley Balfour, M. A., M. D., F. R. S. Clarendon Press, Oxford, 1887. Roy. 8°, pp. 525; 198 wood-cuts.

A faithful and adequate translation of this invaluable work on fungi and fungoid plants places the important facts pertaining to their physiology, structure and classification within easy reach of every English botanist. A feature that characterizes the work above all others on the subject is the broad and philosophical treatment, giving not only a connected view of the whole field, but a systematic arrangement of the subject matter based upon ample knowledge and sound deductive reasoning.

The title indicates the scope of the work, the lichens being included with fungi. The course of treatment for the fungi is as follows: general histological characteristics of hyphæ and growth forms; forms of the mycelium; formation and dissemination of spores; systematic and comparative account of the several groups, the principal ones being Peronosporeæ, Saprolegnieæ, Mucorini, Entomophthoreæ, Chytridieæ, Ustilagineæ, Ascomycetes, Uredineæ and Basidiomycetes, covering over 200 pages; spores and their germination; conditions of growth; and parasitism, including that of lichens. The mycetozoa comprise the myxomycetes, the Acrasieæ and some doubtful forms, which severally receive general treatment. The chapter on bacteria is an admirable summary of the chief facts and relations of their morphology and physiology.

It is needless to go over the contents of the work more specifically, for the limits of a review, even when extended, can give but an imperfect idea of the wealth of matter in so large and carefully prepared a treatise, and the opinion of the reviewer regarding its superior merits must be accepted without argumentative accompaniment.

In its German dress the work is already known to many of our advanced students of fungi, as it was issued about three years ago, being reviewed in this journal for December, 1884. The translators have not attempted to bridge the interval with notes or later discoveries which affect the text. Thus, on page 337, the statement that the germinating sporidia from the teleutospores of Puccinia graminis penetrate into the epidermal cells of the barberry, but "never into a grass," is shown by the researches of Plowright not to be unqualifiedly true. However, in spite of the mutations due to extension of knowledge, the work will be standard for many years to come.

Ueber die Bildung der Knollen. Physiologische Untersuchungen von Hermann Vöchting. (Bibliotheca Botanica, Heft 4.) Theodor Fischer: Cassel, 1887. 4°, pp. 55. Illustrated.

This memoir forms the fourth number of the Bibliotheca Botanica, under the editorship of Drs. Uhlworm and Hænlein. It deals with an investigation into the action of light, moisture and gravitation upon the production of tubers, especially those of the potato; or, as the author has concisely stated it in the first sentence of the introductory chapter, "The subject treated in the following pages is the problem, what causes determine the position and growth of tubers." The potato was used for most of the experiments, being especially well adapted for the purpose. Besides the potato, Helianthus tuberosus and Ullucus tuberosa, the latter a South American esculent, were studied as examples of annual tubers, and two species of Begonia for perennial tubers. The author refers to de Vries' memoir (Landw. Jahrbücher for 1878) for a critical review of most of the literature pertaining to the subject.

The variety of potato chiefly used for the experiments is one not commonly grown in this country; it is known in Germany as the "six-weeks potato," in France as "marjolin," and its peculiarity consists in usually producing a thick leafless growth at one end during the period of rest, being the expansion of the terminal bud.

By many ingenious experiments it was established that light exerted a retarding influence upon the growth of the tuber, and that a certain range of temperature was also desirable. Tubers may occasionally be produced above ground in the light, as is known not only from casual observation but as proven by earlier investigators. The author showed from his own experiments that the potato stem is verticibasal; that at its base it normally produces, besides the roots, the tubers, and at the apex the foliage. When a plant is grown from a reversed cutting, the tubers are produced upon the proper base of the stem, which is now above ground and in the light. Tubers can also be produced above ground by using a cutting which has only part of one internode sunken in the soil, so that no node is below the ground to give off subterranean stolons. Another method is to start the tuber, and when the roots around the base of the shoot are of some length, to remove the old tuber and leave the stem entirely above ground but with the roots in the soil. The base of the stem, which is now above ground, produces tubers. Tubers formed above ground are small, but it was found that if the light was excluded from such a tuber it grew to the usual size.

Space does not permit a further mention of experiments or even a full statement of the results. It must suffice to say that the author concludes that the position and the growth of the tuber and the deposition of starch in the same are separable processes; that gravitation has very little or nothing to do with determining the position of tubers, but that it depends for the most part upon internal causes; and that light has a strong retarding power on their development.

The work is an excellent example of physiological research carried on with inexpensive apparatus and without the employment of a microscope.

NOTES AND NEWS.

PROFESSOR HUGO LOJKA, a Hungarian lichenologist, died at Budapest September 7.

B. T. GALLOWAY, of Missouri, has been appointed assistant in the mycological section of the Department of Agriculture at Washington.

D. BRANDIS (in *Nature*) says that the principal garden roses cultivated in Europe and in India may be traced to Western Asia and China.

PROF. WILLIAM R. DUDLEY, after traveling through parts of Germany and Switzerland, has begun his studies for the winter in De Bary's laboratory at Strassburg.

DR. VASEY'S report for 1886, as botanist to the Department of Agriculture, has been distributed in the form of an author's edition, consisting of 27 pages of text and 21 plates.

EDWARD L. GREENE, in *Torrey Bulletin*, says that Nelumbo of Baillon has precedence over Nelumbium of Willdenow, and that Nelumbium luteum should be *Nelumbo lutea* Baillon.

THE GOVERNMENT of Jamaica offers a prize of £100 for the best practical elementary text-book of tropical agriculture. Manuscripts are to be sent to the Government of Jamaica on or before August 1, 1888.

IN *Journal of Botany* for October, Arthur Bennett describes a new Potamogeton from Mexico (P. Mexicanus), and incidentally remarks that *P. Claytonii* Tuck. should undoubtedly be *P. Pennsylvanicus* Willd.

DR. E. LEWIS STURTEVANT resigns his position as director of the New York Agricultural Experiment Station at the close of the year, and will be succeeded by Mr. Peter Collier, well known for his work on sorghum sugar.

A PAPER of over two hundred determinations of fossil plants, including some new species, by Leo Lesquereux, prepared for publication by F. H. Knowlton, has been distributed as an excerpt of the *Proceedings U. S. National Museum.*

DR. GRAY and wife have returned from their six months absence in Europe in good health and spirits. The results of this visit will appear in the sadly-needed and long-looked-for volume on North American Polypetalæ.

IN *Bulletin of the Torrey Botanical Club* for October, Dr. T. F. Allen describes several new Characeæ (with five plates), two of which belong to this country, viz.: Tolypella Macounii from Niagara Falls, and Nitella Morongii from Nantucket.

COOKE'S BRITISH DESMIDS, which has been issuing in parts, is now completed. It contains 370 species, which is 160 less than recorded by Mr. Wolle for the United States. The bound volume is sold for two and a half guineas, about \$13.12½. It is illustrated with sixty-six colored plates.

IN THEIR STUDY of North American Umbelliferæ Professor Coulter and Mr. Rose desire to examine collections from all parts of the country. Many of the species, as shown by our best herbaria, are greatly confused in naming. They offer to name and return any collection of Umbellifers from North America, and attention is called to the fact that good fruiting specimens are usually necessary for accurate determination.

WILL THRELFALL is at work upon the gentians, and has asked American botanists to assist him in procuring plants, seeds, or dried specimens of our species. He offers to exchange or purchase, and will send a list of desiderata upon application. His address is Hollowforth near Preston, Lancashire, England.

WORD as late as July 29 has been received from Dr. G. M. Dawson's party exploring the Yukon district. Only the great growth of sphagnous mosses and the abundance of reindeer moss give the country a different appearance from that of British Columbia. They speak of sometimes struggling through tangled woods knee-deep in moss.

RECENT WRITINGS on the root swellings and their bacteria-like contents in the Leguminosæ and other plants are reviewed through eight pages of the *Botanisches Centralblatt* (Bd. 31, Nos. 10 and 11) by Dr. Paul Sorauer. No reference is made to articles in English, although such have been published both in England and this country.

A DISTRIBUTION of rust exsiccati will shortly be begun under the title, *Sydow Uredineen*, to contain the different stages, æcidium, uredo, teleutosporic, and the forms upon all the different host plants. It will appear in fascicles of fifty numbers, at nine marks each. Address P. Sydow, Schoeneberg bei Berlin, Goltzstrasse 3, Germany.

BUJWID, in *Zeitschrift für Hygiene*, claims the discovery of a chemical test for the detection of the cholera bacillus. To bouillon-cultures ten to twelve hours old, and gelatine-cultures after twenty-four hours, 5 to 10 per cent. of ordinary muriatic acid is added. In a few minutes a rose-violet color appears, which increases in intensity for half an hour.

IN the *American Naturalist* for October, Dr. Bessey extends the range of several well known trees. *Pinus ponderosa*, var. *scopulorum* Eng., he found as far east as the 100th meridian, along the bluffs of the Niobrara river. Along with it grows *Juglans nigra* L., whose range is thus extended westward to the 100th meridian. Ostrya Virginica was also observed along the Niobrara river and in the Black Hills of Dakota.

THE TOMATO DISEASE called "black spot," caused by *Cladosporium Lycopersici* Plowright, seems to have become very virulent in England. *The Gardeners' Chronicle* for October 1 figures and describes it. The fungus seems first to attack the decayed remains of the style while the fruits are small and green, and thus gains access. The remarkable flattening of the apex of the fruit is one of the peculiarities of the disease.

THE HERBARIUM of H. H. Babcock, who published a well prepared list of the plants of Chicago and vicinity some fifteen years ago, was recently presented to the Northwestern University at Evanston, Ill., by his widow. It contains over 10,000 species. The herbarium of E. R. Brownell, of Hartford, Conn., deceased, containing about 2,500 species, with unnamed specimens from Cuba, has been presented to Brown University at Providence, R. I.

