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THE

BOTANICAL GAZETTE

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ERRATA.

p. 3, line 11 from bottom, after racemes *dele* comma.
p. 9, line 14, for "DURANTEA" read DURANTA.
p. 9, line 1 from bottom, for "brevissim" read brevissimus.
p. 11, line 8, after 6 insert $^{\mathrm{in}}$
p. 31, in 2d, 3d and 4th formulæ, for o following S read O.
p. 32, line 11 from bottom, for "cave" read cove.
p. 40, line 17 *dele* editorial.
p. 75, line 5, for "variety" read rarity.
p. 75, line 10, after brevifolia insert Watson and after parenthesis *dele* L.,.
p. 88, line 16 from bottom for "77" read 76.
p. 134, line 1, for "flesh the" read the flesh.
p. 134, footnote 10, for "permit" read prevent.
p. 156, lines 3, 4, 8, 9, 10 of synopsis should be indented.
p. 187, line 2, for "IX" read XI.
p. 219, line 2 from bottom *dele* the second adaptive.
p. 241, line 5, before secondary insert the.
p. 241, line 6, for "has" read have.
p. 249, line 6, for "-liche" read -lichen.
p. 254, line 5, for "wissenschaftliche" read wissenschaftlichen.
p. 283, line 7 from bottom, for "congesti" read congestis.
p. 292, line 5, after affixis *dele* comma.
p. 292, line 7 from below, for "maximas" read maximos.
p. 295, line 2, for "glaber" read glabra.
p. 321, line 20, for "west" read wet.
p. 326, line 9, for "and" read or.
p. 326, line 10, for "sides" read seeds.
p. 410, line 16 from bottom, transpose Orobanchaceæ and Gentianaceæ.
p. 424, line 4 from bottom, for "Fig. 2" read Figs 2, 3.
p. 424, line 3 from bottom, for "3" read 4.
p. 434, footnote 4, for "Abth I. **4**:" read **I^4**:.
p. 441, line 2, for "on" read of.
p. 446, line 18, for "6,500" read 3,500.
p. 474, line 4, for "plants" read plant.
p. 502, line 9, for "*Virginica*" read *Virginiana*.

DATES OF PUBLICATION.

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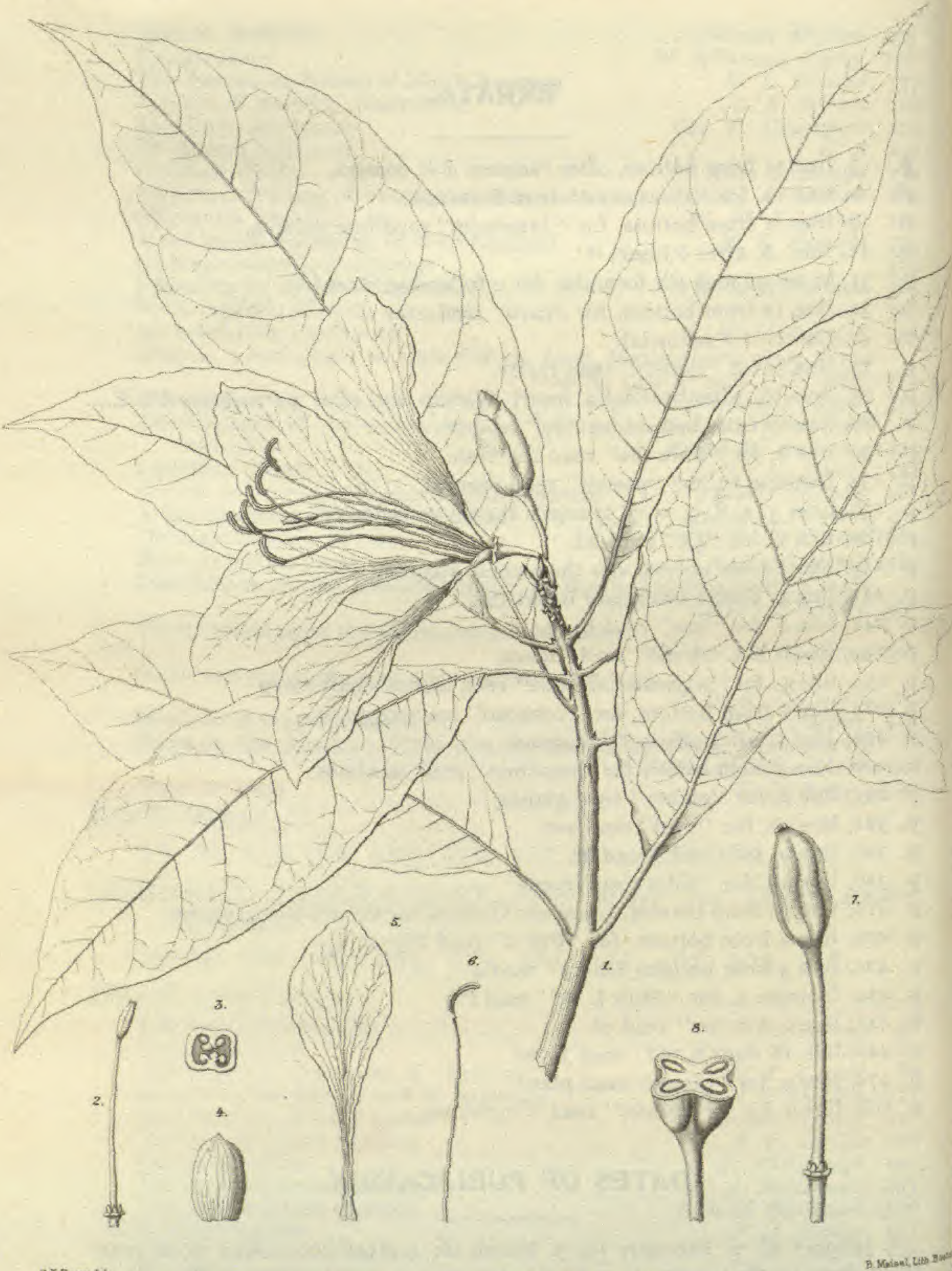

CAPPARIS HEYDEANA, Donnell Smith.

BOTANICAL GAZETTE

JANUARY, 1895.

Undescribed plants from Guatemala and other Central American Republics. XIV.

JOHN DONNELL SMITH.

WITH PLATES I–III.

Porcelia microcarpa Donnell Smith.—Pubens. Folia membranacea, adulta praeter margines nervosque glabrescentia, obovato-elliptica abrupte acuminata, basi acuta. Pedunculi solitarii uniflori, bracteola mediana. Petala exteriora lineari-lanceolata pollicaria, interiora parum longiora angustiora. Stamina obpyramidalia. Ovula pauca subuniseriata. Baccæ stipitatæ parvæ breviter cylindricæ leviter constrictæ apiculatæ, seminibus 1–5 globosis compressis.

Shrub $6–9^{ft}$ high. Leaves distichous with very short internodes, $3–4 \times 1\frac{1}{4}–1\frac{1}{2}^{in}$, paler beneath, petioles $1\frac{1}{2}^{l}$ long. Peduncles opposite to leaves, $5–7^{l}$ long, in fruit twice longer; bracteole ovate-lanceolate, 4^{l} long. Perianth pubescent, fuscous, membranaceous, 3–5-nerved; sepals ovate-lanceolate; exterior petals 3^{l} broad, the interior $14–15 \times 2^{l}$. Stamens subsessile, $\frac{1}{3}^{l}$ long, the dilated incurved apex of connective nearly as broad. Carpels 8–11, oblong, $\frac{1}{2}^{l}$ long, pilose, sessile on truncate apex of hemispherical torus, ovules 4–7, the middle ones occasionally biseriate. Berries 3–4, $9–11 \times 5^{l}$, the interior ones often globose and 1-seeded, stipe $1–2^{l}$ long, seeds 4^{l} in diameter, longitudinally encircled by a groove.—*Porcelia Nicaraguensis* Benth. (represented in the series of *exsiccatæ* by nos. 474, 4,508, 4,519, 5,041), remarkable by petals $4–5^{in}$ long, presents a similar structure of flowers, but the seeds are biseriate and numerous.—Shores of Rio Ocosito, Depart. Quezaltenango, Guat., alt. 300^{ft}, Apr. 1892, J. D. S., no. 1,484.

Cymbopetalum stenophyllum Donnell Smith.—Absque pistillis glaberrimum. Folia anguste oblongo-lanceolata longiuscule acuminata ad basim acutam inaequilatera membranacea pellucido-punctula, petiolis brevissimis. Pedunculus folio aut summo aut pænultimo oppositus ab eoque ter quaterve superatus. Petala interiora magna ovalia quasi calceiformia, exteriora triente minora orbiculari-ovata. Stamina brevia. Pistilla numerosa, stigmate oblique bivalvato uncinato.

A shrub 12–15^{ft} high. Leaves distichous, 6–7 × $1\frac{1}{2}$–$1\frac{3}{4}^{in}$. Peduncle erect, 1–$1\frac{1}{2}^{in}$ long, ebracteolate. Flower $2\frac{1}{2}^{in}$ in diam. Sepals minute, broader than long. Petals glabrous, virescent, transversely wrinkled; the exterior membranaceous, plane, 8–9^{l} long, apiculate; the interior fleshy, 12–14 × 10–11^{l}, very concave, the inflexed margins 3–4^{l} broad. Stamens 2^{l} long, filament minute, gland-dilated apex of connective nearly glabrous. Torus hemispherical. Carpels 16–18, linear, compressed, with the nearly as long style added a little exceeding stamens, 5–6 ribs pubescent; stigma puberulous, bent back at apex; ovules 6–9. Berries not seen.—Banks of Rio Ocosito near Caballo Blanco, Depart. Quezaltenango, Guat., alt. 250^{ft}, Apr. 1892, J. D. S., no. 1,491.

CAPPARIS HEYDEANA Donnell Smith, in BOT. GAZ. **18:** 197. 1893. (*Char. amplif.*).—Glaberrima. Folia elliptico- vel obovato-oblonga 5–9-pollicaria utrinque acuminata, petiolis canaliculatis pollicaribus. Flores pauci in racemo terminali brevissimo dispositi, pedicellis petiolos æquantibus. Petala magna obovato-spathulata sepalis oblongis obtusis 8–10-linearibus in anthesi caducis triplo longiora. Stamina 6 cum carpophoro æquilongo petala pæne æquantia. Ovarium spurie 2-loculare, disci glandulis distinctis triangularibus. Bacca oblonga pollicaris carpophori dimidium æquiparans continua subtetragona parce verrucosa 4-locularis, loculamentis superpositis monospermis. PLATE I.

The additional characters are drawn from more complete specimens collected by M. Adolph Tonduz in Talamanca, Costa Rica, little above sea-level, Mch. 1894 (no. 8,528).[1]

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[1]An exploration of the flora of Costa Rica upon a more extended scale than has heretofore been attempted in any part of Central America is now being prosecuted by MM. Pittier de Fábrega and Tonduz. The *exsiccatæ*, containing already some 9,000 numbers, serve as the basis of *Primitiæ Floræ Costaricensis*, a publication by MM. Durand and Pittier, assisted by various collaborators.

ZANTHOXYLUM LIMONCELLO Planch. et Œrst. To this species, which had been overlooked, must be referred the plant described as *Z. Costaricense* in BOT. GAZ. **13:** 190. 1888. It is represented in the series of *exsiccatæ* by nos. 4,755, 5,726.

Picramnia quaternaria Donnell Smith. — Pubescens. Foliola 9–15 plerumque dissociata glabra supra nitida elongato-lanceolata in apicem obtusum vel retusum sensim angustata præter terminale ad basim valde inæquilatera, ima immutata. Racemi terminales gemini simplices vel parce ramosi, pedicellis gracilibus fasciculatis, floribus 4-meris. Ovarium glaberrimum 2-loculare. Bacca nitida ovalis monosperma semine obovoideo, interdum bisperma seminibus plano-convexis.

Tree 20–30^{ft} high. Leaves 6–8^{in} long, petioles 1–2^{in} long and like rachis puberulous; leaflets 2–3^{in} × 7–10^{l}, approximated in pairs or chiefly scattered, oblique, base somewhat rounded on upper side with the lower narrowly cuneate; petiolules puberulous, $1\frac{1}{2}^{l}$ long, the terminal twice longer. Racemes pubescent, equalling leaves, one in the pair usually with 1–3 branches; pedicels glabrous, chiefly 4–6-umbellate, 2^{l} long. Sepals ovate, aureo-pubescent, a rudimentary fifth one occasionally present. Petals lanceolate, 1^{l} long, thrice exceeding sepals, twice exceeding staminodes. Ovary shorter than petals; stigmas recurved, occasionally three. Berry 5–7 × 3–4^{l}, equaling pedicel; racemes densely fruited. Staminate flowers not seen. The single other species described with 4-merous flowers, *P. tetramera* Turcz., imperfectly characterized, appears to be represented by no. 8,492 Tonduz *Pl. Costaricenses* (fruited specimens with persistent sepals); it differs from the above by indument, less elongated contractedly acuminated leaflets pubescent beneath, the lower pair ovate and equilateral, axillary simple racemes, less densely fruited, obovate-ellipsoid pubescent berry, compressed seed.

Slopes of Volcán Fuego, Depart. Zacatepéquez, Guatemala, alt. 6,000^{ft}, Mch. 1892, J. D. S., no. 2,562. Jumaytepeque, Depart. Santa Rosa, Guat., alt. 6,000^{ft}, Mch. 1892, Heyde & Lux, no. 4,332. Buena Vista, Depart. S. Rosa, alt. 5,500^{ft}, Nov. 1892, Heyde & Lux, no. 4,333.

TRICHILIA SPONDIOIDES Sw., var. **gibbosifolia** C. DC. — Foliolis basi leviter inaequilateris latere longiore rotundatis.

Santa Rosa, Depart. S. Rosa, Guat., alt. 3,000^{ft}, Mch. 1893, Heyde & Lux, no. 4,453.

CUPHEA EPILOBIFOLIA Koehne, var. **canescens** Koehne.—Folia juniora pilis parallele adpressis densissimis incana, mox infra, demum supra glabrescentia. Pedicelli intrapetiolares. Ovarium villosum, stylus ovarii circ. 3-plum æquans. Cetera ut in var. Costaricensi Koehne.

Banks of Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 4,807.

Homalium Hondurense Donnell Smith (§ RACOUBEA Benth. in Journ. Linn. Soc. **4:** 33.).—Folia nitida obovato-elliptica subito acuminata, basi acuta, margine crenato. Racemi axillares, etiam in paniculam terminalem laxam dispositi, floribus canescentibus 5–7-meris, supremis solitariis pedicellatis, inferioribus autem ternis graciliter pedunculatis. Calycis tubus pedicellis brevior, segmentis quam petala dimidio brevioribus triploque angustioribus. Stamina terna. Ovarium hirsutum in stylos 3 distinctos longe productum.

Tree 30^{ft} high. Leaves 6–7 × 3–3½^{in}, thin-coriaceous, veiny, coarse crenatures glandular, petioles 2–3^{l} long. Racemes pubescent, equaling leaves, peduncles 5–7^{l} long, pedicels 2–4^{l} long, flowers chiefly 5-merous. Calyx-segments obtuse, equaling tube. Petals 2½–3 × 1–1½^{l}. Ovary equaling petals, styles very short, ½^{l}, ovules 3 to each placenta.—Flowers about as large as those of *H. racemosum* Jacq., which differs chiefly by leaves, simple racemes, calyx-segments nearly equaling petals, slightly produced ovary. *H. pedicellatum* Spruce (no. 1,689 Spruce!) with similar inflorescence is distinct by foliage, large flowers, quinate stamens, etc.—Rio Permejo near San Pedro Sula, Honduras, alt. 600^{ft}, Sept. 1887, Dr. C. Thieme, no. 5,227.

Centropogon Guatemalensis Robinson.—Glabrous: stems flexuous: leaves ovate-oblong, acuminate at each end, commonly oblique at the base, crenate and denticulate, 4–7^{in} long, 2¼–3^{in} broad; teeth very small, inconspicuous, incurved, acutish, glandular; midrib prominent upon both surfaces but much broader upon the under side; lateral nerves 7–9 pairs, widely spreading and strongly curved; terminal acumination rather abrupt and the point slender; petioles strongly compressed laterally and finely grooved above, 1–2^{in} long: raceme subcorymbose with 8–12 or more flowers; bracts oblong, acutish, denticulate, 4–7^{l} long; pedicels spreading, curved-ascending, the lower ones 1½–2^{in} long: calyx tube hemispher-

C. E. Faxon, del. B. Meisel, Lith. Boston.

CAVENDISHIA CALLISTA. Donnell Smith.

C. E. Faxon, del.

B. Meisel, Lith. Boston

CHAUNOSTOMA MECISTANDRUM, Donnell Smith.

ical, slightly exceeding the adnate ovary; teeth ovate, obtusish, denticulate, purplish, 2–$2\frac{1}{2}^{1}$ long, about equaling the tube: corolla in a dried state deep purple, $2\frac{1}{4}^{in}$ long, cleft more than a third of the way to the base, usually granular-pubescent both upon the outer and inner surface: stamineal column about equaling the corolla, covered especially down one side with short blunt white hairs; the two smaller anthers densely tufted at the apex and with smaller spreading tufts at the base; the other anther cells sparingly hispid at the apex: fruit not seen.—Pansamalá forest, Depart. Alta Verapaz, Guat., alt. $3,800^{ft}$, June 1885, von Türckheim, no. 728.

Cavendishia callista Donnell Smith.—Omnibus in partibus praeter corollam glaberrima. Folia oblongo-ovata vel ovato-lanceolata acutissime acuminata ad basim leviter cordata 5–7-plinervia subtus sparsim nigripunctula. Racemi subterminales elongati, pedicellis gracilibus. Calyx corollæ dimidium fere aequans, limbo campanulato ovarium altero tanto superante usque ad medium fisso. Stamina valde dimorpha.