IN *American Garden*, Prof. L. H. Bailey, Jr., discusses the question of acclimatization. The term he restricts to the operations of man in habituating a species to a climate at first injurious. The discussion is a very interesting one, and is divided into two heads: 1. Acclimatization through a change in the individual plant; 2. Through a variation in offspring. Under each head the modification or variation in constitution and habit are separately considered.

THE THIRD REPORT, to cover the year 1885, on diseases of hyacinths and other bulbous and tuberous plants, by Dr. J. H. Wakker, has recently been distributed. Dr. Wakker was employed by the General Union of Bulb Culturists of Holland to investigate for three years (1883, 1884, 1885) the diseases of flowering bulbs, and his three reports, the last much delayed in the printing, contain valuable information based upon careful research. They are written in the Dutch language.

DRUGS AND MEDICINES of North America, for June, has recently been distributed, containing the concluding part of the account of Erechthites hieracifolia, and most of that of Caulophyllum thalictroides, both plants of much therapeutic value. Upon the completion of the present volume, three or four more parts, the publishers will no longer issue it as a periodical but in completed volumes. This change is necessitated by the numerous protracted investigations on which the work is based, and which give it its special value, but which can not be invariably brought to an end at stated intervals.

THE UNIVERSITY at Graz, Austria, is to have a botanic garden, the sum of $23,000 having been appropriated for that purpose. The *Botanisches Centralblatt* points out the absurdity, from the European point of view, of expecting satisfactory results with this amount of money, as the garden at Leipzig cost $125,000, and that at Strassburg about the same. It will permit the erection of a small garden house and a green-house, but there can be no lecture rooms, no offices and rooms for investigators and no place for students, although the latter are now recognized as a necessary adjunct to a well-ordered botanic garden.

FRIEDRICH T. KUETZING, the learned algologist, will complete his eightieth year on the 8th of December next. He was one of the first to recognize that for the investigation of the cell and its life the simplest plants, such as are found among algæ, are the most serviceable. He made many profound researches, and his systematic works on the algæ of Europe are still standard. It is proposed to offer him on his eightieth birthday some mark of public recognition and gratitude for his eminent services as a naturalist. The committee having the matter in charge consists of Messrs. Ascherson, De Bary, Berthold, Cohn, Cramer, Eberstein, Haussknecht, Kny, Leitgeb, Magnus, Müller, Pfitzer, Pringsheim, Reinke, A. Schmidt, Schwendener, Solms-Laubach, Stahl, and Strasburger, mostly well known names to American botanists. Contributions should be sent at once to Otto Müller, Berlin, W., Köthenerstr. 44.

THE *Kew Bulletin* for October contains an account (with two plates) of the onion disease at Bermuda, caused by *Peronospora Schleideniana* De Bary. Observations were undertaken by Mr. Arthur Shipley, under the auspices of the Royal Gardens. The favoring atmospheric conditions are heavy dews or rains, followed by warm, moist, calm weather, and the absence of direct sunshine and cold winds. The life history of the fungus is well known to botanists, with its internal parasitism in the leaves, its conidial branches protruded through the stomata, and its reproduction by asexual and sexual spores. It is suggested that onion plants should be made as strong as possible to resist attack, and, to prevent spreading, all affected plants should be collected and burned. Diseased plants may be treated with a mixture of powdered sulphur and freshly burnt quick-lime, or sprayed with a weak solution of iron sulphate. In both cases the fungus is destroyed without injuring the plant.

HALSTED on POLLEN NUCLEI.

Three nuclei in pollen grains.

BYRON D. HALSTED.

(WITH PLATE XVI.)

The pollen under consideration was obtained by placing twigs of Sambucus racemosa in a tall bell jar of water on March 3d and keeping them in a warm sunny room. The experiment was begun primarily to illustrate to students the effect of coating the cut surface of the severed twig with asphalt or a similar substance impervious to water. There were four similar twigs, each eighteen inches long, placed in the water. Two of them had their cut surfaces coated with varnish, while the remaining two were set in the liquid with the freshly cut ends fully exposed. The asphalt used was that employed for cementing cover glasses to the slides in making permanent microscopic preparations. The buds upon the stems having free cut surfaces quickly began to enlarge, while those of the twigs that had received the varnish did nothing more than slightly swell, and never produced any leaves. The unvarnished stems sent out their characteristic foliage, and at three of the nodes flower clusters of considerable size were developed. It was from these flowers that the pollen was obtained for the observations herein recorded.

The above facts are given because there may be a difference between the behavior of the pollen thus forced before its time and that which would have been produced normally upon the shrubs several weeks later in the season.

When viewed dry, the pollen is about twice as long as broad (20 μ by 40 μ), and exhibits three dark lines or sutures which run lengthwise of the grain. The appearance of the dry grains is shown at *a* in the plate. All the illustrations were drawn with the camera to the same scale, and are magnified two hundred and eighty times. To the left of *p* are two grains showing the surface of the dry grains. The extine is marked with faint irregular lines, resembling a network of minute cells. This slight obstruction to the view quickly disappears when water is added, and at the same time the grains become nearly spherical and lose all signs of the original tripartite nature. When treated with a mixture of half water and glycerine the nuclei are easily seen. On the right of *p* are three grains; the upper one shows an end view with the three division lines of the grain. Below this are two grains in which the nuclei are evident. There seems to be a nucleus for each third of the grain. After pollen has been in pure glycerine for two days the grains become plump and the contents are nearly colorless, except the nuclei, which are large and well defined. Three such grains are shown at *c*. In many instances the nuclei seemed united by their ends, while in others all three were evident.

For germination fresh pollen was placed in a ten per cent. solution of cane sugar in one of a nest of porcelain macerating dishes, and forty hours after the tubes were of the lengths indicated in the plate. The earlier stages of germination are shown at *d*. Usually there was a single tube, but occasionally the tube branched as it issued from the grain. In some cases there were two points of departure, as shown near *a* and at *h*. The course of the tube was rarely in a straight line, but instead became much twisted and contorted during the early part of its growth. Afterwards it expanded into a swollen tip as at *e*, where there is a strong tendency to fork at its enlarged extremity. To the left of *e* is a tube which makes a sharp twist near the middle and afterwards swells into an Indian-club-like tip.

The coloring substances which proved the best for the study of the nuclei were eosin and azo-rubin. The latter is by far the best of all substances used for the demonstration of the nuclei. Nearly all of the tubes showing three nuclei, as given in the plate, were treated with azo-rubin. No nuclei are shown in some of the tubes, and these, as at *e* and *t*, were drawn from eosin-prepared specimens. The aceto-methyl green recommended by Dr. Strasburger proved of very little service in comparison with the azo-rubin. This latter substance almost instantly developed a deep blood-red color in the nucleus, while the remaining portion of the protoplasm was left of a lighter hue.

Observations were repeated from day to day with fresh specimens dipped from the culture dish, and the presence of the three nuclei was demonstrated in hundreds of cases. In fact, in nearly all long tubes the three blood-red bodies would appear upon the application of the coloring reagent. In many instances the three nearly equal-sized bodies were found after all else in the tube had disappeared.

The attention of teachers who give laboratory instruction is called to the exceedingly easy way in which an unlimited supply of material was provided for this study. A thoroughly cleaned porcelain dish three inches in diameter and a quarter of an inch deep received an ounce of ten per cent. sugar solution, and into this a large quantity of the pollen was dusted from the flowers. A second dish was placed over the first so as to prevent evaporation and the ingress of mold germs. The nourishing solution was kept in a warm room, for it was yet cold out of doors and snow covered the ground. New pollen was dusted into the syrup from day to day so that all stages of the tubes might be obtained at any time. A preparation for the microscope was made by simply dipping out a drop of the syrup on the cleaned tip of a scalpel and placing it upon a glass slide. Fully a week elapsed before molds began to interfere with the culture. Even after the fungus filaments were producing an entangled mass the pollen and their tubes could be easily determined by the addition of the azo-rubin. This substance did not affect the mold unless very strong, while it almost instantly colored all the protoplasm of the pollen grains and of their tubes.

No mention is found of pollen grains having three nuclei, so far as the literature of the subject has been reviewed by the writer.[1] Dr. Goodale[2] speaks of only two nuclei, one of which is usually larger than the other. Professor Coulter in his paper[3] shows only two. In like manner Professor Barnes[4] demonstrates but two nuclei. If we follow Strasburger, in his later works, the larger is called the vegetative nucleus. With the case in hand the nuclei are all of nearly equal size. As a rule they pass out into the tube early in its development, and generally may be found in the lower half, if not within the club-shaped extremity. When only two nuclei were found in a grain or its tube, one was frequently larger than the other. This fact has led to the suggestion that the larger or vegetative nucleus may undergo a process of division early in the development of the pollen grain. In some of the immature grains only two nuclei were observed, and these seemed to be united by their slender tips, as indicated above *(c)* in the plate.

In closing, the attention of teachers of physiological bot-

[[1] Strasburger describes and figures pollen grains with three nuclei in his *Neue Untersuchungen*.—EDS.]

[2] Goodale's Physiological Botany, p. 428.

[3] Pollen spores of Tradescantia Virginica. BOT. GAZ. XI, p. 10.

[4] Process of Fertilization in Campanula Americana. BOT. GAZ. X, p. 349.

any is again called to the very easy manner in which a large supply of germinated pollen was provided for the study here outlined. The same method has proved successful in several other cultures.

Fertilization of Calopogon parviflorus Lindl.[1]

CHARLES ROBERTSON.