Branchlets reddish, terete, estriate, somewhat flexuous. Leaves thick-coriaceous, 4–8×2–$3\frac{1}{2}^{in}$; nerves prominent beneath, the interior pair ascending from near base to apex; petioles 4–5^{1} long. Racemes geminate at apex of branchlets and single in uppermost axil, 4–5^{in} long, exceeding subtending leaves; basal bracts orbicular, the interior 9–11^{1} in diam.; rachis angulate, densely flowered; pedicels 5–6^{1} long, basal bracts obovate, 9–12×4–6^{1}, half covering flowers; bractlets at middle of pedicel 2, lanceolate, 1^{1} long; bracts and bractlets roseate, in anthesis persistent. Calyx 4–$4\frac{1}{2}^{1}$ long; tube angulate, intruded at base; segments ovate, $1\frac{1}{2}^{1}$ long, acute tips coloured. Corolla cylindrical 10×3^{1}, puberulous, white, ovate lobes 1^{1} long. Stamens connate at base, reaching to throat of corolla; larger anthers a half longer than the others with cells half as long as tubes and twice longer than filament, cells of smaller anthers nearly equaling tubes and half as long as filament. Berry (immature) glabrous.—Distributed as *C. pubescens* Hemsl. ? That species (nos. 290, 1,383 Bang *Pl. Boliv.* !; and nos. 3,184, 4,532 of this series) may be distinguished by indument, narrower leaves, short racemes, calyx-tube exceeding limb, nearly similar stamens, cano-hirsute berry.—Forests between Coban and Samac, Depart. Alta Verapaz, Guat., alt. $4,500^{ft}$, May 1886, von Türckheim, no. 941.—PLATE II.

Napeanthus apodemus Donnell Smith.—Caulis subnullus, foliis rosulatis obovato- vel oblongo-spathulatis integris ab initio glabris. Pedunculi in axillis singuli, floribus parvulis. Calyx fere partitus, tubo 5-alato, laciniis elongato-lanceolatis haud reticulatis. Corollæ subrotatæ tubus brevissimus prope basim zona purpurea notatus, lobi inaequales bis terve longiores. Stamina 3–4 cum alius rudimento. Capsula ovoidea cum stylo breviori adjecto calycem æquiparans.

Rhizome very short, fibrillose. Leaves alternate, sessile, semiamplexicaul, $3–4^{in} \times 10–15^{l}$, oblique, obtuse, membranaceous, granular-punctulate, 5–6 lateral nerves ascending to margin, reticulating veins invisible on pale undersurface. Peduncles $1–2^{in}$ long; panicles slender, dichotomous, surpassing leaves; bractlets pubescent, linear, $2–3^{l}$ long; pedicels $4–8^{l}$ long. Calyx pubescent, in fruit glabrate and $2\frac{1}{4} \times 1\frac{1}{4}^{l}$, minute wings decurrent from sinus to pedicel, segments 3-nerved. Corolla seen only before anthesis. Filaments very short; anther-cells oblong, diverging, distinct.—Of the other three described species, all South American, *N. Brasiliensis* Gardn. and *N. primulina* Benth. et Hook., *ex char.*, differ chiefly by developed stem, large leaves and flowers; *N. subacaulis* Benth. et Hook. (no. 2,506 herb. Bot. Gard. Trinidad!), imperfectly described, is distinguished by pointed leaves, larger and less deeply parted calyx, spherical capsule equaling style; and all differ by serrate and more or less pilose leaves, reticulated segments of wingless calyx. *N. Andina* Rusby *ined.* (no. 1,729 Bang *Pl. Boliv.!*) is remarkable by its campanulate tube of corolla exceeding the lobes.—Shaded precipitous banks of Rio Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 5,109.

Arrabidæa dichasia Donnell Smith.—Folia bifoliolata, cirrho caduco, foliolis obovato-ellipticis abrupte acuminatis ad basim imam acutis coriaceis nitidis utrinque reticulato-nervosis, costis in utroque latere 4–5, petiolis cum petiolulis fere aequilongis brevibus. Thyrsi terminales ampli, ramis pluries dichotomis. Calyx campanulatus minutissime glandulo-lepidotus subinteger saepius laceratus. Corolla velutina supra calycem dilatata longe infundibuliformis, limbi obliqui lobis obovatis. Filamenta brevia. Discus pulvinatus. Ovula numerosa.

Scandent (Thieme). Petioles $6–8^{l}$ long, petiolules $5–7^{l}$; leaflets $4–5 \times 2–2\frac{1}{2}^{in}$, lateral nerves ascending to near margin.

Thyrsus broad, 8–10^{in} long; peduncle $1\frac{1}{2}$–3^{in} long; axes puberulous, minutely lepidote, the secondary 1–$1\frac{1}{2}^{in}$ long. Calyx as broad as long, 3^{l}, occasionally with a few large glands. Corolla $2\frac{1}{4}$–$2\frac{3}{4}^{in}$ long; tube nearly cylindrical, at middle 6–7^{l} broad, smooth within except paleaceous-barbate insertion of stamens at contracted base; lobes puberulous within, as broad as long, 7–9^{l}, contracted below. Stamens didynamous; filaments arcuate, 8–10^{l} long; anther-cells divaricate, 2^{l} long, connective round-apiculate. Ovary linear; lobes of stigma elliptical, 1^{l} long; ovules uniseriate at each placenta, 25–30 pairs to the cell. Capsules not seen.—According to the synoptical arrangement of species by Schumann in Engl. & Prantl *Nat. Pflanzenfam.* the above is to be grouped with *A. Chica* Bur. The leaves and inflorescence resemble more nearly those of *Distictis elongata* Bur. The whole plant becomes blackened as an *exsiccata.*

Sandy grounds near San Pedro Sula, Honduras, alt. 600^{ft}, May 1890, Dr. C. Thieme, no. 5,393.

ARRABIDÆA CHICA Bur., var. **viscida** Donnell Smith.—Folia trifoliolata, foliolis supra strigillosis subtus velutinis cuspidato-acuminatis, lateralibus quidem e basi oblique cordata 5-nervia orbiculari-ovatis, medio maximo e basi rotundata 3-nervia orbiculari-obovato interdum in cirrhum immutato lateralibus tunc ovato-lanceolatis. Paniculæ et terminales et axillares cum calycibus glandulo-viscidæ.

Casillas, Depart. S. Rosa, Guat., alt. 4,000^{ft}, May 1893, Heyde & Lux, no. 4,550.

Distictis Rovirosana Donnell Smith.—Folia recentiora stellato-canescentia, adulta praeter petiolos longos et nervos glabrata, foliolis oblongo-obovatis ad formam ovalem vel oblongo-ovatam ludentibus caudato-acuminatis, basi 3–5-nervia plerumque retusa. Thyrsi incani angusti foliis recentioribus bracteati in paniculam terminalem amplam dispositi, cymulis 3-chotomis. Calyx anguste campanulatus, dentibus mucronatis. Corolla recta campanulato-infundibuliformis. Discus latior quam altior. Ovula in utraque placenta 4-seriata. Capsula ecarinata glandulis magnis maculata ceterum glabra, seminibus in utroque loculo 15–18.

Trunk very stout, procumbent; branches scandent, striate, glandular-pubescent. Petioles 2–4^{in} long; leaves 3-foliate, or conjugate with a simple tendril, 4–6 × $2\frac{1}{2}$–3^{in}; terminal petiolule $\frac{3}{4}$–$1\frac{1}{4}^{in}$ long, 2–3 times exceeding the lateral. Thyrsi stellate-tomentulose, often undeveloped and corymbiform; bractlets linear, 2–4^{l} long. Calyx velvety, $2\frac{1}{2}$–3^{l} long. Corolla velvety, roseate, $1\frac{3}{4}$–2^{in} long; contracted tube twice exceeding calyx, pubescent within; lobes subequal, subovate, 7–9^{l} long, pubescent within. Stamens inserted at contracted base of corolla, nearly attaining throat, anther-cells divaricate. Disk $\frac{1}{2}^{l}$ high, twice broader, somewhat cupulate. Ovary oval, lepidote, ovules 7–9 in each series. Capsule ligneous, oblong, $3\frac{3}{4} \times 1\frac{1}{2}^{in}$, acuminate, base rounded, valves thick, septum marked near margins with irregularly biseriate linear hila; seeds pubescent, suborbicular, 7–9^{l}, with wing added oblong and 2×1^{in}.—Very distinct from *D. elongata* Bur. and *D. Mansoana* Bur. (no. III, 50 ex herb. Brasil. Regnell. !), the only species that have been referred to *Distictis* as limited by Bureau.

Collected by Prof. José N. Rovirosa "in clivulis prope Atasta, Tabasco, Mexico, ubi vernacule *Pié de Gallo* dicitur, Maj. 1889, n. 488 Flora Mexicana." Also represented in this series: Obero, Depart. Escuintla, Guatemala, alt. 200^{ft}, Mch. 1892, J. D. S., no. 2,689: Papelón, Depart. Choluteca, Honduras, near sea-level, Feb. 1893, Shannon, no. 5,052: Rio Limón, Depart. Rivas, Nicaragua, near sea-level, Apr. 1893, Shannon, no. 5,053: Rio Sapoá, Depart. Rivas, Nicaragua, alt. 650^{ft}, Apr. 1893, Shannon, no. 5,054.

Tecoma evenia Donnell Smith.—Folia ampla minutissime lepidota ceterum glabrata 5-foliolata, petiolis petiolulisque semiteretibus, foliolis ellipticis acutis ad basim obtusis penninerviis, venis utrinque immersis. Thyrsi corymbiformes subhemispherici densiflori, axibus perbrevibus et calycibus rufotomentosis. Calyx obconicus, dentibus subaequalibus rotundatis mucronatis. Corolla supra calycem sensim ampliata longe infundibuliformis intus unilateraliter pubescens $\frac{1}{3}$-lobata, lobis obovatis pollicaribus punctulis.

Tree 25–30^{ft} high. Petioles 6–7^{in} long; leaflets coriaceous, the interior $5–7 \times 2\frac{1}{4}–3\frac{1}{4}^{in}$ with half as long petiolules, the exterior a half smaller with petiolules 5–7^{l} long; costæ to a side 8–10, very prominent beneath, straight, uniting in submarginal arches. Thyrsus sessile at apex (often furcate) of branches, 8–9^{in} broad, half as high; secondary axes subfasciculate, 4–5^{l} long, 3-chotomous, capitulate hairs glandular. Calyx 6–7^{l} long, exceeding pedicel. Corolla apparently roseate, 3^{in} long; tube below throat 6–8^{l} wide; lobes finely reticulate. Stamens half as long as tube of corolla; anther cells divaricate. Disk annular. Ovary linear; lobes of stigma obovate, 1^l long; ovules irregularly pluri-seriate to the cell. Capsule not seen.—Leaves and inflorescence are very similar to those of *Couralia rosea (Tecoma rosea* Bertol.; *Tabebuia rosea* DC., § COURALIA), represented in the series of *exsiccatæ* by nos. 3,111, 4,912, 5,047, 5,388. That species differs by glaucous veiny leaflets, glabrous inflorescence, bilabiate calyx, uniseriate ovules to the placenta; the last character and the loculicidal dehiscence of capsule, *ex descr.*, seem to warrant its transfer to *Couralia.*

Santa Rosa, Depart. Santa Rosa, Guat., alt. 2,500^{ft}, Mch. 1892, Heyde & Lux, no. 3,110.

DURANTIA MUTISII L., var. **Costaricensis** Donnell Smith.—Rami cum inflorescentia tomentulosi flavescentes, foliis subtus sordide pubescentibus supra puberulis, bracteis foliaceis stipitatis infimis florem superioribus calycem æquiparantibus.

Shrub 10–20^{ft} high, growing in cultivated grounds at Estrella, Prov. Cartago, Costa Rica, alt. 4,400^{ft}, Apr. 1888, Juan J. Cooper, no. 6,007.—This may be presumed to be the undetermined species noted by Polakowsky (Die Pflanzenwelt von Costa Rica, p. 97) as occurring not far from the above locality.

CHAUNOSTOMA Donnell Smith, nov. gen. LABIATARUM.—Calyx obpyramidalis irregulariter plurinervis usque ad medium bifidus, lobis 5 subæqualibus triangularibus, fructiferens auctus. Corolla parva quasi oblonga, tubo breviter exserto, faucibus obliquissimis, labii postici erecti lobis semirotundis, antici longioris sub angulo nullo fere dejecti lobis lateralibus in marginem arcuatam declinatam reductis, lobo medio patente concavo integro. Stamina 4 didynima ascendentia longissime exserta, antica eminentiora, antherarum locellis divergentibus confluentibus. Discus crassus æqualis. Ovarium usque ad basim partitum, stylo staminibus æquilongo breviter bifido, lobis subulatis æqualibus. Nuculæ ovales leves, areola minuta oblique basali.—Inflorescentia axillaris simpliciter racemosa, pedicellis oppositis ad basim bracteatis in medio bibracteolatis unifloris.

Genus ob anomalam characterum conjunctionem sedem in systemate incertam occupat. Nomen inditum corollam latissime hiantem dicere vult.

Chaunostoma mecistandrum Donnell Smith.—Frutex orgyalis incanus stellato-tomentosus, internodiis brevissim

Folia crassa discoloria supra rugosa subtus dense velutina penninervia crenulata oblongo-elliptica vel oblongo-lanceolata utrinque acuta. Racemi a foliis bis terve superati, pedicellis calycem caeruleum aequiparantibus.

Leaves $5–6\frac{1}{2} \times 1\frac{1}{2}–2^{in}$. Petioles $6–9^{l}$ long, equalling or exceeding internodes. Bracts and bractlets linear. Calyx bright-blue, 4^{l} high, in fruit twice larger. Corolla (red ?) like calyx pubescent and aureo-punctulate, $7\frac{1}{2}^{l}$ long, posterior lip 2^{l} long and nearly equaling the arcuate sides of anterior lip, middle lobe 1^{l} long. Stamens twice exceeding corolla, after anthesis declinate and contorted, anther-cells oblong and blue. Nucules black, shining, 1^{l} long.—The racemes, as shown by presence of bractlets, are technically undeveloped thyrsi.—Growing in patches on shaded mountain-summits near Buena Vista, Depart. Santa Rosa, Guat., alt. $6{,}000^{ft}$, Dec. 1892, Heyde & Lux, no. 4,368.—PLATE III.

Ocotea perseifolia Mez et Donnell Smith; foliis adultis subtus pilis brevissimis perobscurisque scabriusculis, late ovato-ovalibus, basi cordatis v. obtusis apice late breviterque acuminatis, penninervibus, utrinque laxe prominulo-reticulatis; inflorescentia submultiflora, abbreviate subthyrsoidea, foliis multo breviore; floribus hermaphroditis, minutissime peradpresseque tomentellis; perianthii tubo brevi; antheris subsessilibus; staminodiis fere abortivis; ovario glabro; stylo brevi.

Arbor v. frutex; habitu ramuli praesentis *Perseæ caeruleæ* memoriam revocat. Ramuli praesertim apicem versus ± angulati, peradpresse paullo sericanti-tomentelli flavido-allutacei. Folia petiolis usque ad 20^{mm} longis, optime canaliculatis stipitata, sparsa, coriacea, sicca supra olivaceo-viridia subnitida subtus pallida opaca, usque ad 0.2^{m} longa, 0.12^{m} lata, venis dorso ± manifeste rubentibus. Inflorescentia peradpresse pallide tomentella; pedicellis $\pm 2^{mm}$ longis, bracteolis deciduis. Flores $3–3.5^{mm}$ longi, limbi tubo obconico, segmentis ovalibus, acutiusculis, papillulosis. Antheræ rectangulares, rotundatæ vel truncatæ, papillosæ; glandulæ ser. III. parvæ, globosæ, sessiles, basales. Ovarium crasse ovoideum, stylo 5–6-plo breviore, stigmate obtuso. Fructus ignotus.

Yzabal, Depart. Yzabal, Guat., alt. 120^{ft}, Apr. 1889, J. D. S., no. 1,807.

Dioscorea cyanisticta Donnell Smith. (§ALLOCTOSTEMON Griseb. in Fl. Bras.).—Absque rhachibus glabra. Folia cordiformia acuminata 11-nervia. Spicæ in axillis aggregatæ, in panicula evoluta singulæ, flaccidæ, rhachibus complanatis, glomerulis distichis, floribus subsessilibus binis aut ternis parvulis. Stamina a segmentis patulis perianthii partiti triplo superata staminodiis filiformibus puberulis aequilonga, locellis discretis. Ovarii rudimentum nullum.

Stem stout, procumbent, branchlets twining. Younger leaves ovate-lanceolate from an acute or rounded base; the mature as broad as long, 5–6 , more or less acuminated, sinus broad and shallow, twice to thrice exceeding petioles, membranaceous, pellucid-lineolate, spotted beneath toward base with numerous large blue glands. Spikes subsessile, 4–6^{in} long, rachis puberulous, clusters approximated; flowers minutely pedicellate, occasionally solitary, equalling elongate-lanceolate bract. Perianth $1\frac{1}{2}^{l}$ in diam.; segments oblong, obtuse, 1-nerved. Filaments inserted at base of segments, little exceeding anthers. Feminine spikes not seen.—Growing over rocks along shores of Rio Turrialba, Prov. Cartago, Costa Rica, alt. 1,600^{ft}, Mch. 1894, J. D. S., no. 4,969.

Baltimore, Md.

EXPLANATION OF PLATES I–III.