While at Orlando, Florida, in February, 1887, I found this plant very common in pine barrens.

The flower is interesting from the fact that the ovary is not twisted, so that the labellum occupies the upper side and the column the lower. These parts are at right angles to each other, the labellum being erect and the column curving outward and a little downward. The labellum gradually narrows to a winged basal portion, on which it is hinged. In the wind it often bends forward: in old flowers it falls from its own weight and lies upon the column. In front it is furnished with a conspicuous crest of club-shaped hairs. From above the hairs increase in length so that their tips rise to about the same level. The lower project strongly from the labellum, and many of them are fused together, especially below. When the labellum is bent down upon the column the crest does not reach as far as the stigma. The stigma is at the summit of the column, and is covered with viscid matter. In a little pocket just under the stigma lies the anther, which is two-celled, each cell containing two pollen masses whose grains are lightly connected by threads.

Small bees, Andrenidæ, approaching the flower in front, light upon the crest, when the labellum bends suddenly, so that the dorsal surface of the insect comes down upon the column. The broad, slightly upturned wings of the column keep the body from passing to either side, and so require it to slip off the end. In doing this the body strikes the stigma and is smeared with viscid matter. The pressure of the insect upon the stigma starts the anther from the pocket, so that the ends of the pollen masses are exposed. As the body slips off the end of the column the exposed ends of the pollinia strike the part which is smeared with viscid matter from the stigma, and the pollinia are drawn out and cemented to

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[1] Kindly determined by Dr. Sereno Watson. For an interesting account of the morphology of Calopogon and a figure of C. pulchellus, see "Goodale & Sprague," "Wild Flowers," pp. 73 and 85, and pl. xiv.

the exact spot which struck the stigma in the first place. When the insect visits another flower, the part to which the pollen is glued comes down upon the stigma.

Cross-fertilization results from the fact that the stigma is struck before the pollinia, from the startling action of the labellum, and from the fact that only two or three flowers are open at a time. Guignard's[2] opinion, that cross-fertilization is not so well assured as in Pogonia, no doubt, rests on an erroneous view of the floral mechanism.

There is no nectar. If there were any real source of attraction about the crest, small insects which are not heavy enough to depress the labellum would be the only ones to enjoy it undisturbed. The hairs of the crest look like a cluster of dehiscent stamens, for which, I think, they are mistaken by insects. If so, the flower is one of Sprengel's "Scheinsaftblumen," except that the attraction imitated is pollen instead of nectar. Specimens of two species of Halictus, which visited the flowers, had their pollen-carrying hairs well filled, showing that they were on pollen-collecting expeditions. On the other hand, butterflies, which do not visit flowers for pollen, paid no attention to the crest, but sought in vain for nectar near the center of the flower. Guignard[3] saw a bumble-bee light upon the column of C. pulchellus, no doubt expecting to find nectar, while one which I saw pull down the labellum had pollen in her baskets and evidently mistook the hairs for stamens.

In regard to the source of attraction, Guignard[4] says: "There is, indeed, no free nectar, but the basis of the lip and of the column, which are connate, are thickened around a small depression which seems to correspond to the spur of the other genera, and are as if swollen with juices. To insects knowing how to draw from this store the winged column offers a most convenient stage while sucking the sweets. Then the anther is behind them and the pollinia must become attached to their legs, as is the case with the milk-weed." But he did not see the thickened parts punctured by any insect, nor did he find pollinia on the legs of any. The thickened base of the lip seems to be intended to keep it from bending below the hinge, and that of the column to support the weight of an insect which falls upon it. From Guig-

[2] "Insects and Orchids," J. A. Guignard, 16th Annual Report Ent. Soc., Ontario, 1886, p. 43. In the 17th report of the same, p. 51, Guignard gives an interesting account of the fertilization of the Cypripedium spectabile by Megachile melanophaea.

[3] Loc. cit. 39.

[4] Loc. cit. 43.

nard's account, the labellum might as well have no hinge, and the crest would do as well if it were a bright spot on the surface.

The Rev. A. B. Hervey[5] also takes it for granted that the pollinia are fastened to the under side of insects.

When I first noticed the curiously hinged and crested labellum it occurred to me that Mr. Darwin would say that here was the place to look for an explanation of the flower,[6] and I soon formed the theory which I succeeded in verifying. On relating my observations to Professor Trelease, I found that he had held the same view of the flower, and had corresponded with Dr. Hermann Müller on the subject. At my request, Professor Trelease has furnished me with the following note: "Briefly, my idea of Calopogon was that the weight of the insect visitor must bend the labellum so as to bring the bee's back against the column, thus enabling it to effect pollination—a view that Hermann Müller wrote me was the only plausible one he could get from my sketches and notes: but it was never demonstrated in the field."

Calopogon is one of a few flowers which move the insect toward the stigma. In Pterostylis,[7] the labellum flies up elastically and imprisons the visitor in the upper part of the flower, and the insect strikes the stigma in escaping.

There is no expenditure in keeping up a supply of nectar, and the flower, although requiring a smooth insect of a certain size and weight, suffers nothing from the visits of those it can not utilize.

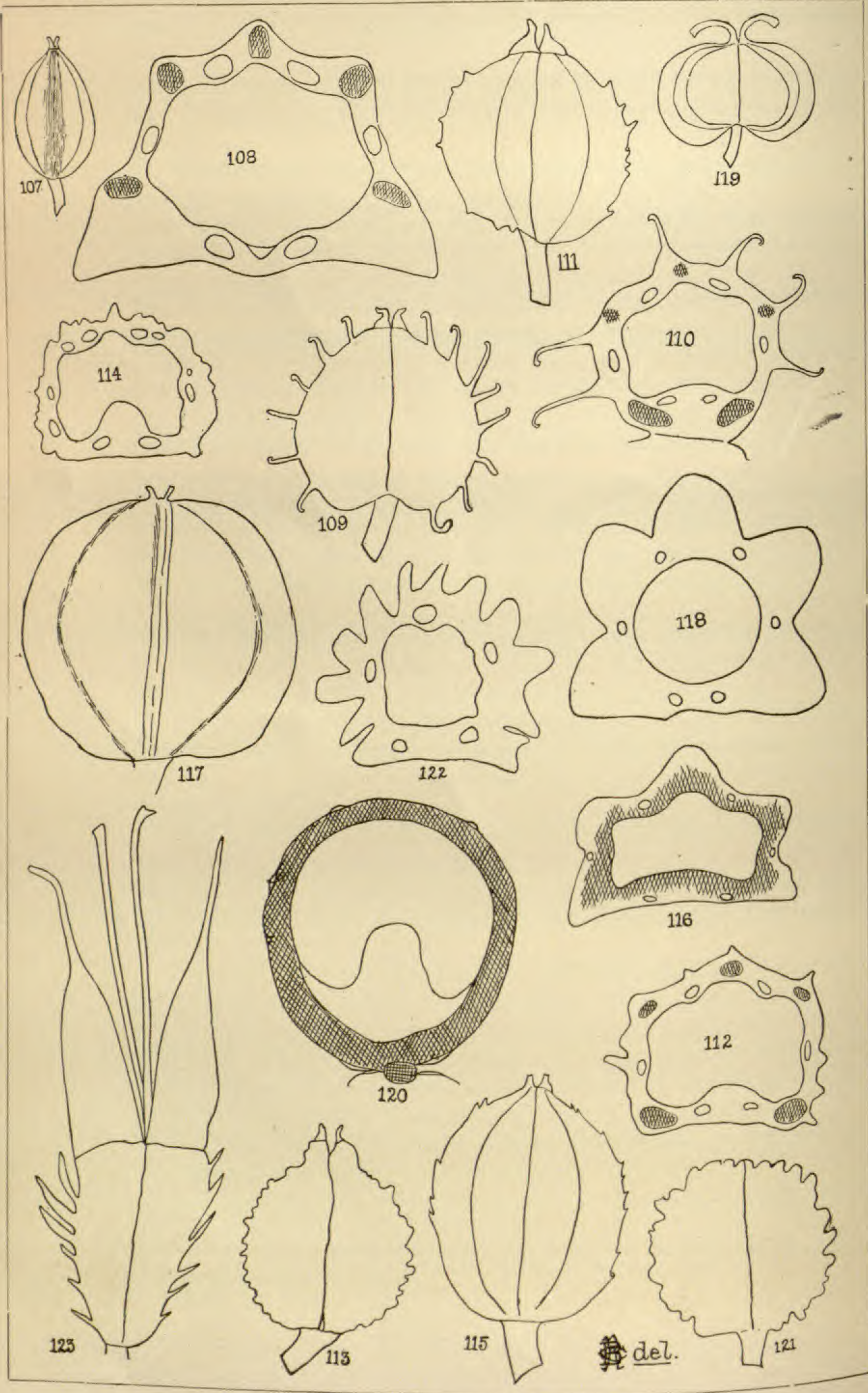
Then, there is no delay caused by the insect waiting to suck, but, as soon as it lights, it is thrown down against the stigma. This occurs so quickly that, while standing with net in hand, I have seen insects effect pollination and escape before I could catch them.

So many orchids fasten their pollinia upon the faces and tongues of insects that it is interesting to find one which applies them regularly to the first abdominal segment. If one wished to place the loose pollinia of Calopogon on some part of the bee where it would be least likely to be disturbed by the bee itself, or by surrounding objects, he could not find a better spot than the place where the flower is adapted to

[5] "Wayside Flowers and Ferns."

[6] Under Mormodes ignea, "Fertilization of Orchids," 216, Mr. Darwin says: "At the close of the twelfth trial I was in despair. The strange position of the labellum, perched on the summit of the column, ought to have shown me that here was the place for experiment. I ought to have rejected the notion that the labellum was thus placed for no good purpose. This plain guide was overlooked, and for a long time I completely failed to understand the structure of the flower."