I. *Capparis Heydeana.*—Fig. 1, flowering branch.—Fig. 2, carpophore with ovary.—Fig. 3, section of ovary.—Fig. 4, sepal.—Fig. 5, petal.—Fig. 6, stamen.—Fig. 7, carpophore with berry.—Fig. 8, section of berry. (Figures 3 and 8 are somewhat enlarged; the others are natural size.)

II. *Cavendishia callista.*—Fig. 1, flowering branch.—Fig. 2, interior bract subtending raceme.—Fig. 3, bract subtending pedicel.—Fig. 4, flower with pedicel.—Fig. 5, section of flower with corolla removed.—Fig. 6, corolla laid open.—Figs. 7 and 8, stamens. (Figs. 1–4 are natural size; the others are somewhat magnified.)

III. *Chaunostoma mecistandrum.*—Fig. 1, flowering branch.—Fig. 2 calyx laid open with pistil.—Fig. 3, corolla in profile with stamens.—Fig. 4, corolla laid open with stamens.—Fig. 5, an anther.—Fig. 6, disk with ovary.—Fig. 7, nucule. (Figures 1 and 2 are natural size; the others are variously enlarged.)

Notes from my herbarium. I.

WALTER DEANE.

A few notes from my herbarium, relating to some of the plants which I have collected from time to time, may be of interest. Roots, runners, rootstocks and the like are rarely well represented in collections, and yet how incomplete the plant is without these characteristics, and what important functions they often fulfil in the economy of nature.

LATHYRUS MARITIMUS Bigelow. Beach pea.

I have a specimen of this species, represented on three sheets. I collected it on Aug. 31, 1888, at Hyannisport, Mass. It was growing in the clear sand near the water, and its importance in helping to bind the sands, and thus to resist the ever-encroaching waves of the sea, can be seen from the following note which I made at the time, and copied on one of the sheets: "The main rootstock of this plant was nineteen feet long. The stock ran along but a few inches, from one to four, under the sand. The nodes of the rootstock were from six inches to one foot apart. At intervals of from one to three feet, short roots were thrown off from the stock at the nodes. There were three branches from the main stock, the longest one being six and one-half feet. These branches were also branching. The fresh young stocks were very white, succulent and brittle. The root descended abruptly two and one-half feet, branching slightly at the end. From the stocks rose eight fresh plants, and three dead stalks of last year's plants." This is certainly a most astonishing record for a single plant. I retained for my herbarium enough of the plant to show all its features, even including the nineteen feet of rootstock. By coiling the stock, I easily managed it. It is about one-eighth of an inch thick, and makes a flat mat, which is readily mounted.

AMMOPHILA ARUNDINACEA Host. Sea sand-reed.

On Aug. 13, 1886, at Rye Beach, N. H., on a sandy beach, I dug up a complete tussock of this tough grass. By a judicious cutting off of the top of the plant, leaving enough to show a few leaves and the inflorescence, and by using a very heavy pressure, a fine specimen was made, showing the size of the plant, with its copious roots and running rootstocks complete. I find this a most satisfactory way of showing the character of the plant. The stocks are tough, wiry, and about a foot long. A specimen like this can easily be supplemented by other specimens, showing individual parts separately.

The character of this grass as a binder of the sea sand is well known. When the ever-shifting sands bury the plant a foot deep or more from its base, it appears as usual the next year, the new plant connected with its buried parent by a tough brown stem one-sixteenth of an inch in diameter, looking exactly like a wire, and rising straight from the center of the old plant. I have a plant from Nantasket Beach, Mass., showing this peculiarity.

RANUNCULUS CYMBALARIA Pursh. Sea-side crowfoot.

This species of crowfoot grows by the sea in various kinds of soil. The average height of the scape is from four to six inches. I have a vigorous plant from the Charles river salt marshes in Cambridge, with a scape eleven inches high. A most interesting feature of the plant is its long rooting runners. It is not always that these runners have a chance to display their greatest activity. When growing amongst other plants, such as grasses and the like, the plant seems to reach a greater development, but the runners have little chance to display themselves. On July 20, 1894, at Wells, Me., I found this plant growing in a ditch of soft black mud. It covered a space of a few square yards, and was literally yellow with flowers. No other plant of any kind hindered its growth and the runners were interlaced in every direction. I took up a single plant with six runners attached. The longest runner was two feet one inch long, and rooted eight times. The plant rooting at the first node was fully developed, bore a flower, and was sending forth a secondary runner which had already rooted twice. Another runner rooted seven times, the first plant bearing a bud, while the smallest runner rooted three times. The parent plant was small, the scape being barely three inches high, as if its numerous progeny had sapped its strength. By careful manipulation I arranged the plant so that it would come within the limits of a mounting sheet, without crowding the runners. It tells a most interesting story of rapid propagation.

ARALIA NUDICAULIS L. Wild sarsaparilla.

I find in my herbarium a fruiting specimen of wild sarsaparilla, which I collected July 19, 1883, in Shelburne, N. H., among the White mountains. The tough perennial root, one fourth of an inch in diameter, ran horizontally a few inches below the surface in opposite directions from the main stem. I dug it up till it broke, and on measurement found that I had a root eight and one half feet long. By coiling the two ends up to the stem, I easily made a good mounting specimen, which shows that far the greater part of the plant is under ground. It takes a separate mounting sheet to show one of the three divisions of the large compound leaf. Smaller specimens show the whole leaf of various sizes. Beside this large specimen I have put a very young plant, collected May 12, 1883, in Belmont, Mass. The scape is two inches, and the leaf three inches high.

GALIUM ASPRELLUM Michx. Rough bedstraw.

This species of bedstraw, which grows throughout the Gray Manual range, has a fine development of root-stock. I collected a specimen Sept. 6, 1889, in E. Jaffrey, N. H., and it takes an entire mounting sheet to show the underground growth. The root-stocks branch very freely from the stem, the longest one being two feet. They run along but a short distance under the surface of the ground, and root copiously at the nodes, which are about one inch apart. Young plants are sent up occasionally from the nodes. On my single specimen I count fifteen of these plants, varying from less than an inch to five inches in length.

ASTER ACUMINATUS Michx.

In a deep, rich wood at Rye Beach, N. H., Aug. 19, 1886, in company with *Woodwardia angustifolia* Smith, which was extremely abundant, I found this aster growing in the greatest profusion. It reached a perfect development here, for the plants ran as high as two and one-half feet. I took up a specimen which showed very beautifully the slender underground stems, connecting different plants. From a rootstock several inches below the surface, three rootstocks branched at intervals of about an inch. Each of these stocks, which were all fifteen inches in length, bore a vigorous plant, the one which I retained for my herbarium being two and one-half feet high, with leaves seven inches long. The other specimens of this species in my herbarium are of the average size, from one and one-half to two feet high, with leaves about four inches long. Twenty shoots, from fifteen inches to less in length, branch off from the three stocks. All this tangle of rootstock I have mounted on one sheet, with about three inches of the stems of the three plants, mounting on a separate sheet the flowering specimen which I retained.

TARAXACUM OFFICINALE Weber. Common dandelion.

I have succeeded in mounting a specimen of our common dandelion with the large head of fruit intact. I did it in this way. I collected the specimen the moment the fruit had opened, and while the akenes were still firmly attached to the receptacle. In this condition I pressed it. By the time the plant was dry, I noticed that the akenes were free from the receptacle, but still in position. I always transfer all my plants too flimsy to handle to the mounting sheet or pasting sheet of blotting paper by reversing the plant with a sheet on each side. This saves much trouble, and the most delicate plants can in this way be very quickly handled and mounted. In the case of my taraxacum, however, I could not touch the pasting brush to the pappus on the fruit, as it would stick to it and spoil my specimen. So when the plant was on the mounting sheet unpasted, I made a few points with a pencil close to the edge of the pappus. Then, after transferring the plant to the pasting sheet, I pasted all the plant but the fruit, and, on the mounting sheet, I pasted the space between the points. By careful reversal of the plant again, the fruit fitted exactly on the former spot, where the glue received it and held it fast. A few blotters and a proper weight, laid on the sheet for a few hours, completed the work.

Cambridge, Mass.

The crystallization of cellulose.

DUNCAN S. JOHNSON.

Previous investigation.

In number two of volume nine of *La Cellule*, Eugene Gilson of the University of Gand has an interesting article on "The crystallization of cellulose and the chemical composition of the cell membrane of plants."

I will give an abstract of the article and then have something to say of some work in the same line done in the winter and spring of 1894 in the biological laboratory of Johns Hopkins University.

The author first sets forth the present state of our knowledge of the constitution of the cell wall, taking the work of Schultze as the most authoritative. Schultze holds that we have in the cell wall dextrocellulose and mannosocellulose. These two agree in being insoluble in dilute acids or alkalies by boiling and in their coloration by iodine and sulfuric acid, but differ in their derived sugars, the first giving only dextrose and the second both dextrose and mannose. Besides these he proposes to give the name of hemicelluloses to those as yet little known compounds occurring in the cell wall that are soluble in dilute acids and alkalies by boiling, and which probably agree with dextrocellulose and mannosocellulose in their reaction with chloriodide of zinc and iodine and sulfuric acid.

None of these bodies, though closely related to the crystalline sugars, have hitherto been considered to be crystalline but rather amorphous.

Gilson hoped to settle the following points: (*a*) Which of the carbohydrates is it that crystallizes from a solution of the material of vegetable tissue in Schweizer's reagent, when strong ammonia is added? (*b*) Is cellulose a distinct chemical individual or are there several compounds in the cell wall that are insoluble in dilute acids and alkalies, and give the blue color with the iodine reagents? (*c*) Is the cellulose free or in combination in the cell membrane with other constituents? (*d*) Is the cellulose distributed through all three layers of the cell membrane or localized in one or two or in certain parts of all?

In his discussion the author uses the term cellulose to designate provisionally the carbohydràte or carbohydrates of the cell wall that are insoluble in acids and alkalies and give the blue color with iodine and sulfuric acid.

For the author's method of obtaining the so-called crystals of cellulose, we may describe the course pursued for the root of the beet (*Beta vulgaris*), which is only modified in individual cases depending upon the resistance of the tissue at hand. Moderately thick sections of the swollen root were — (1) soaked in 1% KOH (or eau de javelle) to dissolve out the cell contents. In repeating his experiments in the Johns Hopkins laboratory half an hour in 1.5% KOH was generally found sufficient. (2) After thoroughly washing in distilled water the sections were put into Schweizer's reagent for four or five hours. (3) The dissolved cellulose is precipitated in crystals by putting the sections after removal from Schweizer's reagent into ammonia, the size of the crystals being said to vary with the strength of the ammonia, 5% giving only spherocrystals, and 20% giving beautiful arborescent or radially arranged spicular crystals.

These bodies, which have the appearance of crystals under the microscope, can be seen best after clearing the sections of copper compounds by washing them with water and treating with dilute HCl and then coloring them with chlor-iodide of zinc (or Congo red before treatment with HCl). They are then found almost entirely within the cell walls, sometimes in the intercellular spaces, those that are formed outside being from the cells opened in cutting the section, very little of the dissolved cellulose diffusing through the cell wall. If the Schweizer's fluid has acted long enough the iodine reagents give no evidence of any cellulose remaining in the cell membrane, the only blue coloring substance being the crystals within the cell cavity.

It is from the beet evidently that Gilson gets his most characteristic crystals, as it is these that he figures for his article, though he has worked in this way upon sections of more than fifty plants. Most of these are angiosperms, but among them are chara and spirogyra of the algæ, and mucor and agaricus of the fungi, with half a dozen mosses and ferns and two gymnosperms. In all of these, except the fungi, he was able to get satisfactory crystals of cellulose, and has also obtained good results with a number of seeds, such as coffea, strychnos, etc., by first treating oily seeds with ether. Cotton fibers and lignified tissues also yield crystals. Another interesting result is the obtaining of crystals from the test of an ascidian, Phallusia mamillata, this being confirmatory of the work of Winterstein who found that tunicine or animal cellulose gave dextrose as a derivative sugar just as vegetable cellulose does, and thus seeming to show that animal and vegetable cellulose are one and the same chemically.

From the results of his work on the plants, the following conclusions are drawn:

1. All that portion of the cell wall that is colored blue by chlorozinc-iodide, and that only, goes to make up the crystals.

2. The crystals are of pure cellulose.

3. All the cell walls contain cellulose, but while the internal layer consists almost entirely of it, the intermediate has only a small proportion, and the intercellular layer only a trace. These three layers were distinguished in sections treated by the method of Mangin, and those stained with methylene blue.

4. That the cellulose is found crystallized within the cell shows that its solution in Schweizer's fluid is not very diffusible, and also gives additional proof that it is derived from the inner layer of the cell-wall.

In the strictly chemical portion of his work, Gilson prepared convenient quantities of cellulose for working with by scraping to a pulp the stalk of cabbage or root of the beet, and proved by putting sections through the same treatment that he had a substance identical with the crystals found within the cells as described above. In fact he got from the pulp a mass of spherocrystals of the same kind formed in the cells.

By the method of Flechsig he finds that when all operations are carried on with extreme care, dextrose only (in the form of the silver salt of the derived saccharic acid) is obtained from cellulose, showing thus that cellulose is a definite chemical individual.

By using the method of Schultze he got from *Coffea arabica* a body corresponding to the mannosocellulose of Schultze. By precipitation from a solution of this with CO_2 he gets characteristic cellulose, and finds another carbohydrate is still left in solution. This second body gives not dextrose but mannose as a derived sugar. Mannosocellulose is then only a mixture of true cellulose and another carbohydrate which Gilson proposes to call paramannane. The formula of the latter as he determined by several analyses is $(C_{12} H_{22} O_{11})_n$.

The paramannane thus obtained was in the form of a white powder of small spherocrystals, which dissolves in Schweizer's fluid as we have seen, and also in H_2SO_4, in the cold when concentrated, but when dilute only by heating, and then it turns to mannose. Gilson does not state whether paramannane turns blue on the addition of iodine reagents.

The results of his chemical work are: (1) Cellulose is a single chemical individual. (2) Mannosocellulose is a mixture of cellulose and paramannane. (3) The so-called reserve-cellulose is probably also a mixture of cellulose and some other carbohydrate or carbohydrates.

Additional investigation.

At the suggestion of Dr. J. P. Lotsy I repeated much of Gilson's work as given in the first part of his paper, in the laboratory of the Johns Hopkins University, at Baltimore.

I obtained a considerable number of the green plants mentioned by Gilson. From these in every case where good material was at hand the so-called crystals were readily obtained. Beta vulgaris gave very fine crystals after three hours or less in Schweizer's fluid, but a longer time was needed to dissolve all of the cellulose out of the cell wall.

Among others dahlia, lactuca, typha, ceratozamia, equisetum, and chara gave especially good results.

As to the diffusibility of the dissolved cellulose, I found that after keeping sections of the beet in Schweizer's fluid for twenty days, the crystals were as plentiful in the cells as at first.

The solution then resembles in diffusibility rather non-crystalline colloidal substances than crystalline ones.

This together with the appearance of the bodies themselves in some cases, led me to think that the things which Gilson called crystals were not really such. I therefore made several sets of preparations in which there were plenty of the bodies present, and examined them carefully under the polariscope. *In no case did they have any effect on polarized light, showing thus that they were not true crystals.*

I was gratified, though greatly surprised, to find later, that Gilson, after calling the bodies crystals all through his paper and saying nothing of having tested them with polarized light, gave expression to the conclusion at which I had arrived, in the following sentence *in fine print at the end of the explanation of the plates:* "Les formes sous lesquelles se présentent le paramannane et la cellulose sont sans action sur la lumière polarisée; ce sont donc plutôt des cristallites que des cristaux."

As mentioned in the abstract of Gilson's paper, he got no *crystallites* (as we shall now call them) from mucor and agaricus. I tried both of these, together with saprolegnia and the fungal portions of several lichens, but although they gave the blue color with the iodine reagents, after treating with potash, they did not give any crystallites. The Schweizer's reagent did not dissolve out the blue coloring constituent of the tissues at all, the addition of chloriodide of zinc giving as strong a color after soaking for two weeks in Schweizer's reagent as at first, the color always being evenly diffused through the tissue.

In regard to vegetable tissues then, my work has been entirely confirmatory of Gilson's.

As mentioned above, the only animal tissue with which Gilson worked was the test of phallusia, and here he states that he obtained crystallites similar to those in vegetable cells.

I also worked on several ascidians, beginning with salpa, but although the test gave a strong blue color with chlorozinc iodide both before and after treatment with Schweizer's fluid, I was never able to get any of the crystallites to form, and also, as in the fungi mentioned above, none of the blue coloring substance dissolved out by prolonged treatment with Schweizer's reagent. There were in some cases bodies which I at first mistook for the crystallites, but on more careful examination it was found that their seeming blue color was due to the color of the surrounding tissue, and moreover they proved to be true crystals when tested with the polariscope.

I decided to try Gilson's method in testing for cellulose on other animal tissues and found many suggestions as to what to use in a paper by H. Ambronn, on "Cellulose Reaction bei Arthropoden and Mollusken," in Mittheil. aus der Zool. Sta. zu Neapel **9**: 475.

Ambronn found that after treatment with alcoholic potash he could get a distinct blue with iodine reagents in several widely separated arthropods, such as eupagurus, squilla, sappharina, calotermes and julus. Among the molluscs he obtained the cellulose reaction in sepia, the pen of loligo, the radula of helix and the opercula of several species of natica.

The skeletons of rhizopods among the protozoans, the perisarc of hydroids among the coelenterates, the tubes of annelids such as onuphis and polyodontes and also the skeletons of bryozoans among Vermes, gave no indication of the presence of cellulose.

Without attempting to verify all of Ambronn's results, I worked on a number of animal tissues, first trying the iodine test for cellulose on various parts of different arthropods and mollusks and then with such tissues as the skeleton of horny sponge, integument of the starfish and nereis, and vertebrate dermal tissues such as hair, skin, and nails. In the mollusks the pen of loligo and radula of paludina, and among the arthropods the integument of the abdomen of eupagurus, the stalk of lepas, gills of limulus, and tests of ascidians such as salpa, molgula and amaroecium, all gave results confirmatory of those of Ambronn. As was to be expected from the lack of mention of such a thing in the literature, the vertebrate tissues gave no indication at all of cellulose.

I next applied Gilson's test for the presence of cellulose to some of the above which gave the strongest color with chlorozinc iodide, to see if I could obtain the blue-staining substance in the form of crystallites. The pen of loligo gave an intense violet with chlorozinc iodide but keeping for fifteen or twenty days in Schweizer's fluid did not decrease the intensity of coloration when the sections were stained with chlorozinc iodide afterward, nor could any crystallites be obtained by precipitating with ammonia.

In the same way the tissues of eupagurus, molgula and paludina were tried and all gave results like that in the case of loligo, the blue-coloring substance not seeming to be dissolved out but remaining as at first uniformly diffused through the tissues.

The occurrence of the blue coloration in so many of the truly chitinous animal tissues suggested the idea that chitin or some derivative of it might give the blue color. The method of preparation of glycosamine by Ledderhose resembles in several steps that of Ambronn for the demonstration of cellulose in animal tissues. I therefore (although a blue staining with the iodine reagents had not been mentioned as one of its properties) made a preparation of glycosamine by the method of Ledderhose, and tried it with chlorozinc iodide to see whether it gave the blue color, and found that it did not.

This subtance is dextro-rotatory and reduces Fehling's solution as readily as dextrose, and these facts may account for the supposed derivation of true dextrose from chitinous tissues by the older observers, and hence we have only the work of Winterstein on tunicine to prove the existence of true cellulose in animal tissues.

In conclusion then, I am inclined to think that Gilson's test for cellulose is a much more satisfactory one than the ordinary chlorozinc iodide test, and should therefore replace the old method in the demonstration of cellulose in vegetable tissues in the laboratory. Its use in my hands seems to prove that the blue staining substance present in tunicates, arthropods and certain mollusks is not identical with vegetable cellulose chemically.

We must, however, consider the animal substance under discussion as possibly quite similar to, perhaps only a slight modification of, true cellulose. For as we have seen above, the substance of the supporting tissue of the fungi, which as we know have arisen from plants that in all probability possessed true cellulose, are still as refractory as animal tissues when treated with Schweizer's solvent.

Johns Hopkins University, Baltimore, Md.

Noteworthy anatomical and physiological researches.

The periodic reduction of chromosomes in living organisms.

Under this title Professor Eduard Strasburger communicated a very important paper to section D of the British Association last August. A translation of the paper appears in the *Annals of Botany* for September, and so many of our previous views are affected by it that it deserves a somewhat full mention.

Calling attention in the outset to the fact that sexual differentiation in plants was preceded by asexuality, the author shows that when this differentiation was attained it finally led to the production of a new generation set apart to spore production, and that in alternation of generations the sporophyte is the newer generation, having arisen from the gametophyte. In the production of this sporophyte it has been noted that the two gametes concerned have nuclei containing half the number of chromosomes characteristic of the nuclei of the resulting sporophyte, and this reduction has been regarded as a special preparation for the sexual act. Upon this hypothesis there have been constructed various theories with regard to the reduction and to the significance of the sexual act. Strasburger and other observers find, however, that this reduction in the number of chromosomes in the generative nuclei of angiosperms is determined in the mother-cells of the pollen and embryo-sac, and not during the maturation of the sexual cells. The physiological utility of this reduction is evident in the prevention of the indefinite increase of chromosomes with every succeeding generation and in securing the equal representation of each parent. The morphological cause, however, is phylogenetic, for it is simply a return to the original generation which had attained sexual differentiation, and which in consequence had developed as offspring sporophytes containing nuclei with double the number of chromosomes. This reduction, therefore, is not the outcome of a gradually evolved process of reduction, but is the sudden reappearance of the primitive number of chromosomes as it existed in the nuclei of the generation in which sexual differentiation first took place. This reduced number which is determined in the spore mother-cells in angiosperms persists in all subsequent divisions to the formation of the generative nuclei, involving usually four divisions in the history of the male nucleus, and five in the case of the female, although in the latter case the divisions may be three, four, five or more. It is evident that the attempt to establish homologies between the successive divisions preceding the formation of the two generative nuclei is futile; and it is equally worthless to claim on physiological grounds the necessity for a certain definite number of nuclear divisions that the two nuclei may be brought to the same bulk. The reduction in the number of chromosomes, therefore, is not to be regarded as a preparation for the sexual act, but it marks the beginning of a new generation which comes into existence with the primitive number of chromosomes, of which generation the spore mother-cell is the initial cell.

Professor Strasburger traces backwards the phylogenetic course of the reduced ontogeny exhibited by the primitive sex-differentiating generation in angiosperms. In the developing endosperm of gymnosperms the reduced number of chromosomes is found long before the development of archegonia has begun.

This further emphasizes the fact that the number of successive nuclear divisions which precede the generative nucleus is very variable and holds no relation in the parallel male and female generations. In pteridophytes and bryophytes the number of chromosomes is hard to determine on account of the small nuclei of the latter and the great number of chromosomes of the former. In some ferns, however, as Osmunda regalis, the number of chromosomes is as small as in phanerogams, and in this case the reduction appearing in the nucleus of the spore mother-cell persists throughout the prothallium, and is half the number found in the sporophyte. Among bryophytes the counting of chromosomes has been accomplished in a liverwort, which showed four chromosomes in gametophyte nuclei and eight in sporophyte nuclei, the number four appearing first in the spore mother-cell. No countings of the chromosomes in algæ and fungi have been made, due partly to the difficulty of the operation and partly to the lack of appreciation of its importance. That the number of chromosomes in these lower cryptogams is definite Strasburger believes from the few preparations he has examined.

CLENDENIN on SYNCHYTRIUM.

While constancy in the number of chromosomes in the generative nuclei is doubtless of great importance, there is no such constancy in the nuclei of the somatic cells in either generation. Variations in the number are often observed in cells that are no longer embryonic, and especially in those definitively excluded from the sphere of reproduction (as the lower nucleus of the embryo-sac from which the antipodal cells are derived, and also the definitive nucleus which originates the endosperm). In the prothallial nuclei of Pinus sylvestris it has been observed that the reduced number is adhered to until the development of archegonia, and then it may be departed from, sometimes even doubling in the large nuclei of the wall-cells of the archegonia.

In the case of apogamy among ferns it seems probable that the number is doubled on the development of the growing points of the sporophyte. In the case of apospory it seems probable that there is a corresponding reduction, or else the resulting prothallia must contain twice as many chromosomes as normally developed prothallia.

The continuity of the chromosomes from generation to generation is maintained, and while they may lose their morphological individuality in the resting nucleus, their physiological individuality is retained. The reduction in the number at the initiation of the sexual generation is said to be due to the fusion of two chromosomatic individuals into one, and this is preceded by the ordinary nuclear division. There is no such thing among plants as nuclear divisions resulting in the reduction of the number of chromosomes by one-half.

It is also shown that there is no such thing as hereditarily unequal divisions in karyokinesis. The author believes thoroughly in epigenesis, and that cell-nuclei, wherever in the body they may be, are and remain endowed with all the characteristics of the species and are stimulated to activity in definite directions by prevalent conditions. He approves of Weismann's term "id," as it represents something supported by direct observation. He would recognize as ids the serially arranged discoid segments of the chromosomes. These ids are repetitions of each other, and in the sexual act the chromosomes of the parents do not lose their independence, but show various results in various parts dependent upon the interaction of the chromosomes giving rise to phenomena of interference. In this way the various resemblances of hybrids and also atavistic phenomena are to be explained, the latter showing that the ids whose action is neutralized are not destroyed.

While one-half reduction takes place in bryophytes, pteridophytes and phanerogams in spore mother-cells, in the lower cryptogams, where the oospore does not give rise to a definite sporophyte, the reduction probably takes place on the germination of the oospore. This reduction is the return of the most highly organized plants, at the close of their life cycle, to the unicellular condition, the repetition of phylogeny in ontogeny.

In carefully comparing the generative processes of animals and plants it becomes evident that there is nothing in plants which corresponds to the polar bodies of animals, and that such reference of the ventral canal-cells of archegoniates is without foundation.

The spore mother-cell, therefore, is to be regarded as the first term of the new generation. The center of gravity of the developmental processes which take place in sporangia does not lie in the cells styled the "archesporium," which still belongs to the asexual generation, but in the spore mother-cells. It is of little importance whether there be a well-defined archesporium or not, as it is merely the meristematic tissue from which the spore mother-cells are derived, so that its differentiation cannot be of any special significance.—J. M. C.

Anatomy of the genus Carex.

It seems very natural that a genus so large as Carex, estimated to contain about 800 species, has caused considerable trouble to the systematists in regard to the most natural arrangement of the numerous species. The modern discrimination of species by means of anatomy is far from always to be applied as a support for the systematic position of species in natural groups; this is only too manifest, when we compare the results gained by recent investigations. And with the genus Carex, we are far from through yet, though the present time seems to throw some light upon the conception of the true relationship among the species. Valuable assistance has been rendered to students of this genus by the authors who have made a special study of the anatomy of a number of species. Bordet[1] and Mazel[2] have given several anatomi-

[1] Recherches anatomiques sur le genre Carex. Revue générale de Botanique, **3:** 57. 1891.

[2] Etudes d'anatomie comparée sur les organes de végétation dans le genre Carex. 1—213. *pl.* 7. 1891. [Thèse. Genève.]

cal details of many species of this genus, and we have now received a still more comprehensive treatise by Lemcke,[3] wherein an attempt has been made to arrange the species in natural groups by means of their anatomical characters.

The first chapter of this interesting and important work contains a review of the literature upon this subject.

The author has studied especially the internal structure of the rhizome, but several points of interest have also been given in regard to the anatomy of the aerial stem and the leaf. Boeckeler's system[4] has been followed as a basis in the present investigation.

The material examined includes representatives from Europe and North America, so that the paper becomes very helpful to similar studies in this country.

Very little has been added to the results given by earlier authors, and the most essential points seem to have been already discovered. The important studies of Klinge, Laux, Mazel and Schwendener seem to contain all of the salient features in the structure of this genus, but the present paper embodies the first attempt to arrange the species anatomically.

It would be impossible to give a satisfactory review of all the anatomical peculiarities in condensed form, and we therefore restrict ourselves to a brief comparison of some of the results.

The author has found the anatomical structure of the rhizome sufficient for the discrimination of the various groups, and in many instances the species are readily distinguished. The system suggested by Christ,[5] seems to be the most natural, although the author admits that he was not able to find in anatomical characters sufficient foundation for several of the sections in this system.

The arrangement of the species in Heterostachyæ, Homostachyæ, Cephalophoræ and Monostachyæ in the system of Christ is widely different from that which has been proposed by Bailey.[6] For instance: Christ refers CC. obtusata, pyre-

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[3] A. Lemcke: Beiträge zur Kenntniss der Gattung Carex. 1–130. 1892. [Inaug. Dissert. Königsberg in Pr.]

[4] Die Cyperaceen des königlichen Herbariums in Berlin. Linnæa N. S. **5–7:**—1875–77.)

[5] Nouveau catalogue des *Carex* d' Europe. Comptes-rendus d. séances de la Société Roy. de Botanique de Belgique **24:**—. 1885.

[6] A preliminary synopsis of North American *Carices*. Proceed. of American Academy of Arts and Sc. **22:**—. —.

naica, microglochin, gynocrates, and dioica to a section "Psyllophoræ" and CC. capitata and scirpoidea to "Capitatæ," both sections of the group Monostachyæ. These species are widely separated from each other in the system of Bailey, so far even that C. microglochin has been enumerated as no. 1 under the section "Physocarpæ," C. scirpoidea as no. 184 under Sphaeridiophoræ, C. pyrenaica as no. 211 under Lamprochlaenæ, C. obtusata as no. 215 in the same section, while the remaining C. capitata, C. gynocrates, and C. dioica as nos. 255, 258, and 259 under the section Acroarrhenæ.

Lemcke shows now that these species are most naturally combined in one single section, Psyllophoræ, of the Monostachyæ. C. pyrenaica and C. scirpoidea are closely related to each other by having subepidermal groups of stereome in their rhizomes, which the others have not. C. pyrenaica has thick walled epidermis cells, while these are papillose-prominent in C. scirpoidea. C. Fraseri is closely related to these two species.

Tangential aeriferous lacunes are present in the bark of C. capitata and C. gynocrates, while these are radial in C. dioica and microglochin. C. dioica has a closed sheath of stereome around the mestome bundles, which is not observed in C. microglochin. It is to be seen from these investigations that we meet with great discrepancies in regard to the anatomical structure if we compare the species as they have been arranged by Bailey. The large number of well differentiated species in proportion to the relatively few morphological characters makes it exceedingly difficult to reach even an approximation to a truly natural classification, but we should not be surprised if extended studies justify the system given by Drejer in his excellent treatise, Symbolæ Caricologicæ.—THEO. HOLM.

BRIEFER ARTICLES.

Synchytrium on Geranium Carolinianum.—(With plate IV.)—On the fourth of February of last year, some distorted leaves were gathered from *Geranium Carolinianum* L. growing in a low place in the botanical garden at Baton Rouge, La., and examination showed the distortions to be due to a *Synchytrium*. On the margins of some of the lobes, and extending in along the veins, on the lower surface, were purple-red swellings. The hypertrophy of the diseased parts was in many places so great as to cause a cupping of the upper surface. The older swollen portions were brown, and had a sticky feel, and the centers of the confluent pustules composing them were depressed, giving the appearance of small cups placed side by side (fig. 1). The pustules were almost entirely confined to the blades of the leaves.

On the date mentioned, only one Geranium was found affected with Synchytrium but in the same locality, three weeks later, the disease had spread to a number of individuals, and the red swellings were numerous on both petioles and blades. On leaves recently attacked, single red pustules were scattered here and there over the lower surface, occasionally on the upper, but on those longest subjected to the action of the fungus, the pustules had multiplied and become confluent, giving the appearance observed on the leaves first collected.

A section through one of these pustules, in a direction perpendicular to the surface of the leaf, shows an elongated, usually pear-shaped cavity (figs. 2 and 3), filled with a coarsely granular, reddish brown substance whose particles cohere into a sort of network of varying openness of texture. Toward the lower part of the cavity, the granular material becomes finer and more compact (fig. 3), and imbedded in it is either a sorus or a resting-spore; in the material examined, sori were far more numerous than resting-spores.

The resting-spores have a dark brown, laminated, outer covering, and a delicate, colorless, inner coat (figs. 4 and 5), enclosing yellowish granular contents, bearing occasional oil globules. These spores vary greatly in size, ranging from 35μ to 150μ in diameter. The smaller ones often lack the surrounding granular deposit that seems always to attend the larger resting-spores and sori, and as many as four are frequently found in the same cavity (fig. 5). The outer coat of the small spores also appears more compact and more close fitting than that of the large ones (figs. 5 and 4). The large spores are usually spherical, but not infrequently ellipsoidal, and in very rare cases are crescent shaped. These marked differences between the large and small resting-spores would indicate the possibility that the larger ones are sori in process of formation, and whose contents have not yet broken up into sporangia.

The sori are usually spherical, occasionally ellipsoidal, and range from 75μ to 125μ in diameter. The outer covering of the sori is essentially the same as that of the large resting-spores; the inner sack is thin and colorless, and encloses numerous sporangia (fig. 6). The sporangia are irregularly polyhedral, and have delicate, colorless walls filled with finely granular, reddish yellow contents. They vary from 20μ to 37μ in diameter (fig. 7).

The cells of the tissue surrounding the spore-bearing cavities are usually filled with a red sap that gives to the pustules their purple-red color. The hypertrophy seems to be mainly due to multiplication rather than enlargement of the cells; these are noticeably increased in size only in that part of the pustule immediately surrounding the upper part of the cavity (fig. 3). The enlarged cells have much thinner walls than do those of the normal size, and as the pustule ages, these thin walls break away and leave a large opening through the epidermis into the cavity below. This exposure of the reddish brown substance within probably gives to the older diseased parts the sticky feel mentioned above.

The only representative of the Geranium family given in Farlow and Seymour's Provisional Host-Index as a host for Synchytrium, is *Erodium cicutarium* L'Her. The naked-eye appearance of the Synchytrium on Geranium is very similar to that of *S. papillatum* Farl., on Erodium, but the sori average considerably smaller, and the resting-spores have a much greater range of size. Schroeter mentions *S. aureum* Schroeter, as occurring on *Oxalis stricta* L., in Silesia, but the Synchytrium in question has not the characteristics of S. aureum. Neither Saccardo's Sylloge Fungorum, Schroeter's Kryptogamen-Flora von Schlesien, nor Rabenhorst's Kryptogamen-Flora von Deutschland, Œsterreich und der Schweiz gives Geranium as a host for Synchytrium. It is possible that the Synchytrium on Geranium Carolinianum is a new species, and if so, I would propose the name Synchytrium Geranii.