[7] Darwin, loc. cit. 86.



COULTER and ROSE on UMBELLIFERÆ.

fasten it. Mr. Darwin[8] has observed that absence of hair on the tongues of Lepidoptera and on the faces of Hymenoptera has led to the more usual adaptations, and sparseness of hair has its influence in this case. Species of Augochlora are the only insects on which I found pollinia. These bees are very smooth, depending for ornament on the metallic sheen of their bodies. An Halictus repeatedly pulled down the labella of flowers from which pollinia had not been removed; and the only reason I can assign for its failure to extract pollinia is that it is more hairy than the Augochloras.

I watched the flowers on five mornings between February 21 and March 4, and caught the following insects (Mr. E. T. Cresson kindly determined the Bombus and species of Augochlora):

Apidæ: (1) Bombus separatus Cress[9], bending lip but not removing pollinia; *Andrenidæ:* (2) Halictus, do.; (3) Halictus, not bending lip; (4) Halictus, do.; (5) Augochlora festiva Sm., do.; (6) Augochlora sumptuosa Sm., with pollinia on first abdominal segment; (7) Augochlora *n. sp.* do.; *Vespidæ:* (8) Odynerus histrio St. Farg., bending lip, no pollinia; *Syrphidæ:* (9) Mesograpta marginata Say, not bending lip, determined by Dr. S. W. Williston; *Papilionidæ:* (10) Papilio Philenor Linn., not lighting; *Hesperidæ:* (11) Pamphila, the only insect lighting on column.

Notes on Umbelliferæ of E. United States. VIII.

JOHN M. COULTER AND J. N. ROSE.

(WITH PLATE XVII.)

DISCOPLEURA DC. Fruit ovate, flattened laterally: carpel with 5 primary ribs subtended by strengthening cells; dorsal and intermediates prominent and rather acute; laterals broad and united with a thickened corky margin: oil-ducts solitary in the intervals, two on the commissural side: seed-section roundish (figs. 107, 108).— Smooth branching annuals, with finely dissected leaves (filiform divisions), and white flowers. Fl. June to October.

1. **D. capillacea** DC. Mem. Umbel. 38. t. 8. Umbels 5 to 20-rayed; involucral leaves (filiform) usually cleft or parted;

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[8] Loc. cit. 72.
[9] All of the bees are females.
* Section of carpel of Eryngium diffusum X 40.

involucels more or less prominent.—Wet ground, Massachusetts to Florida, and westward to the plains. Runs through many intermediate forms into the

Var. **Nuttallii,** with umbels 15 to 30-rayed, involucral leaves usually entire, and involucels minute (*D. Nuttallii* DC.).—In the lower Mississippi Valley.

Although var. Nuttallii is set apart as a variety, it must be understood to include only extreme forms. There are many forms which intermediate and combine the characters of the species and variety. The number of rays is very inconstant, while the involucral leaves are frequently cleft and entire in different umbels on the same plant, and the involucels may be as prominent in forms which are var. Nuttallii in every other respect, as in true D. capillacea, or they may be very minute in the species itself. Fruit characters entirely fail to give any distinction. As for the form called *D. capillacea*, var. *costata* DC., we are at a loss to discover even any varietal characters. In a large series of specimens so labeled from different herbaria we fail to find the slightest distinction from D. capillacea; and if there is a var. costata we have never seen it, nor is it known to our best collectors.

The two following genera have been referred to *Apium* L.: *Leptocaulis* by Bentham and Hooker, and *Ammoselinum* by Gray. The general habit of the plants and the size of the fruit may indicate some such common relationship, but a study of their fruit structure reveals differences fully as great as obtain among other genera of Umbelliferæ as at present considered. In fact, a glance at the figures representing these two genera and Apium on plate xvii will show a diversity of fruit characters greater than exists among any other three allied genera we have figured. Including these three genera under one would be entirely inconsistent with the definition of other genera of Umbelliferæ. We therefore restore the genera as follows:

LEPTOCAULIS Nutt.—Fruit ovate, flattened laterally, bristly or tuberculate: carpel with 5 primary ribs somewhat prominent or obsolete, each subtended by a prominent group of strengthening cells (except in L. patens): oil-ducts solitary in the intervals (except occasionally in L. patens), two on the commissural side: seed-section dorsally flattened, with face more or less concave: stylopodium conical (figs. 109–114).—Very slender smooth branching annuals, with finely dissected leaves (filiform or linear segments), and white flowers.

1. **L. echinatus** Nutt. DC. Prodr. 4. 107. A span to a foot high: fruit about half line long, echinate with spreading hooked bristles; ribs obsolete and seed-face slightly concave (figs. 109, 110). *Apium echinatum* Benth. & Hook.—Alabama to Arkansas and westward.

2. **L. divaricatus** DC. Mem. Umbel. 39. t. 10. One to two feet high, with spreading branches: umbels more diffuse than in the last, and usually with fewer rays: fruit half a line long, tuberculate; ribs somewhat prominent and seed-face slightly concave (figs. 111, 112). *Apium divaricatum* Benth. & Hook.—North Carolina to Florida and westward to Texas.

3. **L. patens** Nutt. DC. Prodr. 4. 107. One to two feet high, branching above: fruit half a line long, tuberculate; ribs obsolete and seed-face decidedly concave; pericarp thinner than in the preceding species and without strengthening cells; oil-ducts in the intervals often accompanied by smaller accessory ones (figs. 113, 114). *Apium patens* Watson, Bibl. Index, Polypet. 413.—From Missouri to Louisiana and Texas. This species, while undoubtedly most closely related to Leptocaulis, is exceptional in certain important characters. The thinner pericarp, the entire absence of strengthening cells, the frequent increase in the number of oil-ducts, and the almost sulcate seed-face are all characters that do not belong to Leptocaulis. While, therefore, we include it under this genus, it must be considered as an outlying member.

AMMOSELINUM Torr. & Gray.—Fruit ovate, flattened laterally: carpel with 5 prominent equal more or less scabrous ribs, the laterals closely contiguous to those of the other carpel, forming apparently a single rib: pericarp exceedingly hard, composed almost entirely of strengthening cells: oil-ducts solitary in the intervals, two on the commissural side, rather small and not close to seed cavity: seed-section dorsally flattened, with face slightly concave: stylopodium conical, with very short style (figs. 115, 116).—Low diffuse annual, with ternately divided leaves, the small ultimate segments linear to spatulate, and white flowers in small sessile or short-pedunculate unequal-rayed umbels.—This is one of the best marked genera of Umbelliferæ. Its affinities are doubtful, but it holds no relation whatever to Chærophyllum, as was surmised in the original description, followed by Bentham and Hooker.

1. **A. Popei** Torr. & Gray, Pacif. R. Rep. 2. 165. About a span high, angles, midribs, rays, pedicels, and ribs of fruit rough scabrous: leaf-segments narrowly linear: fruit ovate-oblong, 2 to 2½ lines long, with thick corky commissure. *Apium Popei* Gray.—Texas *(Wright, Parry, Reverchon).* Fl. April, May.

2. **A. Butleri.** Smaller, nearly glabrous: leaf-segments narrowly oblong or spatulate: fruit ovate, about a line long, with ribs smooth or minutely scabrous, and corky commissure much less prominent (figs. 115, 116). *Apium Butleri* Eng. Proc. Am. Acad. xxi. 453.—Texas *(Hall, Reverchon, Joor);* Indian Territory *(Butler).* Fl. March, April. Distributed in various collections as Apium Popei.

APIUM Linn.—Fruit ovate or broader than long, flattened laterally: carpel with 5 prominent obtuse corky nearly equal ribs: pericarp with no strengthening cells: oil-ducts solitary in the narrow intervals, two on the commissural side: seed-section round: stylopodium depressed or wanting (figs. 117, 118).—Erect or prostrate herbs, with pinnately or ternately divided leaves, umbels opposite the leaves, and white flowers.

1. **A. leptophyllum** F. Muel., Benth. Fl. Austral. 3. 372. A few inches to two feet high: leaves ternately divided into filiform segments: umbels sessile or short-pedunculate: fruit a line long. *Helosciadium leptophyllum* DC.—Florida to Texas and westward. March to June.

A. nodiflorum Benth. & Hook. (*Helosciadium nodiflorum* Koch), an introduced species, reported first by Walter around Charleston, S. C., and not afterwards found, has been recently collected by Dr. J. H. Mellichamp. It is also found on the ballast grounds near Philadelphia by I. C. Martindale.

BIFORA Hoffm.—Fruit broader than long, flattened laterally, the two globose carpels connected only by a narrow commissure: carpel with primary ribs obsolete, and 4 filiform secondary ribs: pericarp thin and very hard, made up almost entirely of strengthening cells: oil-ducts none: seed-face deeply concave: stylopodium conical: styles recurved over the carpels (figs. 119, 120).—Slender smooth annuals, with pinnately dissected leaves (segments filiform), and white flowers in few-rayed umbels.

1. **B. Americana** Benth. & Hook. Gen. Pl. 1. 926. A foot or more high, branching above, rays and angles of stem (es-

pecially summit of internodes) roughened with minute callous points: fruit 1½ lines long, 2½ lines broad. *Atrema Americana* DC.—Missouri *(Tracy)*, Arkansas and Texas.