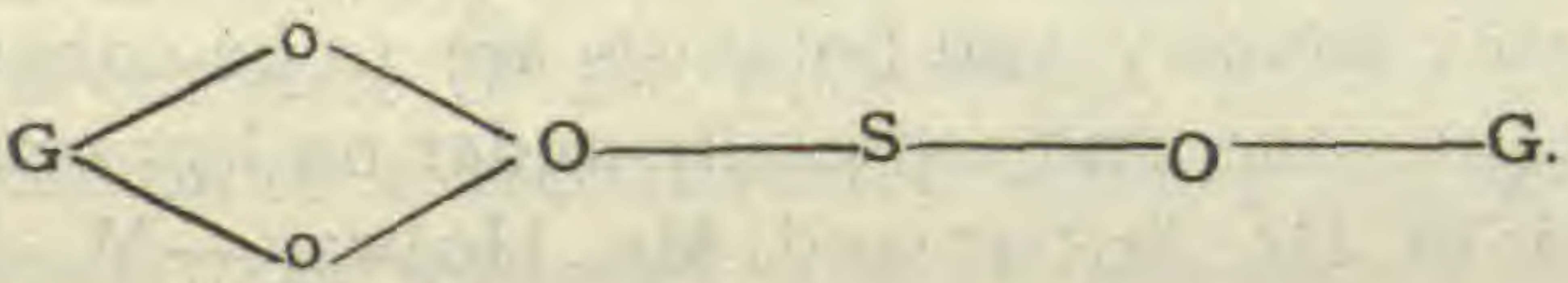
NOTE.—Since writing the above, I find in the herbarium of the University of Michigan a specimen labeled *Synchytrium Geranii*, E. & G., College Station, Texas. In reply to my inquiry in regard to it, Mr. Ellis writes me that the fungus was first named *S. Geranii* E. & G., and the name was afterwards changed to *S. Fairchildii* E. & G., but neither was ever published.—IDA CLENDENIN, *Baton Rouge, La.*

EXPLANATION OF PLATE IV.—Fig. 1. Lobe of leaf of *Geranium Carolinianum* L., attacked by *Synchytrium*. Slightly magnified.—Fig. 2. Section through confluent pustules on vein of leaf. Section does not pass exactly through center of pustules; × 60.—Fig. 3. Section through center of pustules; granular mass almost fills the cavity, and resting-spore lies imbedded in lower part; × 150.—Fig. 4. A large resting-spore; × 315.—Fig. 5. Section through cavity containing several resting-spores; × 315.—Fig. 6. Sorus, with portion of reddish brown covering adhering to one side; × 315.—Fig. 7. Sporangium of same; × 315.

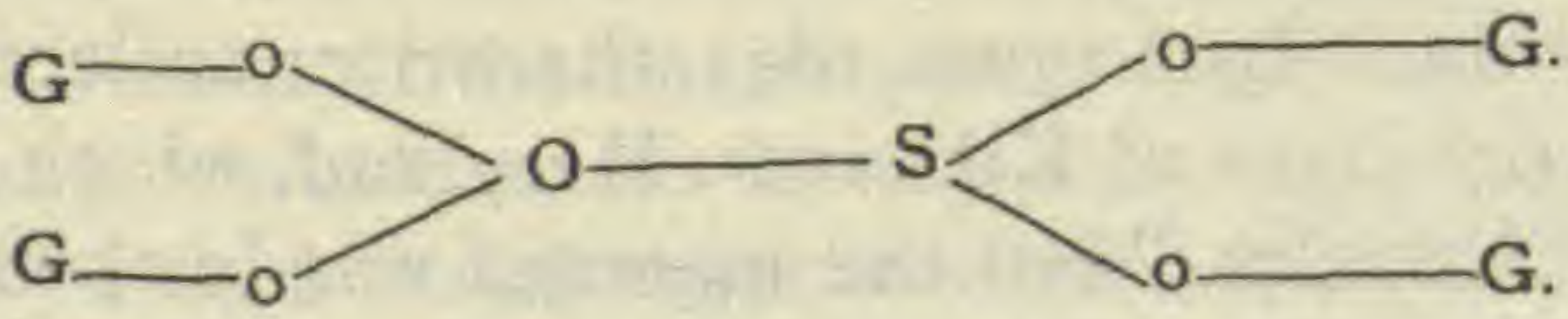
Formulæ for life histories.—I have found certain formulæ very useful in presenting general life histories to my classes. I do not know whether others are using them or not. If not, it might be well to suggest them, for they are very helpful in fixing the broad facts.

G = gametophyte; o = gamete; O = spore (sexual or asexual); S = sporophyte.

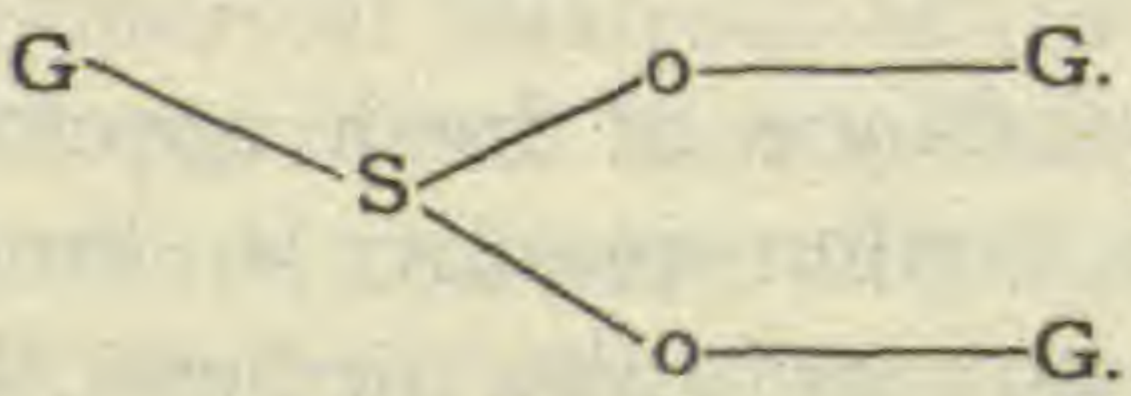
Isospory =



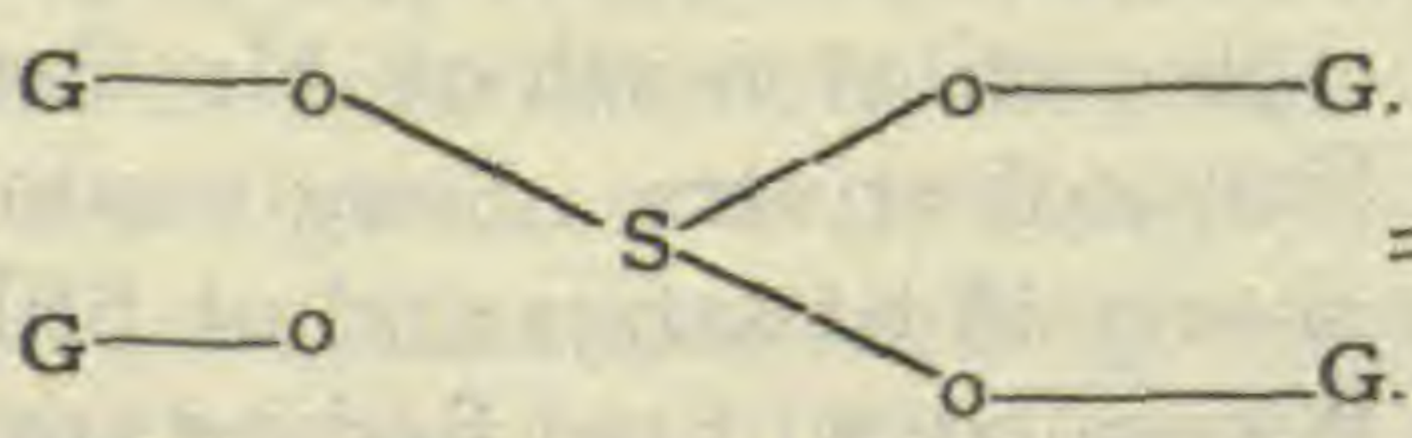
Heterospory =



Apogamy =

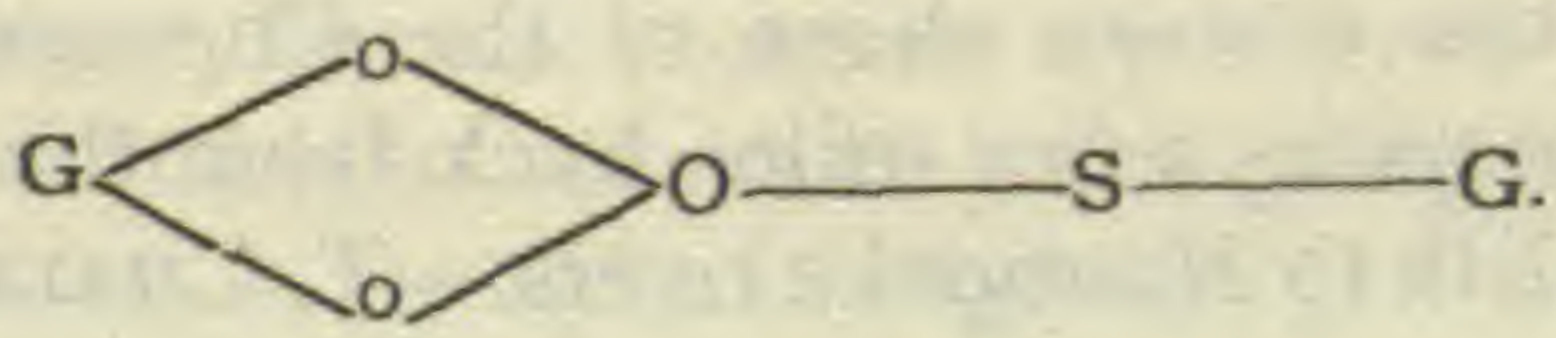


= vegetative apogamy, with heterospory.



= parthenogenesis, with heterospory.

Apospory =



and so on *ad infinitum*.

This is useful not only in presentation but in quizzing. For instance, ask a student to indicate in this way the life history of an angiosperm, a fern, a mildew, anything. It seems to make it very real to him.—JOHN M. COULTER, *Lake Forest, Ills.*

Uredineæ Americanæ Exsiccatæ.—It is almost a year since the author published his prospectus of the above series of exsiccatæ, and only one fascicle has been issued. Two facts, if known at that time, would have precluded any thought of publication of this series; the one, that of change of employment of the author which would make it utterly impossible to give sufficient time to the work; the other, that preparations for a similar series by other parties had been begun a long time before. These facts will therefore serve also to explain why no other fascicles have appeared. It is thought best now to announce definitely that the series will be permanently discontinued.

Such announcement has been delayed because of the hope that it would yet be possible to continue the series, upon which so much labor had already been bestowed. The encouragement given to the work by various botanists in America and Europe is very much appreciated.

There is no doubt whatever of the desirability of such a series of Uredineæ in this country, and botanists are to be congratulated that we are still to have one, and especially under no less reliable management than that of Dr. Arthur and Mr. Holway.—M. A. CARLETON, *U. S. Dept. Agric., Washington, D. C.*

Isoetes saccharata.—In August, 1893, the writer collected specimens in Back creek, a tributary of Elk river, Maryland, which seemed to be *Isoetes saccharata* Engelm.," but the material was lost, with the exception of one poor specimen, and identification was not entirely conclusive.

In August of last year, an abundance of fresh specimens was procured at the same place, and a further quantity in Piney creek cave, Elk river. There is no doubt now as to the species. This station is in the neighborhood of eighty miles north of Mr. Canby's original station on Wicomico and Nanticoke rivers. Some exploring was done by me this year along the shores of Sassafras and of Still pond, intervening between Elk and Wicomico, without finding any of the plant. But it is probable that the distribution will be found, eventually, to be continuous along the eastern shore of the Chesapeake, in a belt cutting the numerous rivers a few miles back from the bay, and extending at least from Elk to Nanticoke rivers.—T. CHALKLEY PALMER, *Media, Pa.*

EDITORIAL.

IT IS probably true that never in the history of botany has the development of our knowledge advanced at such a rapid rate as now. Investigations have multiplied so enormously and technique is becoming daily so much more refined that facts are coming to light too rapidly to classify. This state of affairs has brought upon us a period of hasty and broad generalization that is to be deplored. The only useful function of generalization is to suggest lines of further inquiry, and broad generalization is never so much out of place as when facts are coming in rapidly. It seems impossible now to write a book upon any general subject in botany which is not antiquated in some parts before it reaches our shelves. Especially is this true in reference to generalizations concerning phylogeny. Treub's discovery of the so-called chalazal entrance of the pollen-tube in Casuarina no sooner lays the foundation of a reconstructed scheme of classification, current long enough to be followed in other publications, than two other observers announce the same condition of things in *Amentiferæ*. The immense importance of the development and form of the archesporium is no sooner embalmed in books that have appeared and have been announced than Strasburger transfers the "developmental center of gravity" to the mother-cells, and opens up a vast field of new inquiry in the numerical relations of chromosomes. The boundary line between gametophyte and sporophyte is no sooner well established in our texts and minds and generalizations, than it is shifted. Examples might be multiplied on every hand, and they serve to emphasize the point we intend to make, namely, that only such generalization as suggests further investigation is to be thought of at such a time as this, and that broad generalizations leading to extensive reconstruction of views are worse than useless. The record of facts, the stringing of these facts upon some consistent thread of theory, are now and always must be necessary, but the constant reconstruction of phylogenies is surely as unprofitable as it may be misleading.

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IT IS IN ORDER for the resuscitators of *Science* (which we are glad to greet again), to rise and explain to the botanists whose support they seek, why phanerogamic taxonomy only should be represented in the editorial committee while five specialists are considered necessary for proper presentation of zoological matters.

CURRENT LITERATURE.

An introduction to structural botany.[1]

This book contains a description of the morphology of the wallflower, white lily, and spruce fir as types of dicotyledons, monocotyledons, and gymnosperms, respectively. In writing it Dr. Scott has intended to make it a first guide to the study of the structure of the seed plants, and has sought to put before beginners in the study of botany information which is correct as far as it goes. The book is of course to be used only in connection with laboratory study of the plants themselves. The author has succeeded admirably in executing his design, and there is little to be criticised unfavorably. One can hardly help the feeling that for beginners he sometimes goes too far into details, but it is not easy to say what should be passed over.

Aside from a few unfortunate phrases, such as "male flower," what we should consider a blemish in the book arises from the order of treatment. The author begins with the seed plants. Had he made the proposed second volume on cryptogams the first, we think he would have done wisely. But there will always be difference of opinion on this point, and Professor Scott doubtless considered carefully the objections and advantages in both modes of treatment.

By reason of the order selected, however, he meets insuperable difficulties in the presentation of a really modern view of the flower and the reproductive organs connected with it. There is no hint at the nature of pollen grains and the embryo sac, or of the cells formed in them. In discussing the gymnosperms he is obliged to refer to the resemblance of the sexual organs of the female gametophyte to corresponding organs in certain cryptogams. If it be replied that these are matters too recondite for an elementary book on morphology, it may be answered that they would be matters of course had they been approached from the other direction. Naturally one can not drive the butt end of the wedge into a log.

An excellent chapter on nutrition is introduced after the description of the two angiosperms; from which we fear the ordinary student (whose capacity for misunderstanding is almost limitless) might infer that the matter did not apply to the gymnosperms.

We trust that Dr. Scott will find this volume meeting with such success that he will soon prepare the companion volume on cryptogams.

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[1] SCOTT, D. H.: An introduction to structural botany (flowering plants). 12mo. pp. xii + 288. figs. 113. London: A. & C. Black. [New York: Macmillan & Co. $1.00.]

A "practical flora."[1]

What is it? Barring the need of a distinctive name and one that would aid in selling the book any one would be puzzled, we imagine, to say why it should bear such a title. True, Mr. Willis, the compiler (for he is nothing else), says in the preface that his design is "to show the practical aspects of the vegetable world," and asserts that "there has been a long-felt want for a work of such practical character, and this book has been prepared to meet the demand." But his book is neither a *flora* nor *practical*, so far as we can judge. It is a compilation of descriptions of flowering plants selected from all countries under the sun, including a large number of native plants. On what principle the "careful selection" is based does not appear except in the preface. The exotics described are generally plants of economic importance, but many other species of *equal* economic importance are not described.

Indeed the writer seems to have selected his plants to fit his pages. At the beginning, when the pages were all before him, we find among the Ranuculaceæ forty-three species described, including such unimportant ones as Ranunculus rhomboideus and Anemone parviflora; of Viola eighteen species, including V. Selkirkii; while as space began to diminish, the Compositæ are cut off with six and Liliaceæ with nine!

How this book could be "the outgrowth of a successful class-room experience" we cannot understand. Does Mr. Willis have his students "analyze" Cinchona calisaya, or Diospyros ebeneum, or Areca catechu, or any of the multitude of other plants that they never saw, and never will see, in this country? We could understand an encyclopedia of economic plants; but this book, with its mixture of native and exotic, valuable and useless plants, with its "keys" and descriptions, its scrappy accounts of history and use, is quite beyond our understanding.

We cannot afford space for quotation, except of a few definitions which introduce the book, that our readers may be enrolled among "the people we have smiled with."

"*Structural Botany* has for its object the investigation of the structure, mode of growth, and functions of the cells and vessels that make up the plant. *Organography* is a division of this department that has special reference to the organs. *Morphology* is properly a division of Structural Botany and notes the changes that take place in the cells and tissues of plants. *Physiological Botany* takes into consideration the vital action in the reception, preparation, and disposition of the nourishment necessary to keep up the growth of the plant and to

[1] WILLIS, O. R.: A practical flora for schools and colleges. 8vo. pp. xvi + 349. New York: American Book Co. 1894.

enable it to perform the offices of flowering and fruiting. . . . To the above may be added the *Art* or *Practice* of Botany, which consists in applying the principles investigated under the above heads to determining the class, order, etc., of an individual plant."

Comment is unnecessary. The American Book Co.'s "reader" must have been on a vacation when they accepted this book!

Bacteriology and the dairy.

Dairy products constitute a valuable source of wealth in the United States, and several colleges have already established dairy schools. Wisconsin is not only in the front rank of s ates in the value of its milk products, but was the first to establish a thoroughly equipped dairy school. Shortly after that was done Dr. Russell was put in charge of the bacteriological work of the experiment station and the dairy school, and much important work is now in progress. The experiment station now conducts a creamery throughout the year, which gives opportunity for bacteriological and other experiments on a commercial scale. A science so important to the dairymen of course demands a place in the instruction of the dairy school. Finding no suitable small manual of bacteriology in its relation to the dairy, Dr. Russell set himself to write one.[1] It is divided into three parts, the first giving a summary account of the bacteria in general, while parts two and three are concerned with bacteria in their relation to milk, and bacteria in their relation to milk products. The author's endeavor has been to present the important facts in regard to the bacteria in a compact and simple way, and then to apply these principles to the practice in the dairy, creamery, and cheese factory. Since the book is intended mainly for students and dairymen the author has written in language as free from technical terms as possible, though he has not sacrificed clearness for the sake of doing this. He has also avoided overburdening his text with references to literature, though authority for many facts is cited.

We hope that the conciseness, simplicity, and accuracy of this little manual, as well as its commercial bearing, will insure it a wide sale, and that the first edition will soon be exhausted. This edition has been purposely kept small so that the book may be kept up to date in the rapidly advancing science of which it treats.

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[1] RUSSELL, H. L.: Outlines of dairy bacteriology. Small 8vo. pp. viii+186. Madison, Wis.; published by the author. $1.00.

An outdoor book.

The list of those who love to wander afield and drink in the beauties of unspoiled Nature under all skies is a long one. A few have seen, and have tried by telling their visions to awaken the love of others. Thoreau, Flagg, Burroughs, Abbott, Gibson, are names well known in this form of literary effort; and there are a host of others less familiar, perhaps, but scarcely less interesting. There lies before us a book[1] by Mr. Joseph Jackson, of Worcester, Mass., entitled, "Through Glade and Mead," which brings visions of the same fields, meadows, and woodlands, seen this time through the eyes of a botanist. Mr. Jackson writes of the plants and birds with the pen of a lover and even the "closet botanists," as they are reproachfully called, reading his lines, will want to go back to their freer days and prowl through glade and mead once more.

As appendix A appears the second edition of the Flora of Worcester county, a catalogue of the phaenogamous and vascular cryptogamous plants containing 1,098 species and varieties, of which fifty-five are cryptogams. Appendix B is a list of the trees, shrubs, and evergreen plants growing in the same region.

The book is most elegantly printed and is illustrated by a series of half-tones from photographs by Mr. Lyford. An *edition de luxe*, thirty-five signed copies illustrated by fourteen platinotypes, has also been issued, and the ordinary edition is limited to 500.

Minor Notices.

While books of this nature hardly come within the scope of this journal, Mr. Foster-Melliar has given us such a charming volume in his "book of the rose"[2] that it deserves mention. The writer is a successful enthusiast in the cultivation of roses, and gives the benefit of his long experience in a clear and full way that leaves little to be desired. A history and classification of roses is followed by a consideration of soils, planting, manures, pruning, stocks, propagation, etc. An interesting chapter deals with "pests," both insects and plant parasites, and a monthly calendar of necessary operations closes the volume, which is also completely indexed. The happy style of treatment, and the clear presentation of the needful operations would tempt almost any one to become a "rosarian."

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[1] JACKSON, JOSEPH: Through glade and mead; a contribution to local natural history. 8vo. pp. xiv + 332, illust. Worcester, Mass.: Putnam, Davis & Co. 1894.

[2] FOSTER-MELLIAR, REV. A.: The book of the rose. 8vo. pp. 336. pl. 29. London and New York: Macmillan & Co. 1894. $2.75.

OPEN LETTERS.

The term phytobiology.

The ever increasing attention given to the different phases of adaptation is making evident the need for an agreement upon some comprehensive term to express its study. At present the word *biology* is generally employed for the purpose in English, and there is perhaps a tendency to limit its application to this use; but the fact that the word has been understood in so many meanings, or at all events, shades of meaning, makes it by itself an unsatisfactory term, especially for botanists who must fain explain that it is plant biology they mean. The words *œkology* and *bionomics*, coined for this very purpose, are awkward, little used, and except to the learned do not explain their own etymology. A single word in English, answering to the German *Pflanzenbiologie*, does not appear to be in use, and I have therefore ventured to employ in publication (reference in BOT. GAZ. 19: 345. 1894) the equivalent and self-explanatory word *phytobiology*. I wish to ask whether there is any objection to this term, etymological, botanical or practical, and if so, what better one can be suggested; and also whether it has yet been published elsewhere in English.—W. F. GANONG, *Smith College, Northampton, Mass.*

[We may call Prof. Ganong's attention to the action of the Madison Botanical Congress (Proceedings p. 36) upon this point in recommending the use of the term *ecology* to designate the subject matter covered by the German Pflanzenbiologie. It is quite true that ecology has as yet been little used, but it is rather because the subject matter has been little studied in this country than because the word is awkward or unintelligible. Moreover the objection that it is "little used" lies equally against "phytobiology" and must lie at first against any new word. Ecology is already in the dictionaries, though (in the Century at least) under Œ. The committee of the Congress which considered this subject thought it better to take a word already coined than to construct a new one. The modification in spelling suggested is in harmony with spelling reform and with the common word *economy*, of similar roots.

The word phytobiology seems to us open to very serious objection because of its etymology. It ought by construction to be the equivalent of the word botany, i. e., that division of biology which is engaged with plants. Witness, similarly, phytopathology, phytochemistry, phytogeography. Phytobiology, moreover, is already in the language under the meaning just stated, for it is defined in the Century dictionary and a citation of its use in this sense given.—EDS.]

NOTES AND NEWS.

MR. R. SCHLECHTER publishes in *Journal of Botany* (Dec.) his second decade of new species of *Asclepiadaceæ* from South Africa.

MR. GEORGE HANSEN of the Agricultural Experiment Station, Jackson, California, announces the distribution of sets of the flora of Amador, Calaveras and Alpine counties.

ERYTHEA (Dec.) contains several new western species, by Greene; and some corrections in nomenclature by the same author, notably the replacement of *Hesperochiron* Watson by *Capnorea* Raf.

BULLETIN L'HERB. BOISS. (Nov.) contains a new *Riccia* (with two plates) from Lusitania, by Levier; a new *Eragrostis* from France, by Daveau, making four species belonging to the flora; and a monograph of the Swiss *Massarieæ*, by Jaczewski.

THE USUAL interesting report of the Department of Botany of the British Museum for 1893 appears in *Journal of Botany* (Dec.) A very large series of collections is indicated as having been received, but there is no summary to indicate the total additions.

A GARDEN SCHOLARSHIP in the Missouri Botanical Garden is to be awarded by the Director before the first of April next. Applications must be in his hands before March 1st. Information as to conditions of the award may be obtained by addressing the Director, Dr. Wm. Trelease, St. Louis, Mo.

THE TENTH ANNUAL meeting of the Indiana Academy of Science during the last week of December developed the usual large number of botanical papers. Botanical work in Indiana is rapidly increasing both in interest and amount. Of the fifty-two biological papers presented thirty were botanical.

PROFESSOR EDWARD L. GREENE has been appointed Professor of Botany in the Catholic University at Washington. This transfer from the Pacific to the Atlantic coast is a notable one botanically. We wish him pleasure in the more frequent contact with botanical friends and workers that this will bring him.

IN *New Education* Professor Stanley Coulter is giving a series of papers on "Graded instruction in botany below the high school." The suggestions made seem to be wise from the standpoint both of science and pedagogy, a combination which is too rare in these days of the introduction of elementary science training.

PROFESSOR F. A. FLUECKIGER, formerly of the University of Strassburg, died at his old home in Bern, Switzerland, on December 11th, at the age of sixty-six years. He had been in somewhat poor health for some time, but his death was not anticipated. Many botanists and other scientific men had the pleasure of greeting Prof. Flückiger at the Brooklyn meeting of the A. A. A. S. last summer.

MR. J. N. ROSE desires both living and herbarium specimens of Tradescantia and Commelina from all parts of the United States. He is especially anxious for roots and flowering specimens of the various forms of T. Virginiana. He will name and return specimens when desired. Franks for the sending of specimens will be furnished on application.

GARDEN AND FOREST continues to publish fine illustrations of our interesting native plants. Among the late ones we note (Dec. 12th) *Quercus Garryana* of the Pacific slope, and (Dec. 19th) the "Muskeag Spruce," characteristic of the forest lakes of Minnesota. In the latter number Mr. Charles H. Coe gives an interesting illustrated account of the so-called "Florida sea beans," which he says belong to four genera, only one of which grows in this country.

THE PUBLICATION of *Science* has been resumed for the third time, by the recent publication of number 1 of volume I of a new series, under the direction of a committee of eighteen, made up of representatives from different editorial sciences in rather unequal fashion. The department of botany is in charge of Dr. N. L. Britton. The list of names given is a very strong one, and if the financial backing is as strong as the scientific the journal should be very successful. We wish it a long and prosperous life.

FOLLOWING M. Vesque's recent monograph of *Guttiferæ* Mr. Edmund G. Baker in *Journal of Botany* (Dec.) presents notes of the group obtained from a revision of the material in the British Museum. The chief purpose of the notes is to call attention to the fact that M. Vesque has almost entirely lost sight of any work done in the group during the past ten years in England. As an illustration Mr. Baker appends a list of the Mascarene Symphonias, among which are described two new species. Of the thirteen species enumerated M. Vesque had only made note of six.

AT A MEETING of the Linnean Society last December, as reported in *Gardener's Chronicle* (Dec. 15th), Sir Dietrich Brandis presented a revision of the *Dipterocarpeæ*, an order which consists almost entirely of large trees which do not flower until they have attained great size, with a spreading crown on a branchless stem often more than 100 feet high. For this reason adequate material for determinations has been very difficult to secure, and has only lately been at all full. In 1840 Korthals described 34 species; DeCandolle, in 1868, described 126; Thistleton Dyer, in 1874, estimated the number at 170. Sir D. Brandis now estimates that there are 320 species belonging to 16 genera.

PROFESSOR E. L. GREENE continues his "Observations on the Compositæ" in the current number of *Erythea* (Jan.). The maze of asteroid forms are further considered and new generic lines proposed. Maintaining *Solidago* as a genus, and restricting it on the basis of habit and inflorescence (never flat-topped), he outlines the Nuttallian genus *Chrysoma*, with fifteen species, which have been variously referred to Solidago, Aster, Aplopappus, Ericameria, Linosyris, Bigelovia, Diplopappus, and Gundlachia. *Stephanodoria*, *Petradoria*, and *Osbertia* are proposed as new genera; the first to contain *Xanthocephalum tomentellum* Robinson; the second, *Solidago pumila* T. & G.; the last of the various forms of the Mexican and Central American plants that have been referred to Aplopappus stoloniferus.

BOTANICAL GAZETTE

FEBRUARY, 1895.

New or noteworthy Compositæ from Guatemala.

JOHN M. COULTER.

WITH PLATES V AND VI.

Capt. John Donnell Smith has submitted to me his recent collections of Compositæ from Guatemala, and the following results are thought worthy of publication. All of the most critical material was taken to the Gray Herbarium and Library for final study, where every facility for work was provided through the courtesy of the curator, Dr. B. L. Robinson.

VERNONIA CANESCENS HBK.—Aquacatepec, Depart. Zacatepequez, alt. 4,300^{ft}, March 1892, *John Donnell Smith* 2,837. Apparently quite common from Peru and Venezuela to Panama. Reported also from Nicaragua (*Wright*) and Huasteca (*Ervendberg*). Very closely related to *V. geminata* Less. of Brazil, and often confounded with *V. arborescens* Sw. of Central America.

Vernonia Luxensis, n. sp.—A shrub 3^{m} high, glabrous except more or less pubescence in the inflorescence which forms large pyramidal clusters of more or less leafy panicles: leaves oval, tapering at both ends and petioled, upper ones often narrower, entire or obscurely toothed: involucral scales in five or six rows, innermost ones linear-oblong and often quite elongated, the outer ones gradually passing into much broader and shorter forms, all sharp pointed and membranous except for the greenish center and tip: heads 3 or 4-flowered, cylindrical, more or less pedicellate: achenes strigose pubescent, often densely so.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, April 1892, *Heyde & Lux* 3,421.

Very nearly related to *V. Palmeri* Rose from Alamos (N. W. Mexico), but differing in pubescence, leaves and involucral scales.

Vernonia Heydeana, n. sp. Like the last; but lower (2^m high), with broader leaves which are often not so taper-pointed at either base or apex, 6-flowered heads, involucral scales in but two or three much looser series and all of them obtuse, and glabrous achenes.—San Miguel Uspantán, Depart. Quiché, alt. 6–12,000^{ft}, April 1892, *Heyde & Lux* 3,392.

The two preceding species, with *V. Palmeri* Rose, may all be forms of one shrubby species which extends the whole length of western Mexico. With the material at hand the forms are readily separated, but they give evidence of such close relationship that more abundant material may show intergradations.

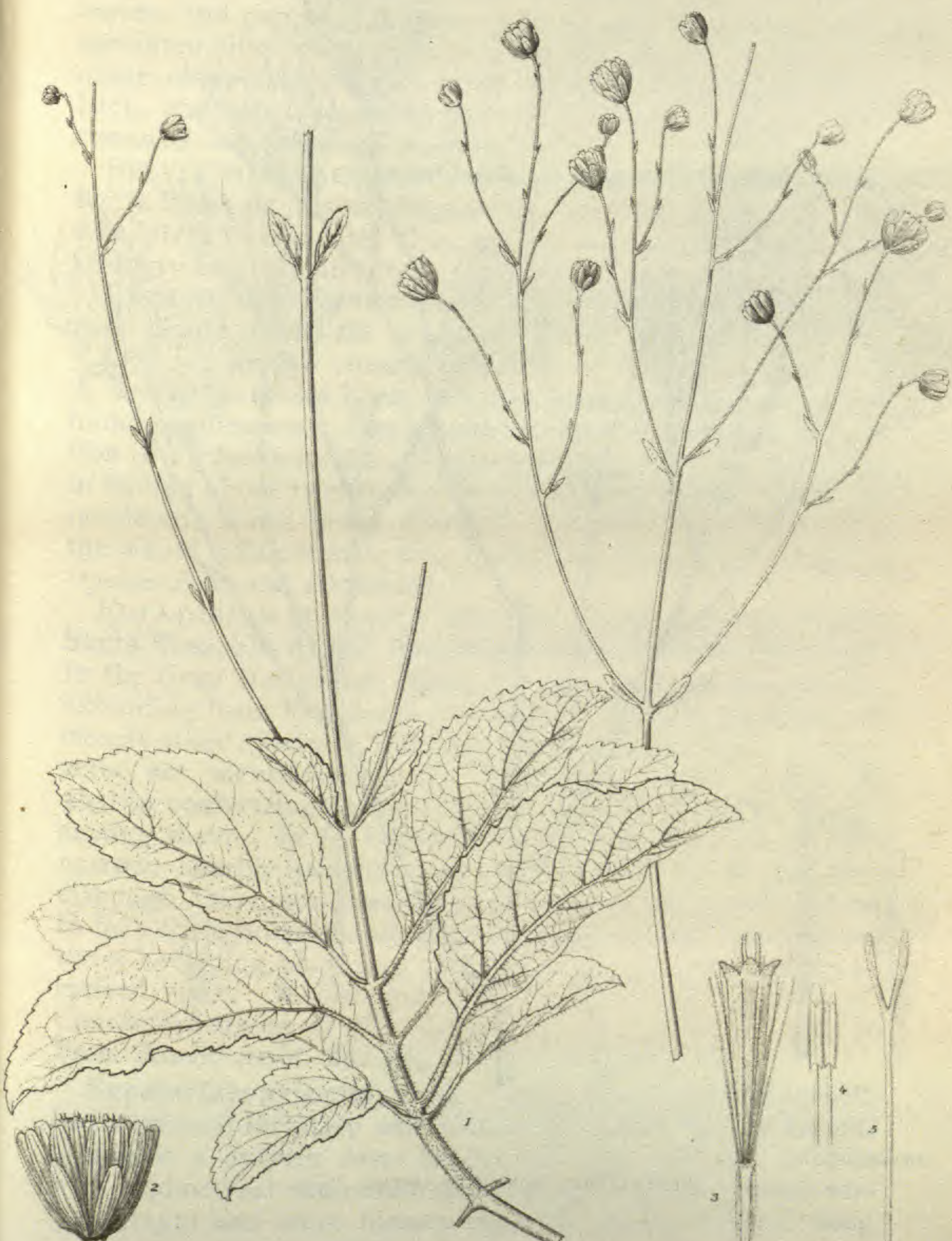
VERNONIA PATENS HBK.—Santa Rosa, Depart. Santa Rosa, alt. 3,000^{ft}, February 1893, *Heyde & Lux* 4,524.—A South American shrub 2 to 3^m high, heretofore not reported north of Panama, but likely to have been confounded with *V. Deppeana* Less.

Vernonia Shannoni, n. sp.—A tree (height unreported): leaves long-oval, taper-pointed at each end, petioled, entire, glabrous: heads 5-flowered, somewhat closely corymbose and pedicellate: involucral scales in five or six rows, the inner ones elongated-oblong and obtuse, the outer ones becoming gradually shorter, more broadly ovate and acutish, all somewhat purplish-tinted and sparsely hairy on the margins: achenes glabrous.—"Continental divide," Depart. San Márcos, alt. 9,191^{ft}, January 1892, *W. C. Shannon* 605.