ERYNGIUM Linn —Fruit ovate or obovate, flattened laterally, scaly, tuberculate or bristly: carpel with ribs obsolete (in ours): pericarp without strengthening cells: oil-ducts solitary beneath the ribs (or their normal position), two on the commissural side (making 5 in all): seed-face plane: styles filiform (figs. 121–124). — Herbs with spiny or prickly mostly lobed or toothed leaves, and bracted flowers closely sessile in dense heads. — A large genus, with about 20 North American species, chiefly southern. The genus is so well defined by its general habit, and mature fruit is so completely lacking in our herbaria, that in the present series of papers we will not undertake to define the species. We would urge upon collectors the necessity of securing good fruiting specimens of all our Eryngiums, as in the few species studied there is indicated a wide range of fruit structure.

With this paper is concluded the presentation of our 80 species of Umbelliferæ east of the 100th meridian. It is to be hoped that the characters presented will be subjected to a thorough test by collectors and herbarium workers, that in the final elaboration of the North American representatives of the family the most permanent possible results may be obtained. At the same time we would ask for additional material from all quarters, especially fruiting specimens. We are under great obligations to many botanists, to whom we have already, in earlier papers, given our grateful acknowledgments.

EXPLANATION OF PLATE XVII.—Fig. 107, fruit of Discopleura capillacea; fig. 108, section of carpel of same; fig. 109, fruit of Leptocaulis echinatus; fig. 110, section of carpel of same: fig. 111, fruit of L. divaricatus; fig. 112, section of carpel of same; fig. 113, fruit of L. patens; fig. 114, section of carpel of same; fig. 115, fruit of Ammoselinum Butleri; fig. 116, section of carpel of same; fig. 117, fruit of Apium leptophyllum; fig. 118, section of carpel of same; fig. 119, fruit of Bifora Americana; fig. 120, section of carpel of same; fig. 121, fruit of Eryngium aromaticum; fig. 122, section of carpel of same; fig. 123, fruit of E. diffusum. Fig. 119 is $\times 5$; fig. 107 is $\times 7$; figs. 109, 111, 113, 115, 117, 120, 121, 123, are $\times 22$; figs. 108, 110, 112, 114, 116, 118, 122, are $\times 40$.

BRIEFER ARTICLES.

Solanum triflorum Nutt.—Five years ago this plant was comparatively uncommon in Northern Montana. It might then be found here and there on the prairies or near water-courses, but now, during the past three years, it has been noticeably increasing, owing to the rapid influx of people who, instead of going into stock-raising or mining, have turned their attention to agricultural occupations. The plant grows better in cultivated ground, and it is a fact worth recording that it grows best of all in situations particularly suited to the development of S. tuberosum. In its finest condition the plant spreads over the ground in mats three feet or more across the branches, usually rooting all along the portions touching the earth, and bearing many pale blue to purplish flowers, similar in general appearance to those of S. tuberosum, but much smaller. Where the plant is found on the wild prairies it is often low but nearly erect, sending out short lateral ascending branches, which bear small, pale, often yellowish, less conspicuous flowers, and the subsequent berries are usually a little smaller and less numerous than in the field form.

One day during August, passing through a field of potatoes, the owner of which, who was with me, and evidently an intelligent man, pointing to a heavy musky-smelling mat of S. triflorum, asked the name of those "wild potatoes." I replied by asking why he called them wild potatoes. "Well," said he, "they are, aren't they? They bear flowers like a potato, and potato-bugs live upon the leaves." I had noted the latter fact several years before, but had never seen the larvæ very numerous upon the plants. This season, however, an enormous crop of potato-beetle larvæ has been produced, and chiefly upon S. triflorum. This species seemed, even where S. tuberosum was also present, to be mainly used as the preliminary or original host, from which many, but by no means all, of the larvæ, after attaining a certain size, would crawl to plants of the other species.—F. W. Anderson, *Great Falls, Montana.*

Coptis, section Chrysocoptis.—Any one collecting in Idaho (say on the Pend d'Oreille river, or on the Lolo trail above Clear Water) in the spring should look out for Coptis occidentalis, the flowers of which are a desideratum. In Wyeth's four specimens they are undeveloped, and little can be made of Nuttall's figure in this respect. Geyer's specimens were going out of flower; but I have found withered remains of a sepal and a petal. When good flowers are obtained the three following species will propably be confirmed:

C. occidentalis Torr. and Gray. Leaves simply trifoliolate: leaflets long-petiolulate (2 or 3 inches long at maturity, with terminal petiolule 1–1½ inches long, and lateral ones hardly half shorter), of roundish outline, 3-lobed to middle; the lobes obtuse, slightly 3-cleft or incised, and obtusely dentate: petals shorter than sepals, subulate from a subsessile hardly nectariferous base: mature carpels longer than stipe: seeds oblong.

C. LACINIATA Leaves trifoliolate: lateral leaflets comparatively short petiolulate; all ovate in outline, nearly 3-parted, with divisions 3–7-cleft or incised and dentate, mostly acute: sepals linear-attenuate, and filiform-attenuate petals nearly of the next species: mature carpels longer than stipe: seeds oval.—*C. asplenifolia* Gray, Proc. Am. Acad., viii. 375, and Watson, Bot. Calif, ii. 427. This we have only from Oregon and Northwest California, collected by E. Hall, Cusick, Henderson, G. R. Vasey, Rattan. Only Cusick has sent it in blossom.

C. ASPLENIFOLIA Salisb. Leaves pinnately 5-foliolate; with leaflets all slender-petiolulate, ovate-oblong in outline, and pinnately divided or parted, lower divisions short petiolulate and upper confluent: sepals and petals filiform-attenuate, nearly equal; the latter with thickened concave nectary between middle and base: mature carpels shorter than the stipe. We have this only from British Columbia and Alaska.—ASA GRAY.

Dredge for Chara.—Last year, in giving directions for the collection of Characeæ, I recommended a modification of a dredge used by Prof. Nordstedt, of Sweden. I am constrained to say that a dredge more like his original one is better for deep water, and that the one here illustrated answers perfectly every purpose, provided one carries, as I now do, a small rake for shallower water. This dredge consists of a disk of lead about three inches in diameter and three-fourths of an inch thick, in the edge of which are imbedded about ten hooks. I have had them bent backward in order to furnish a kind of "shoulder" to give greater strength in case of catching in an obstruction. These will firmly hold a boat, or raise a couple of hundred pounds from the bottom. Through the center of this disk is passed, vertically, an iron rod about a foot long, which has a ring in the upper end, for a line, and which is allowed to project about three inches below the disk. It takes apart readily by means of a nut and screw on the rod, and packs in a small box. It weighs about two and a half pounds, and is made by Flynn & Doyle, Bantam, Conn., at a cost of four dollars.—T. F. ALLEN.

OPEN LETTERS.

Vitality of seeds.

In making the excavation for the new building of Franklin College last fall, the dirt was hauled upon the campus, and in a short time it was noticed where the soil was placed a great many specimens of poke-weed (Phytolacca decandra) were growing. The north building was erected in

1844, and the south building in 1854, and these two buildings stand forty-seven feet apart. It was in this space the excavation was made. These seeds have been lying dormant in all probability since 1844, as students do not generally permit such plants to grow within forty-seven feet of the college. D. A. OWEN.

Franklin, Ind.

Dispersion of seeds in Euphorbia.

It may be worth noting, in connection with the interesting remarks of Dr. Schneck on the dispersion of seeds of Euphorbia marginata (page 226), that the phenomenon is recorded in connection with other Euphorbiaceæ, especially in a small Mexican tree, there known, according to Hernandez, as 'Quauhtcatlatzin," which I suppose might be translated as the "creaking tree." In view of this Mexican term, Linnæus seems to have given it the name of Hura crepitans. De Candolle (Prodromus 18, p. 1229) remarks on it: "Cocca * * *valde crepitanter dissilientia seminaque dejicientia.*" THOMAS MEEHAN.

Germantown, Penn.

Systematic Botany—A correction.

In the note on "the old and new botany," in the October GAZETTE, an error occurs, namely, the omission of the word *systematic* before botany in the seventh line from the last. As it stands, it reads that the general subject, *botany*, is falling into disfavor, which I am sure is not true. But it is quite clear to me that systematic botany is considered as quite detached from the living processes going on in plants, and, therefore, falling into disfavor. E. L. GREGORY.

Bryn Mawr College.

CURRENT LITERATURE.

Hepaticæ Americanæ; prepared by Lucien M. Underwood and O. F. Cook. Decades I and II. Syracuse, N. Y. 1887.

Under the above title Dr. Underwood, of Syracuse University, and Mr. Cook have begun issuing a set of *exsiccatæ* for the special encouragement of students undertaking the collection of Hepaticæ. As no preface to the set has been issued, we are authorized to say that the object of the publishers has been:

1. To issue this preliminary set more for the assistance of beginners than as a matter of *special* interest to those who have long studied the Hepaticæ. Later numbers may have a wider interest.

2. By issuing a *few* numbers to bring the price[1] within the reach of the most moderate means.

3. To issue representative (though common) species.[2] The four

[1] The set of twenty numbers will be sent postpaid for $1.25. Address Dr. Lucien M. Underwood, Syracuse, N. Y.

[2] The twenty numbers are as follows: Riccia natans, Marchantia polymorpha, Conocephalus conicus, Anthoceros lævis, Blasia pusilla, Steetsia Lyellii, Frullania Grayana, Lejeunia serpyllifolia, var. Americana, Madotheca porella, Radula complanata, Ptilidium ciliare, Bazzania trilobata, Trichocolea tomentella, Lepidozia reptans, Kantia trichomanis, Geocalyx graveolens, Cephalozia curvifolia, Jungermania Schraderi, Scapania nemorosa, Plagiochila porelloides.

orders, all the larger genera, and the thallose, incubous and succubous Jungermaniaceæ will be found represented.