The material is very scanty, but seems sufficient for characterization and subsequent recognition. Apparently very nearly related to *V. liatroides* DC. and *V. serratuloides* HBK., but they are herbaceous. Mr. Shannon notes the tree as being "white-flowered."

Ageratum rugosum, n. sp.—More or less rough pubescent throughout: leaves short petioled, ovate, crenate, acuminate, thickish (almost coriaceous), somewhat scabrous above and more softly and abundantly hairy beneath especially along the prominent reticulations, 5 to 7^{cm} long: heads purple-flowered, the linear involucral scales with slender often elongated acuminations: pappus of five lanceolate scales, but one, two or three of which taper into awns: achenes very glabrous.—Santa Rosa, Depart. Santa Rosa, alt. 3,000^{ft}, November 1892, *Heyde & Lux* 4,243.

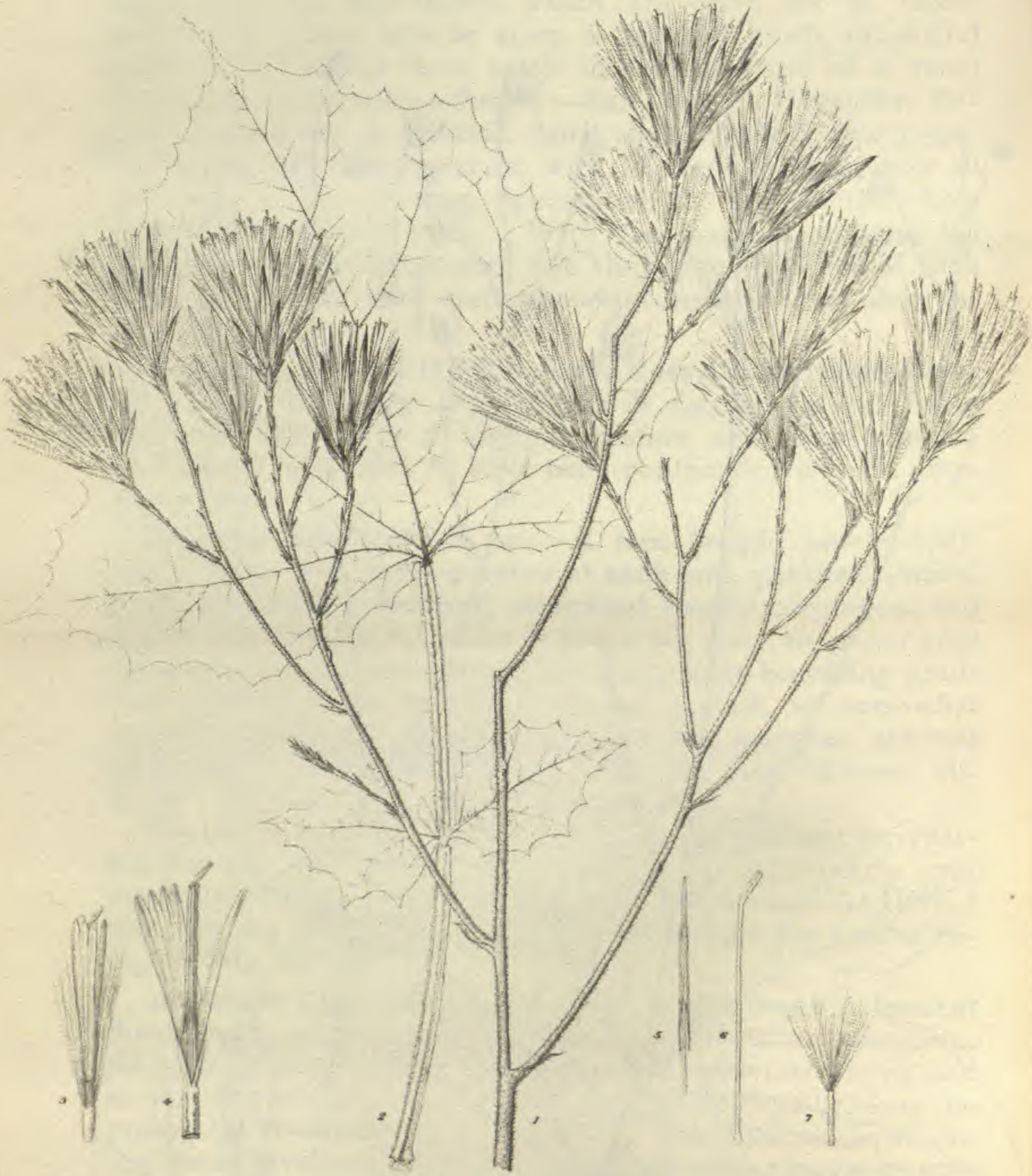
The whole habit of this species is that of *A. corymbosum*



C. E. Faxon, del.

B. Meisel, Lith. Boston.

MALLINOA CORYMBOSA, Coult.



C. E. Faxon del. B. Meisel, Lith. Boston.

PEREZIOPSIS DONNELL-SMITHII, Coult.

Zucc., to which doubtless it has often been referred; but its pappus refers it at once to EUAGERATUM and near to *A. conyzoides* L., from which species it differs in general habit, leaves, and pappus. I have seen an unnamed West Indian specimen all of whose pappus scales are not awned, but whose other characters refer it more nearly to *A. muticum* Grisebach, and which probably represents a form intermediate between *A. muticum* and *A. conyzoides.*

STEVIA NEPETAEFOLIA HBK. (?)—Ojo de Agua, Depart. Santa Rosa, alt. 3,500^{ft}, September 1892, *Heyde & Lux* 3,780. The plant is evidently this species, but the leaves are less strongly toothed and less pubescent than in the usual form.

EUPATORIUM EHRENBERGII Hemsley.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, March 1892, *Heyde & Lux* 3,427. A species closely related to *E. Benthamii* Klatt and *E. septuplinervium* Klatt, but those species have much more numerous flowers. Our specimens differ from Klatt's description of *Hebeclinum Ehrenbergii* Sch. Bip. (Flora, 1885, 202) in having about twenty-five flowers instead of fifty, and in the involucral scales being decidedly glandular tomentose, as is the whole inflorescence, and inclined to be obtuse, instead of "puberulent and acuminate."

EUPATORIUM FILICAULE Sch. Bip.—Jumaytepeque, Depart. Santa Rosa, alt. 6,000^{ft}, November 1892, *Heyde & Lux* 4,234. In the Gray Herbarium there are specimens of this species extending from Venezuela (*Fendler*) to Orizaba, Mexico. A closely allied species in Chihuahua is *E. Palmeri* Gray. A character not mentioned by Dr. Gray (Proc. Amer. Acad. **21:** 383) in contrasting the two species may be of service in separating them. In *E. Palmeri* the involucral scales are very narrow, sharply pointed and entire; while in *E. filicaule*, although there are similar scales, most of the scales are apt to be a little broader and more or less toothed at apex, sometimes becoming blunt and with broad more or less toothed or incised apex. In our specimens the heads are 12-flowered. Characterizations of this species will be found not only in Proc. Amer. Acad. **21:** 383, but also l. c. **27:** 170.

Eupatorium griseum, n. sp. Whole plant (including both leaf surfaces) hirsutely and somewhat glandular pubescent, giving it a grayish cast: leaves opposite, perfectly cordate with a somewhat acuminate apex, sharply dentate, lower surface grayer and more hirsute than the upper, 8 to 10^{cm} long by 7 to 8^{cm} broad, rather long-petioled below, becoming sessile and much reduced towards and in the inflorescence which is open and comparatively few-headed: heads rather large (12^{mm} high), more than 20-flowered: involucral scales obtuse, glandular pubescent on the back and apt to be purplish-tinged, the inner narrower ones occasionally acutish, all conspicuously striate-nerved: achenes minutely pubescent on the sharp angles.—Casillas, Depart. Santa Rosa, alt. 4,000^{ft}, December 1892, *Heyde & Lux* 4,250.

In De Candolle's § SUBIMBRICATA, with the large-headed Brickellia-like forms, such as *E. Parryi* Gray and *E. Fendleri* Gray, but more nearly related to the South American *E. urticæfolia* L.

EUPATORIUM GUADALUPENSE Spr.—Rinconcito, Depart. Santa Rosa, alt. 4,000^{ft}, November 1892, *Heyde & Lux* 4,206. This widely distributed species has gone under the name of *E. paniculatum* Schrad. in the West Indies, *E. Sinclairii* Benth. in Central America, and *E. Guadalupense* Spr. on Guadalupe Island.

EUPATORIUM HEBEBOTRYA (DC.) Hemsley.—Chiapas, Depart. Santa Rosa, alt. 3,500^{ft}, December 1892, *Heyde & Lux*. A species of Costa Rica, and apparently reported but once from Mexico (*Haenke*).

EUPATORIUM PAUPERCULUM Gray.—Santa Rosa, Depart. Santa Rosa, alt. 4,000^{ft}, December 1892, *Heyde & Lux* 4,194. This species was first discovered in Arizona, then in Sonora, and now in Guatemala. The Arizona material, from which the original description was drawn, proves to be not at all representative. The Sonoran and Guatemalan specimens are more or less pubescent, with lanceolate (in the Guatemalan specimens very narrowly so) long acuminate leaves with tapering base and sharply toothed in the middle, loose almost diffuse inflorescence, and corolla more often pink than white.

EUPATORIUM POPULIFOLIUM HBK.—Volcan Tecuamburro, Depart. Santa Rosa, alt. 6,000^{ft}, February 1893, *Heyde & Lux* 4,521. This material has achenes somewhat pubescent. Evidently a very variable species in foliage, the leaves varying from lanceolate with attenuate base to very broad ovate with either truncate or cordate base. *Heyde & Lux* 2,840, from San Felipe, Depart. Retalhulen, alt. 2,050^{ft}, April 1892, has the usual glabrous achenes, and is reported as a showy virgate plant 14^{ft} high.

EUPATORIUM PYCNOCEPHALUM Less.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, May and November 1892, *Heyde & Lux* 3,406 in part and 4,229; Jumaytepeque, Depart. Santa Rosa, alt. 6,000^{ft}, January 1893, *Heyde & Lux* 4,219; San Miguel Uspantán, Depart. Quiché, alt. 6–12,000^{ft}, April 1892, *Heyde & Lux* 3,397. Evidently the same as *E. Schiedeanum* Schrad. Very variable in foliage, but the intergradations are so complete that no varietal distinctions can be drawn. The variations extend from narrowly lanceolate with long acuminate apex to cordate ovate and even rotund towards and in the inflorescence. Reported to be a little more than three feet high.

EUPATORIUM SCHULTZII Sch. Bip.—Teocinte, alt. 2,500^{ft}, February 1893, *Heyde & Lux* 4,515. Entirely too near *E. malvaefolium* DC., and the two should probably be merged. The present material has the involucral scales of *E. Schultzii*, but the heads are more than 20-flowered, as in *E. malvaefolium*, a larger number than is credited to the former species. Reported as nine feet high.

Eupatorium vernonioides, n. sp. of OSMIA.—Shrubby and leafy, with the general aspect of a *Vernonia*, more or less glandular pubescent in the region of the inflorescence and apt to be sparsely so upon the leaf veins (especially beneath), otherwise glabrous: leaves short-petioled, thickish but hardly coriaceous, lanceolate with tapering base and apex (perhaps the lower leaves broader and more rounded at base), entire or obscurely mucronulate-toothed, with prominent midrib and conspicuously reticulated beneath, dark green and somewhat shining above, paler and often reddish tinged beneath, 15 to 20^{cm} long, 2.5 to 4.5^{cm} broad: heads rather numerous in the open somewhat leafy cymes, about 9^{mm} high and 40- to 60-flowered: lower scales of the cylindrical or urn-shaped involucre short and broad, with ciliate margins and glandular pubescence on the back, upwards becoming gradually narrower, longer, more delicate, less glandular and ciliate until the innermost linear scales are almost smooth; all obtuse except a short apiculation of the innermost ones; the striations not distinct, but obscure and irregular, the outer scales especially inclined to a purplish tinting: achenes glabrous (poorly developed in the material at hand).—Cenaguilla, Depart. Santa Rosa, alt. 4,000^{ft}, November 1892, *Heyde & Lux* 4,240.

Related to *E. conyzoides* Vahl.

Willugbaeya globosa, n. sp.—A glabrous twiner or somewhat puberulent in the inflorescence: leaves ovate and acuminate, obtuse at base, with margins (which are obscurely mucronulate) revolute, 5-ribbed near the base and prominently cross-veined, long-petioled, blade 9 to 12^{cm} long, 5 to 7^{cm} broad: heads sessile in glomerate (head-like) clusters which are borne (one to seven in number, usually three or five) at the ends of the opposite somewhat wide-spreading branches of an elongated bracteate raceme: involucral scales very short (about one-third as long as the corolla and pappus), broad and truncate (sometimes a little notched), glandular-puberulent at apex: pappus white: corolla narrowly funnel form: achenes glabrous (or very sparsely pubescent under a lens).—Santa Rosa, Depart. Santa Rosa, alt. 4,000^{ft}, March 1892, *Heyde & Lux* 3,430.

This species is listed as *Mikania globosa* Coulter, n. sp. in the forthcoming part of John Donnell Smith's "Enumeratio Plantarum Guatemalensium," where it seemed desirable to make the nomenclature consistent with that of the other parts. The inflorescence is striking, with its display of globose heads, and the species resembles closely in habit and structure *Mikania smilacina* DC. of Brazil.

WILLUGBAEYA SCANDENS (L.) Kuntze. (*Mikania scandens* Willd.)—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, June 1892, *Heyde & Lux* 3,434. A form with purple flowers and reddish pappus, which is easily separated from the typical form, but which is referred by Hemsley to *M. scandens*.

Coleosanthus Pacayensis. (*Brickellia Pacayensis* Coulter).—Teocinte, Depart. Santa Rosa, alt. 2,500^{ft}, January 1893, *Heyde & Lux* 4,218.

ASTER SPINOSUS Benth.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, April and December 1892, *Heyde & Lux* 3,424 and 4,210. The development of the characteristic spiny branches in these Guatemalan forms is much stronger than in the forms heretofore collected in Northern Mexico and adjacent United States; a development that appears also in specimens from Costa Rica. The spines are often very strong and thick set, flattened like sword blades, 2.5 to 5^{cm} long, evidently doing leaf-work, while the leaves are reduced to the merest rudiments, very different from the "soft subulate spines" of the more northern forms. The longer spines frequently branch.

In the original description Bentham questions the generic reference, a question which may still be seriously raised. Were not the genus Aster so all-embracing it would seem better to separate this species from it generically. It has no stamens in the ligulate flowers, the styles are very short and obtuse, the ligules are exceedingly small, and the whole habit of leaf reduction and spiny phyllocladia is peculiar.

ASTER JAMAICENSIS Less. (*Erigeron Jamaicensis* L.)—Santa Rosa, Depart. Santa Rosa, 3–4,000^{ft}, June 1892, *Heyde & Lux* 3,363. This species of the West Indies has also been found occasionally in southern Mexico. I very much doubt its proper reference to Aster.

CONYZA CORONOPIFOLIA HBK. (Incl. *C. hirsuta* HBK.)—Chiul, Depart. Quiché, alt. 8,000^{ft}, April 1892, *Heyde & Lux* 3,378. Exceedingly variable in foliage even on the same plant. Our specimens represent the very hirsute form with linear-lanceolate mostly entire (but frequently 1- or 2-lobed) leaves described by Kunth as *C. hirsuta*, and usually maintained as a distinct species. The two, however, completely intergrade, and different branches of the same plant will sometimes show all the differences between *C. coronopifolia* and *C. hirsuta*.

MALLINOA, n. gen. of INULOIDEÆ?—Heads many-flowered, homogamous, the flowers perfect: involucre campanulate, with three or four series of imbricate striate bracts, the outer ones shorter: corolla tubular, somewhat narrower below and with a much constricted and easily separable base, 5-toothed, the teeth hairy outside: anthers appendaged, sagittate at base: style-branches long, clavate and obtuse, the conspicuous hairy appendages representing more than half the length: achenes linear, 5-angled, with a prominent indurated base and constricted above to meet the distinct pappus ring which bears numerous stout barbellate bristles as long as the corolla.

Mallinoa corymbosa, n. sp.—Herbaceous, 40 to 50^{cm} high, leafy and hairy at base, naked, smooth and corymbosely branching above: leaves opposite, more or less woolly pubescent on both sides, especially along the venation, rather long petioled, ovate and dentate, obtuse, paler and conspicuously reticulate beneath, 3 to 7^{cm} long (blade), above reduced to bracts: heads about 5^{mm} high, solitary at the ends of the elongated corymbose branches: involucral bracts smooth and striate, oblong, the outer series somewhat shorter, the inner ones equal, very obtuse, more or less scarious margined: achenes sharply 5-angled, somewhat hairy, especially on the angles.—PLATE V.

Jumaytepeque, Depart. Santa Rosa, alt. 6,000^{ft}, December 1892, *Heyde & Lux* 4,255.

To decide the affinities of this genus is very perplexing, The style characters are those of EUPATORIACEÆ, and its pappus coalesced at base into a prominent ring suggests the Brazilian genus *Symphyopappus* Turcz., but the distinctly sagittate anthers are opposed to such reference. It seems also to resemble certain groups of SENECIONIDÆ, and this may be the true reference, but the involucre is hardly consistent with it. It is tentatively referred here to INULOIDEÆ, to which group it is as easily referred as *Dimeresia* Gray, with which genus it has a number of important characters in common.

NOCCA SUAVEOLENS Cass. (*Lagascea suaveolens* HBK.).—Carrizal, Depart. Santa Rosa, alt. 5,000^{ft}, November 1892, *Heyde & Lux* 4,227. A somewhat variable species, which also includes *L. helianthifolia* HBK., *L. latifolia* DC., and *L. macrophylla* Steud. *Lagascea* Cav. is 1,803, and *Nocca* Cav. is 1,794.