4 To procure specimens as free as possible (a by no means easy task) from other and misleading plants

From an examination of the set we are prepared to say that the specimens are admirable, and leave nothing to be desired. The labels are full and are accurately printed. We sincerely hope that the au hors will be liberally encouraged not only by the purchase of sets, but also by the contribution of material; and that the sets may soon begin to include the rarer species. Certainly, the enterprise is most commendable, and must prove of great benefit to all students of Hepaticæ.

Synopsis of the Flora of the Laramie Group. By Lester F Ward Sixth Annual Report of Director of the U. S. Geological Survey, 1884-85. Washington, 1886; pp. 405-557, pl. 31-65.

Perhaps no controversy over the stratigraphic position of any of the various members in the geologic series has been waged with greater persistency than has that over the position of the member now so well known as the Laramie Group. This group was first brought to light by the pioneer investigators of the geology of our western territories, and they, together with prominent paleontologists, from considerations of its animal remains, were led to refer it to the cretaceous age. Others, equally eminent, basing their conclusions upon examinations of the plant as well as animal remains, argued for it a tertiary age So persistently have these two theories been attacked and defended that the subject has developed a copious literature of its own; and for the general student to attempt to read this and decide for himself is a nearly hopeless task. What was needed was a succinct account of the progress of opinion regarding it, irrespective of partisan feeling. This is precisely what Prof. Ward has done in the historical review of opinion which occupies the first forty pages of his memoirs, and the result must be conclusive. From this it is seen that the conclusion generally accepted at present is that the Laramie group belongs as much to the cretaceous as to the tertiary, or rather occupies a somewhat intermediate position between the two. But, as Prof Ward so pointedly suggests, it makes very little difference whether we regard it as belonging to the one or to the other, so long as we clearly understand its relative position. We know positively that the next member below it is upper cretaceous and the next above it is lower tertiary.

As it is now understood, this formation, which has a thickness of more than 4000 feet of strata, occupies a vast area, extending for hundreds of miles on either side of the Rocky mountains and from Mexico to far within the British possessions. This immense inland sea was at first filled with brackish water, with at least one opening into the ocean; but afterward, through the gradual cutting off of this avenue of intercommunication, it became nearly or quite fresh. The period of change from the one to the other must have been very gradual, and have extended over an immense interval of time; long enough, indeed, as Dr. C. A. White has so clearly shown, for the transformation of a distinctively brackish water molluscan fauna to a fresh water fauna, without extinction of types. It is in these peculiarities that lies the explanation of the difficulty experienced in attempting to correlate this formation with others probably deposited at the same time in different parts of the world. It would be extremely improbable that precisely similar conditions should prevail in widely separated localities cut off, as we know they must have been, by barriers of both land and water that existed at that time.

In order to ascertain what answer an exhaustive examination of the plant remains would be able to give to the question, Prof. Ward has prepared an elaborate table, in which are compared all the known species found in the Senonian, Laramie and Eocene formations. The result shows that the Laramie flora resembles the one about as much as the other, which in itself proves nothing; but in the discussion which follows the table it is concluded, in a manner satisfactory to the author, at least that it has a stronger Senonian than Eocene facies. This is because more important types extend from the Senonian into the Laramie, and when, as it is well known, the vegetation was less diversified than later. The flora of the Laramie period is perhaps no more remarkable than could be accounted for on the ground of the peculiar conditions which obtained at the time of its deposition. Its isolated character, its change from a brackish to a fresh water deposit, are sufficient to impress upon it a strong individuality. This examination shows more plainly than ever that the whole discussion resolves itself into a mere question of a name, and what this shall be is not of as much importance as might at first be anticipated.

This discussion is followed by the systematic portion of the paper which deals with the results of the personal observations of the author upon the flora of this group. This is in the form of a list, unaccompanied by descriptions, of the type or representative species detected in the collections made by Prof. Ward in Colorado, Wyoming and Montana. The descriptions and discussions of species are to be found in a later work, to which this list is but supplementary; and, indeed, both papers are designed as an introduction to the larger monograph which the author has in preparation.

The illustrations, which are by the photo-lithographic process, are among the best of the kind that we have seen.

Taken as a whole, this paper must be regarded as one of the most valuable contributions that have been made to the discussion of the Laramie group.*

Types of the Laramie Flora. By Lester F. Ward. Bulletin of the U. S. Geological Survey, No. 37. Washington, 1887. Pp. 1–115, pl. 1–57. In this paper the species given in a list in the former work are described and discussed at length. The illustrations are also the same, having been rearranged to accommodate them to the reduced size of the work.*

Grasses and Forage Plants. By Charles L. Flint. Revised edition, 12°, pp. 398. Lee & Shepard: Boston, 1888.

This, although called a "revised" edition, is practically the same as that published twenty-four years ago, the only changes of any importance being confined to about half a dozen pages, where new illustrations of some more recent agricultural machines are substituted for old ones, with some cutting out and change of type to correspond. The only new matter relating to forage plants is on page 196, where a short account of Japan clover (Lespedeza striata) is introduced, and even this is not included in the systematic index. The preface is unchanged from the sixth edition of 1864, except in giving a new date—1888 instead of 1859—not even mentioning the few changes already noticed. It is, therefore, little more than a reprint of the old edition of twenty years ago. As that has been a long time before the public, its many excellent qualities are well known.

But, in a "revised edition," after the lapse of so many years, some important changes or additions might reasonably have been expected. Within the last ten to twenty years the subject of grasses for cultivation has in certain portions of our country attracted very great interest. Extensive tracts of country west of the Missouri river, and southwestward in Texas and New Mexico, have been brought under culture, subject to climatic conditions very different from those of the Northern and Eastern States, and the belief is very generally entertained that the older kinds of cultivated grasses are not adapted to use there; and intelligent agriculturalists are inquiring and experimenting with reference to some grasses better adapted to their wants. Very much the same condition exists in the South Atlantic and Gulf States, where long summer droughts prevail, greatly to the injury of the grazing interests, and a number of new and promising grasses and forage plants are under trial. These points are entirely ignored in this "revised edition."

In another particular the public might naturally look for some change. This is in relation to the botanical terms and the classification employed in the description of grasses in the introductory chapter. A proper revision would have changed the botanical names of ten or twelve genera, and would have changed the application of some of the terms used in describing the parts of the flower. Thus, Calamagrostis (of our country) is now Deyeuxia, Brizopyrum is Distichlis, Lepturus (of our country) is known as Schedonnardus, our Triticums are Agropyrums, Dupontia is called Graphephorum, Gymnostichum is Asprella, etc. The application of the terms glume and palet should have been modified so as to express the modern view of the structure of grass flowers—the term glume being now extended to include what was formerly called the lower palet, and the term palet being restricted to that bract or scale formerly known as the upper palet. Several other needful changes of terms will occur to the botanist, as well as in the loose employment of the terms ovary and seed on page 15.—GEORGE VASEY.

Monographiæ Phanerogamarum. Vol. quintum, pars secunda. Ampelideæ. Auctore J. E. Planchon. Pp. 305–654. Paris, July, 1887.

Few groups of plants are more perplexing than the one forming the subject of this monograph, and as a consequence there are wide differences in its treatment. The present presentation makes some radical changes. Bentham and Hooker in their Genera Plantarum group three genera under Ampelideæ, viz.: Vitis (including Ampelopsis and the large tropical genus Cissus), with 230 species; Pterisanthes, with three; and Leea, with about twenty. Planchon, in the monograph before us, does not include Leea as being among the true Ampelideæ; accepts Pterisanthes as defined, but increases its species to eleven; and of Bentham and Hooker's Vitis makes nine genera. VITIS is left with twenty-eight species, and in it are all our American vines (sixteen in number) except the few noted further on. *V. araneosa* Leconte, from N. Georgia and Athens, Ill., is new to our manuals, and the *V. monticola* of Eng. is *V. Berlandieri* Planchon. AMPELOCISSUS is a new tropical genus of sixty-two species, heretofore included under Vitis, none of which concern us, except two in Mexico and one in the West Indies. CLEMATICISSUS is the Australian Vitis angustissima, and is monotypic. TETRASTIGMA, once a section of Vitis, and also of Cissus, is an Asiatic genus of thirty-eight species. LANDUKIA is a monotypic genus, founded upon a species which has been variously referred to Ampelopsis, Cissus and Vitis, and now rejoices in the name Landukia Landuk. PARTHENOCISSUS is *Ampelopsis* Mx., in part, and to it belongs our Virginia creeper, which is, therefore, *Parthenocissus quinquefolia* Planch., and six other species. AMPELOPSIS Mx., the other part, we get back again, not to include our old Ampelopsis, however, but some species that we have been referring to Vitis. *Vitis indivisa* Willd. is now *Ampelopsis cordata* Mx., and *Vitis bipinnata* T. & G., which was *V. arborea* L., is *Ampelopsis bipinnata* Mx. RHOICISSUS is separated from Cissus, with nine species, while CISSUS remains the largest genus, with 214 species.

The Development of the Ostrich Fern. By Douglas Houghton Campbell, Ph. D. Memoirs of the Bost. Soc. Nat. Hist., Vol. IV, No. 2. Pp. 17–52, with four plates. Boston, April, 1887.

This is the Walker prize essay of 1886, that was so worthily won by Dr. Campbell. Since that time the author has been studying in Germany with Strasburger, Pfeffer, and now with Kny, and we predict for him a very successful botanical career. The paper before us gives evidence of fine ability, and is a model in its way. It is so compact and technical that it hardly admits of a review further than a notice of its contents.

The important points discussed the author himself sums up as follows: The presence of a third coat in the spore; the marked dioecism displayed by the prothallia; formation and development of the apical cell of the prothallium; continuity of the protoplasm in the cells of the prothallium; development of the antheridium and antherozoids; absence of the ventral canal-cell in the archegonium; succession of the divisions of the embryo, and the establishment of the apical cells of its different members; development of the different tissues of the embryo; development of the leaf from the apical cell and the relation of the different tissues of the leaf to the segments of the apical cell; method of formation of the pinnæ; development of the stem from the apical cell; development of the sporangium. These subjects indicate the completeness of the study. A very interesting fact brought out is the vitality of the spores, and the ease with which they can be germinated. The plant can thus be had at any time for study.

Illustrationes floræ insularum maris Pacifici. E. Drake Del Castillo. Fascicles I–III. Quarto. G. Masson, Paris, 1886–1887.

The author proposes to issue from time to time fascicles of ten species; each species with descriptive text and a full page lithographic plate. Not all the Pacific island species are to be included, but those that are new, rare, or especially interesting. In the resumé of the publications concerning the flora of this region one is surprised at its copiousness. The three fascicles before us bring us thirty species, many of them new, and thirty plates. It is one of those works that demonstrate the highest possible skill of the printer and engraver, and to which one sits down as to a book of fine engravings. The typography, although of marvelous clearness, can be equaled in this country, but it is to these matchless European engravings that we must yield. Our artistic engravings, such as appear in *Century* or *Harper*, are fine enough, but our scientific engraving and plate-printing, compared with that in the work lying before us, is dreadfully coarse. The explanation probably lies in the fact that all such work here must be done as cheaply as possible, and of course in an inferior way.

Parasitic Fungi of Illinois. Part II. Erysipheæ. (Bulletin of the Illinois State Laboratory of Natural History, Vol. II, No. 6.) By T. J. Burrill and F. S. Earle. Peoria, 1887. 8°, pp. 46. Illustrated.

The surface mildews have been elaborated in the present paper with the same thoroughness and discriminating judgment that the rusts received in the first contribution to the parasitic fungi of the state. The introduction deals with their structure, development and classification, together with an account of the parasite, Cincinobolus. The genera are illustrated after the manner of Winter in the "Flora von Deutschland," and are provided with a key.

Twenty-eight species are admitted, with full diagnoses drawn from the specimens in hand, the synonymy traced, each host with its locality and herbarium number given, and critical remarks appended. The list embraces all the species enumerated by Trelease for Wisconsin (Parasitic Fungi of Wisconsin), by Bessey for Iowa (Bull. Iowa Ag. Coll.), by Rose for Indiana, except one (BOT. GAZ., ix), and forty-two of the sixty-one species given by Bessey for the whole United States (the Erysiphei), with two in addition.

The feature which gives a value beyond that of a local list is the careful study of the limits of the species, and the consequent synonymy. The forty-two species of Bessey's United States list, with two not in it, making forty-four, are reduced to twenty-eight, showing an actual condensation of more than one-third, although two of the species were doubled instead of contracted. The principal changes are as follows:

PRESENT NAMES.	FORMER NAMES.
Sphærotheca Humuli (DC.) Burrill.	S. Castagnei in part.
Erysiphe Galeopsidis DC.	E. lamprocarpa in part.
Erysiphe Cichoracearum DC.	E. lamprocarpa in part. E. Montagnei. E. horridula.
Uncinula Salicis (DC.) Winter	U. adunca. U. heliciformis. U. leuculenta.
Podosphæra Oxyacanthæ (DC.) DeBary	P. Kunzei. P. trydactyla. P. minor. P. Myrtillina.
Microsphæra Quercina (Schw.) Burrill	M. extensa. M. abbreviata.
Microsphæra Alni (DC.) Winter.	M. Hedwigii. M. penicillata. M. pulchra. M. Friesii. M. Platani. M. Van Bruntiana. M. Viburni.

Furthermore, Erysiphe communis is made to include E. Martii, and Uncinula Ampelopsidis to include U. Americana, U. spiralis and U. subfusca. It is now also pointed out that the gooseberry mildew belongs to Sphærotheca Mors-Uvæ, and not to S. pannosa, while the clematis mildew is Erysiphe communis, and not E. tortilis; changes which appear to be necessitated by former errors of determination. The data and conclusions given under Podosphæra Oxyacanthæ are essentially the same as published in this journal three years and a half ago by one of the authors, but the fac is not mentioned.

Few classes of fungi were in greater need of revision than the surface mildews, and the advancement made by Dr. Burrill and Mr. Earle in this paper will doubtless, in the main, meet with the approval of systematists. A change, the value of which might be questioned, is the placing of so many forms under M. Alni, including the exclusively American one on lilac. Culture experiments are much needed to throw more light upon points like this.

NOTES AND NEWS.

DR. B. D. HALSTED is spending his winter vacation at Passaic, N. J., his old home.

"THE CONCEPTION of species in cryptogamic botany" is the title of a paper by Dr. W. G. Farlow read before the Boston Society of Natural History at its November meeting.

IT HAS BEEN found that herbivorous fish aid largely in disseminating algæ, numerous species being found in the stomachs of such fish. Very often the fertile portions are eaten and the viable spores voided.

DR. J. W. ECKFELDT and W. W. Calkins have begun an enumeration of the lichen flora of Florida in the *Journal of Mycology* for November. The first installment embraces 146 numbers, and reaches Cænogonium.

A SEPARATE author's edition of the report for 1886 of the mycologist to the U. S. Department of Agriculture, Prof. F. L. Scribner, has been distributed. It contains forty-four pages, seven plates, three maps and one diagram.

DR. HERMANN VÖCHTING has been called to the Professorship of Botany in the University of Tübingen, and Dr. Klebs, privat docent at Tübingen, to the professor's chair at the University of Basel, vacated by Dr. Vöchting.

IN THE August GAZETTE (p. 199) we made the unintentional blunder of announcing that Dr. DeBary had been appointed professor at Leipzig to succeed Prof. A. Schenk. Instead of Dr. DeBary, it should have read Prof. Pfeffer.

REV. F. D. KELSEY, of Helena, Montana, recently delivered a lecture before the teachers' institute of Lewis and Clarke counties, entitled, "A bird's-eye view of botany," in which he gave an outline of the history of botany and an explanation of modern classification.

THE Western Pennsylvania Botanical Society, of Pittsburgh, has elected the following officers for the coming year: John D. Shafer, president; Dr. A. Koenig, vice-president; Miss Willa Matthews, recording secretary; Prof. B. H. Patterson, corresponding secretary; C. C. Mellor, treasurer.

SOME marked differences between the typical Acer saccharinum and the variety nigrum are pointed out and illustrated by Prof. L. H. Bailey, Jr., in *Popular Gardening* for November. The chief differences lie in the shape and size of the fruit, and in the contour and habit of the leaves.

THE ELECTRIC lighting of the Winter Palace at St. Petersburg has brought great damage to the ornamental plants used for decoration. The complete illumination of the room for a single night is enough to cause the leaves to turn yellow, dry up, and ultimately to fall off. The celebrated collection of palms has especially suffered.

A NEW weekly journal of horticulture, landscape gardening and forestry, entitled *Sylva*, is to be started early in the new year, under the editorship of Prof. Charles S. Sargent, of Harvard College. It aspires to be an authority on questions coming within its scope, and will prove a welcome addition to scientifico-practical literature.

THE NEW fossil group, *Bennettites*, recently described by Count Solms-Laubach as between angiosperms and gymnosperms, accord with cycads in vegetative structure, but possess undoubted gymnospermous fruits.

THE OCTOBER number of the *Journal of the Royal Microscopical Society* contains a monograph of the genus Lycoperdon by G. Massee, F. R. M. S. Mr. M. recognizes 129 species, of which 49 are found in Europe and 26 in the United States. Doubtless, the revision of the puff-balls of the United States, which we may expect at an early day from the pen of Dr. William Trelease, will modify this estimate materially.

A COURSE of five lectures on the dissemination of plants by Dr. William Trelease, Director of the Shaw School of Botany, has been announced. The course began on November 18th, and is to be continued on Friday evenings. Dr. Trelease has collected numerous illustrations for this series, both from the works of others and his own studies, and the synopsis of the lectures promises a most interesting course.

MR. C. R. ORCUTT, of San Diego, Cal., desires to secure young, active men, with enthusiasm for natural history work, and with scientific training, as well as older and more experienced scientists, to collect for him in all departments in Lower California, Western Mexico and Central America. It is not a financial venture, and little more than expenses need be expected, but due credit will be given collectors for their work.

C. C. BABINGTON, in a review of Professor Areschoug's paper on the genus Rubus, in *Journal of Botany*, remarks that "it is far too thoroughly pervaded by the theory of evolution to be quite satisfactory to those who continue to look upon that as a *theory rather than a fact*." (Italics in the original.) The student of European Rubi who is not tainted with evolution has a faith in the fixity of species that very few things could shake.

DR. ROBERT CASPARY, director of the Botanical Garden, Königsburg, died September 18, from the effects of a fall. He was born at Königsburg, in 1818, and was originally an assistant professor at Bonn. His original work was chiefly anatomical, and the best known was his *Monograph on Water-Lilies*, a model of fullness and accuracy. He first pointed out the distinction of the endodermis or bundle-sheath. He also made a thorough investigation of the flora of Prussia.

THE SYNTHETICAL production of glucose by Drs. Fischer and Tafel in the chemical laboratory of the University of Würtzburg, recently announced in the *Berichte*, and referred to in *Nature* and *Science*, adds another to the list of vegetable products which can be formed artificially. Glucose is one of the most important substances having to do with the nutrition and growth of plants, and the discovery may confidently be expected to lead to valuable additions to the present knowledge of chemical changes within the living plant.

THE OROBANCHACEÆ have lately had full treatment at the hands of two investigators. M. Maurice Hovelacque presented to the French Academy of Sciences, recently, two notes,[1] entitled "Développement et valeur morphologique du suçoir des Orobanches," and "Sur le développement et la structure des jeunes Orobanches." while Dr. Ludwig Koch has just published[2] a book of nearly 400 pages on the "Entwickelungsgeschichte der Orobanchen, mit besonderer Berücksichtigung ihrer Beziehungen den Culturpflanzen."

[1]Comptes Rendus, cv, 470–473 and 530–533. (Sept., 1887.)
[2]Heidelberg, 1887. Winter's Universitäts buchhandlung.

PROF. JOHN MACOUN is now engaged on Part IV of his "Catalogue of Canadian Plants," which will be published next spring. It will contain the ferns and their allies, including the charas. Part V, to follow, will contain the lower cryptogams. Centuries of these are to be issued, determined by the most eminent authorities. The first century is about ready for distribution.

J. KRUTTSCHNITT, of New Orleans, has been making some observations on "Sarraceniaceæ or Pitcher Plants." Among them we quote the following: "The fly has evidently a task to perform in connection with the Sarraceniaceæ; it consists in exciting the plant to certain actions by the gentle friction exerted by the padded foot of the fly." Objecting to the theory of development, it is said, "the Sarraceniaceæ, after it has obtained its full growth, is brought into intimate connection with the fly; but the fly derives apparently no advantage from the Sarraceniaceæ." It is to be hoped that these valuable observations will be continued.

G. KARSTEN has discovered that under certain circumstances Fegatella (Conocephalus) conica reproduces by gemmæ. These gemmæ are only formed when the conditions are unfavorable for growth and the thallus is about to die. The whole vegetative strength is then concentrated upon the development of one or two globular gemmæ on the midrib beneath, which arise from the division of cells of the epidermis or the subjacent layer. Upon the return of suitable conditions for growth these gemmæ send out rhizoids and extend their single growing point into a narrow thallus, which, after attaining a certain length, suddenly broadens to the normal width. (See *Bot. Zeitung*, xlv, 649, Oct. 7, 1887.)

SEVERAL METHODS for preparing orchids for the herbarium so as to preserve their colors have been tried by R. Hegler, and the results given in the *Deutsche botanische Monatsschrift.* Salicylic acid was used with good success by dusting the dry substance upon the plants as they lie in the press. When they are taken out of the press the salicylic acid is removed from the flowers with a brush, and can be used for other plants. It specially preserves the intensity of the red colors. Powdered boracic acid may be used in the same way with nearly as good results. A solution of one part salicylic acid to fourteen parts of alcohol, applied by moistening pieces of blotting paper and placing them above and below the flowers in the press, or by wetting absorbent cotton and putting it in and about the flowers, forms a simple method of attaining the same end.

MR. F. W. OLIVER has investigated the mode of conduction of the irritation in the stigmas of Martynia lutea and proboscidea and Mimulus luteus and cardinalis, and believes it to be due to the continuity of protoplasm from cell to cell, which he was able to demonstrate by Gardiner's method of sulphuric acid and Hoffmann's blue. In both the genera mentioned the tissue of the stigma consists of two lamellæ, which are sensitive to contact on the inner side only. The internal tissue of the lamellæ is composed of 15 to 20 layers of excessively thin-walled prismatic cells, with a great development of intercellular spaces. Between the lower and upper epidermis of the lamellæ runs a simple axile vascular bundle of spirally thickened tracheids. The bundles from the two stigmas do not unite before they reach the ovary. The irritability is confined to several layers of the prismatic cells of the inner side of the lamellæ, and it is here that the continuity of protoplasm from cell to cell was determined. . . . That the conduction does not take place through the vascular bundle was demonstrated by the fact that it was not affected by cutting the bundle.—*Jour. Roy. Mic. Soc.*

AN EXCERPT from *Comptes Rendus*, cv, p. 473 (although such source is not stated), giving an account of the new rot of the grape, Greeneria fuliginea, found in North Carolina by Messrs. Scribner and Viala, has been distributed. It states no facts in addition to those in the paper read by the authors before the Society for the Promotion of Agricultural Science.

T. F. BOURDILLON, writing to *Nature* from India, describes the fertilization of the coffee plant. It is protogynous and chiefly fertilized by bees, though somewhat visited by night-flying insects and butterflies. "Owing to all the plants of one clearing being usually grown from seed of a single estate, there must be a great deal of interbreeding, more especially as all the coffee of Ceylon and most of S. India is supposed to be descended from a single plant introduced into Batavia about two centuries ago." He suggests that this may have something to do with the deterioration of the younger coffee.

THE PROCEEDINGS of the Society for the Promotion of Agricultural Science have been printed and distributed with remarkable promptness, the credit for which is due the efficient secretary, Prof. W. R. Lazenby. Besides the nine papers mentioned in the September GAZETTE, the volume also contains the following articles of botanical interest: "A study of Poa pratensis," by W. J. Beal, in which the author seeks to determine whether the variations in growth are due to external or internal influences, but has neglected to state his conclusions. "A disease of broom-corn and sorghum," by T. J. Burrill, is a description of a disease of considerable economic importance, which the author traces by pure cultures and inoculations to a specific bacillus, whose appearance and transformations are described. It is a very important contribution to the subject of true bacterial parasites in plants. "Some botanical and horticultural generalizations," by E. Lewis Sturtevant, relate to the origin and stability of cultivated varieties. "Some crosses in corn," by A. A. Crozier, gives the result of observation and experiment, showing that "foreign pollen affects the appearance of the crossed kernels the first season, but also that an unusual appearance may be due to a cross of a previous year."

SINCE this number of the GAZETTE has gone to the printers, Dr. Asa Gray has been taken seriously ill. Late word from Cambridge indicates no change, but we hope for the best.

GENERAL INDEX.

****Names of new species are printed in* **bold-face** *type; synonyms in italics; † signifies death.*

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THE

BOTANICAL GAZETTE

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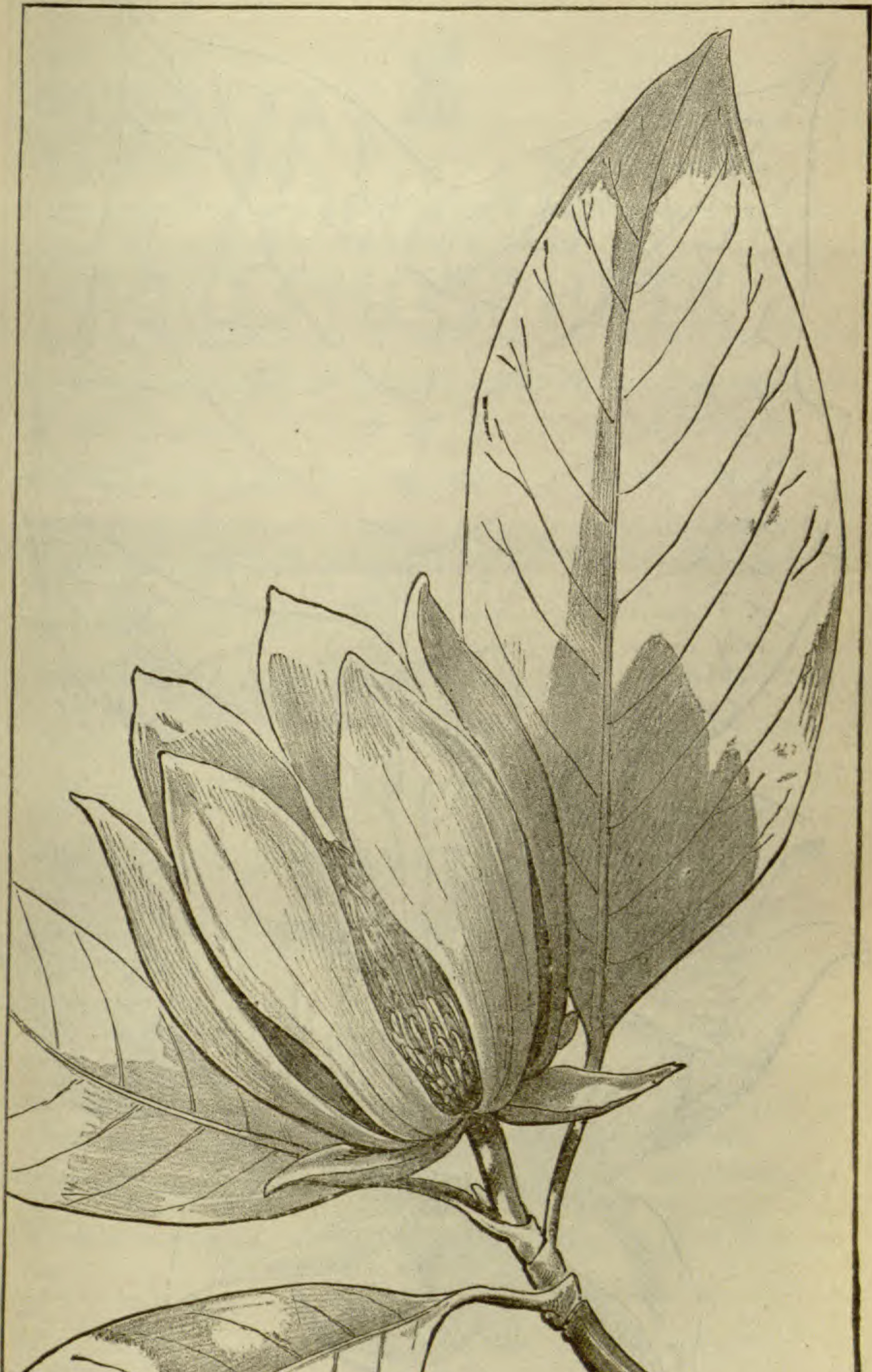

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