DESMANTHODIUM GUATEMALENSE Hemsley.—Volcan Acatenango, Depart. Zacatepequez, alt. 12,000^{ft}, August 1892, *W. C. Shannon* 3,693. The only record I find of this very interesting plant is the original collection by Salvin on Volcan de Fuego, at 6,000^{ft}, in which material the achenes were immature. The specimens before me have perfect achenes, which show the oboval-oblong outline of the other species, are perfectly smooth, and become black and hard, but instead of being biconvex in section have a flat face and a prominently angled face, giving a low triangular section.

Polymnia Quichensis, n. sp.—Smooth, excepting the more or less roughened leaves, about 1^{m} high: leaves ample, opposite, ovate-lanceolate, acuminate, tapering at base to a short petiole, dentate or denticulate (sometimes almost entire), moderately scabrous above and somewhat pubescent beneath, especially upon the conspicuous reticulations (becoming smoother with age), 12.5 to 25^{cm} long, 5 to 7.5^{cm} wide: heads solitary or few in a terminal corymb whose lateral branches bear at least a pair of ovate (sometimes narrower) acute leaves; the disk about 15^{mm} broad: outer involucral bracts broadly ovate and acute: rays 7 to 15, yellow, linear-oblong, hairy at base, about 2^{cm} long: disk-corollas tubular-inflated from near the base, prominently glandular-nerved: achenes 5^{mm} long.—Chiul, Depart. Quiché, alt. 8,000^{ft}, April 1892, *Heyde & Lux* 3,375.

Very closely related to the Chilian *P. glabrata* DC. according to the description in DC. Prodr. **5:** 515.

JAEGERIA HIRTA Less. includes *Spilanthes sessilifolia* Hemsley.—San Miguel Uspantán, Depart. Quiché, alt. 6–12,000^{ft}, April 1892, *Heyde & Lux* 3,395, 3,794, 3,796.

SCLEROCARPUS DIVARICATUS Benth. & Hook. was sent out in a previous distribution as *S. uniserialis*, no. 2,376.

MONTANOA MORITZIANA Sch. Bip.—Coban, Depart. Alta Vera Paz, alt. 4,300^{ft}, November 1885, *Tuerckheim* 814. I have not discovered any description of this species, the material having been named from Andean specimens so labelled and distributed by Sonders and by André.

MONTANOA PATENS Gray.—Jumaytepeque, Depart. Santa Rosa, alt. 6, 000^{ft}, December 1892, *Heyde & Lux* 4,216. The specimens are more bushy and profusely flowered than those heretofore collected. The leaves are densely and softly pubescent beneath, glabrous or nearly so above. The species is very near *M. arborescens* DC., to which some of its forms have at times been referred.

Montanoa Samalensis, n. sp. — Apparently a suffruticose plant, about 3^{m} high; branchlets more or less woolly pubescent (becoming glabrate), the inflorescence densely so: leaves (only upper ones seen) petioled, ovate-lanceolate with a rhombic short-cuneate triplinerved base tapering into a more or less winged petiole, acuminate, crenate or somewhat toothed, scabrous-puberulent above, pubescent beneath, 20 to 30^{cm} long (including petiole), 7.5 to 10^{cm} broad in widest part; those that subtend or belong to the inflorescence narrowly lanceolate, acute or acuminate, wing-petioled, nearly or quite entire (the lower ones 15 to 17^{cm} long): inflorescence a lax leafy few-flowered trichotomous cyme: heads long-peduncled, 7 to 9^{mm} high, with about ten narrowly to broadly spatulate white (yellowish in drying), more or less pubescent rays 10 to 15^{mm} long: involucral scales ovate, acute, woolly pubescent: chaff of the receptacle more or less toothed towards the base, broadly truncate, the midrib ciliate on the back and extended as a prominent mucronate point: disk corollas yellow and pubescent.—Rio Samalá, Depart. Retalhulen, alt. 1,700^{ft}, April 1892, *John Donnell Smith* 2,858.

In the rhombic base of the leaves there is indication that the lower leaves may be three-lobed.

Verbesina Donnell-Smithii, n. sp. of VERBESINARIA.—Pubescent, becoming glabrate, about 5^{m} high: stem and branches wingless: leaves ovate to lanceolate, scabrous puberulent above, pubescent beneath, tapering to a more or less winged petiole, acuminate, from sharply serrate or even toothed to almost entire with a few mucronulations, 10 to 20^{cm} long, 3 to 5^{cm} broad: heads about 10^{mm} high, rather numerous in a spreading cyme: involucral scales oval, obtuse, erect and pubescent: chaff of the receptacle pubescent, as are the very broad and somewhat toothed wings of the achenes above and the stout awns.—San Miguel Uspantán, Depart. Quiché, alt. 6–12,000^{ft}, April 1892, *Heyde & Lux* 3,385.

Related to *V. Virginica* L., but distinct enough from the forms of that variable species that I have seen, notably so in the size of its heads.

OTOPAPPUS CURVIFLORUS Hemsley, var. **glabratus,** n. var. Leaves almost entirely glabrous and very long acuminate, only vestiges of the scabrous character above, the lower surface glabrous (instead of woolly pubescent).—Jumaytepeque, Depart. Santa Rosa, alt. 6,000^{ft}, November 1892, *Heyde & Lux* 4,235.

O. curviflorus Hemsley = *Salmea curviflora* R. Br. and *Zexmenia salmeoides* Sch. Bip. It is a serious question whether *O. curviflorus* should not be the basis of a new genus, for the characters are not strictly those of either *Salmea* or *Otopappus*, although the latter genus was extended by Hemsley to include it.

COREOPSIS GALEOTTII Hemsley was distributed in a previous collection as *C. Mexicana* Hemsley, no. 3,792.

COREOPSIS TRIFOLIATA Bertol.—Buena Vista, Depart. Santa Rosa, alt. 5,500^{ft}, December 1892, *Heyde & Lux* 4,193. Apparently reported heretofore only from Volcan de Agua by Velasquez, and described by Bertolini in Fl. Guat.

BIDENS ALAUSENSIS HBK.?—Embaulada, Depart. Zacatepequez, alt. 5,500^{ft}, December 1889, *Heyde & Lux* 4,503; Santiago, same depart., alt. 6,500^{ft}, 1891, *Rosalió Gómez.* A number of South American species of *Bidens* appear in the Guatemalan collections, but there is such confusion of descriptions and of specimens in herbaria, that determinations must be tentative. This species has been reported also from S. Mexico.

BIDENS ANDICOLA HBK. ?—San Miguel Uspantán, Depart. Quiché, alt, 6,000^{ft}, May 1892, *Heyde & Lux* 3,404, 3,788. This reference to a species of the Andes of Ecuador is made with some hesitation, on account of lack of type material. With published descriptions and distributed material it accords fairly well. Perhaps the same reference should be made of *John Donnell Smith* 1,678, from Samac, Depart. Alta Verapaz, alt. 4,600^{ft}, but the material is entirely too immature for definite statement.

BIDENS HIRTELLA HBK.—Santiago, Depart. Zacatepequez, alt. 6,500^{ft}, 1891, *Rosalió Gómez* 1,074. This species seems to have been referred only to Mexico and then doubtfully, as though it had not been rediscovered. The material in hand conforms exactly with the published description, but there has been no opportunity of comparison with authentic specimens.

BIDENS HUMILIS HBK.—At the summit of Volcan Acatenango, Depart. Zacatepequez, alt. 12,400^{ft}, August 1892, *W. C. Shannon* 3,691. Heretofore reported only from the mountains of Ecuador. The peduncles and involucral scales are very often hairy, and the heads vary much in size, sometimes becoming as large as those of *B. grandiflora*.

CALEA INTEGRIFOLIA Hemsley, var. **dentata**, n. var. Leaves much thinner, glabrous (except perhaps a little sparse pubescence beneath), very narrowly lanceolate to linear, with conspicuous mucronulate teeth, and tapering into a long almost caudate acumination, the leaves subtending the inflorescence elongated.—Nebaj, Depart. Quiché, alt. 7,000^{ft}, April 1890, *Heyde & Lux* 4,506.

SCHKUHRIA ANTHEMOIDES (DC.) (*Hopkirkia anthemoides* DC. *Schkuhria Hopkirkia* Gray).—*Heyde & Lux* 3,802.

GALEANA HASTATA Llav. & Lex.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000^{ft}, July 1892, *Heyde & Lux* 3,364. The plants are much more leafy than usual, with larger leaves and a fewer-flowered inflorescence than heretofore recorded.

TAGETES LUCIDA Cav.—Santiago, Depart. Zacatepequez, alt. 6,500^{ft}, 1891, *Rosalió Gómez* 1,063; 1892, *Heyde & Lux* 3,798. Our 3,798 is more branching than usual, with obconical (rather than cylindrical) involucres which are 7-toothed (rather than 5) and 15 to 17-flowered (instead of 5 to 7), but the intergradations seem to be too complete for varietal separation.

TAGETES TENUIFOLIA Cav.—*T. peduncularis* Lag. & Rod.

It seems probable that these two species thus merged, with some others, should be included in *T. patula* L.—San Cárlos, Depart. Quezaltenango, alt. 8,622ft, December 1891, *W. C. Shannon* 598.

PECTIS CANESCENS HBK., var. **villosior,** n. var.—Stems and leaves much more woolly pubescent, the involucral bracts densely so, being like those of *P. Liebmannii* Sch. Bip.—Santa Rosa, Depart. Santa Rosa, alt. 3–4,000ft, March and May 1892, *Heyde & Lux* 3,401 and 3,413.

SENECIO GHIESBREGHTII Regel, var. **Uspantanensis,** n. var.—Leaves entire, elongated oblong and acuminate.—San Miguel Uspantán, Depart. Quiché, alt. 6–12,000ft, April 1892, *Heyde & Lux* 3,368; also distributed in previous collection as *S. Ghiesbreghtii*, no. 1,598, with leaves similar but with marginal mucros; also *Botteri*, 609 and 820 from Orizaba. In looking over the allied tree-forms, *S. Ghiesbreghtii* Regel, *S. grandifolius* Less., and *S. arborescens* Steetz, it becomes evident that we are dealing probably with a single species having leaves varying from pinnately divided to entire. *S. grandifolius* Less. must certainly absorb *S. arborescens* Steetz, but I do not feel the same confidence as yet in such a disposition of *S. Ghiesbreghtii* Regel, although Hemsley refers the latter to *S. grandifolius*, but keeps *S. arborescens* distinct.

SENECIO SCHUMANNIANUS Schauer.—Chiul, Depart. Quiché, alt. 8,000ft, April 1892, *Heyde & Lux* 3,377. I have no record of the discovery of this interesting species other than that of Aschenborn about Zimapan. Although no authentic specimens have been accessible Schauer's description in Linnaea completely accords with our plant.

WERNERIA NUBIGENA HBK.—Volcan de Tajumulco, Depart. San Márcos, alt. 12,000ft, January 1892, *W. C. Shannon* 607. A very interesting discovery of a high Andean genus, not reported before north of the high mountains of Bolivia.

PEREZIOPSIS, n. gen. of MUTISIACEÆ.—Heads rather few-flowered (10–15), homogamous, the flowers perfect: involucre conical, with three or four series of dry loosely imbricated narrow bracts, the outer ones short and grading into the bractlets, the inner ones becoming successively more elongated: receptacle densely pilose: corolla elongated, deeply bilabiate, the upper lip broad and 4-toothed, the lower of a single narrowly linear petal, all the lobes erect (not even spreading); the lower portion of the tube sharply 5-angled with tuberculate ridges, differing sharply from the upper portion: anthers caudate; filaments free and pubescent, arising from the top of the angled base of the corolla tube: stigma lobes short and obtuse, coalescent to maturity (but easily separable), sharply deflexed at the summit of the anther tube; style with an indurated bulbous base which detaches readily from the achene, which is linear and pubescent: pappus of numerous conspicuous puberulent slightly tawny bristles about as long as the flowers.

Pereziopsis Donnell-Smithii, n. sp.—Probably woody below, 1.8 to 2.4^{m} high, densely woolly tomentose at least above: leaves alternate, ample, pinnately divided, white with a dense pannose tomentum beneath, more or less floccose woolly above and becoming glabrate; terminal lobe ample, broadly deltoid, irregularly lobed and dentate, conspicuously palmately veined, 20^{cm} long by 25^{cm} broad at the almost truncate base (dimensions doubtless larger in the lower leaves); lateral lobes (usually two) distant and very much smaller, the intervening rhachis and petiole more or less winged: inflorescence an ample naked corymb, with large terminal heads (about 3^{cm} high) on the elongated branches, the ultimate divisions bracteate: involucral scales narrowly linear and long acuminate, more or less pubescent and purplish tinged, the inner ones becoming as long as or even longer than the head: flowers over 20^{mm} long.—Rio de Los Esclavos, Depart. Santa Rosa, alt. $2,500^{ft}$, February 1893, *Heyde & Lux* 4,527. —PLATE VI.

Herbarium Lake Forest University.

EXPLANATION OF PLATES V AND VI.

V. *Mallinoa corymbosa.* Fig. 1. Plant, nat. size.—Fig. 2. A head, enlarged.—Fig. 3. A flower, enlarged.—Fig. 4. Two stamens, enlarged.—Fig. 5. A pistil, enlarged.

VI. *Pereziopsis Donnell-Smithii.* Fig. 1. Portion of a flower cluster, nat. size.—Fig. 2. A leaf, natural size.—Fig. 3. A flower, enlarged.—Fig. 4. The same laid open, enlarged.—Fig. 5. A stamen, enlarged.—Fig. 6. A pistil, enlarged.—Fig. 7. An achene, nat. size.

A preliminary paper on Costaria with description of a new species.[1]

DE ALTON SAUNDERS.

WITH PLATE VII.

In the latter part of last July, I found on the shores of Monterey Bay a few imperfect specimens of one of the Laminariaceæ which seemed to me at once to be different from anything described in the literature accessible in the Hopkins Sea Side Laboratory. It was evidently a *Costaria*, but the two described species of *Costaria* have five narrow ribs, while this plant had one broad one.

A few days later I collected the same plant a mile further east near the steamship landing at Monterey. In the course of a week or so two of the Stanford students who were dredging for the zoologist of the Hopkins Laboratory brought me several fragments of the same *Costaria*. These fragments had been brought up by the dredge a half-mile from the shore from a depth of about fifty feet. A systematic search showed that the plant was quite common, at least in one part of the bay, growing in large clusters attached to rocks twenty to thirty feet from the shore, in eight to fifteen feet of water. As one looked at it waving back and forth in eight or ten feet of water he would take it at once to be *Dictyoneuron Californicum* Rupr., which is abundant all along the Californian coast.

I obtained a large number of plants, many of which were in fruit. A careful search along the shore of other parts of the bay, and also of the neighboring ocean, has so far failed to reveal any trace of the plant.

I am informed that specimens have been sent to at least one of the leading phycologists of the United States, and he referred it to *Costaria costata* (Turn.) (*C. Turneri* Grev.). The specimens sent must have been very imperfect indeed to give one such an impression as will be seen by comparing *C. costata* (Turn.) with this plant.

GENERAL DESCRIPTION.—The plant is of an olive-green color, and varies in shape from oblong to lanceolate linear.

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[1]Read before the Botanical Seminar, University of Nebraska, December 22, 1894.

SAUNDERS on COSTARIA.

The blade is thin and very brittle, and is covered throughout with peculiar reticulations which diminish in size as they approach the growing point (the union of blade and stipe). The midrib is about twice the thickness of the body of the plant, and is broad and smooth, no reticulations ever crossing it. The reticulations vary much in prominence; in some individuals they are barely visible, while in others they are very prominent. The midrib also varies much in plants of the same or nearly the same size. In some plants evidently mature it is little over $\frac{1}{4}^{in}$, while in others of about the same size it is often 2^{in} broad. At the base the plant is either heart-shaped and abruptly contracted, or in smaller specimens lanceolate and gradually contracted into a short thick stipe. From the ends and sides of the stipe innumerable dichotomously branched rootlets are given off which attach the plant very firmly to rocks, etc. Frequently the lower half of the stipe is turned abruptly at right angles to the upper half and the rhizoids are then attached to the lower surface (fig. 2, *R* and *R'*).

HISTOLOGY.—A cross section of the stem reveals three kinds of tissue; the epidermis, hypodermis and medullary layer (fig. 3, *e*, *h*, and *m*). The epidermis consists of a single row of cells oblong in cross-section, 16–20μ in length, 8μ broad, the outer wall considerably thickened. In a longitudinal section they are the same shape, showing that they are quadrilateral, the long axis lying in a radial plane (fig. 3, *c*).

The hypodermis is made up of five rows of parenchymatous cells. The outer hypodermal row is made up of very small (8μ broad) rounded cells. The remainder of the hypodermis is composed of large, irregular, thin walled cells, which increase somewhat in size towards the medullary layer (figs. 3, and *h*, and 4). The chloroplasts are confined mostly to the outer two or three rows of the hypodermis.

The medullary layer presents a very interesting structure. We may distinguish three varieties of cells in it: (*a*) Two or three rows of narrow, elongated, rather thick walled cells, along the sides next to the hypodermis (figs. 3 and 5, *c*). (*b*) Large oval or flask-shaped cells (*Schleimgänge*) some of which seem to have been formed by the union of two cells. Connected with one end of the flask-shaped cells there are long, narrow cells with few or no cross partitions. The tubular cell sometimes ends blindly and sometimes seems to unite with other cells. The opposite end of the flask-shaped cell is usually closed and not connected with any other cell (fig. 5, *b*). (*c*) In the central part of the medullary layer between the flask-shaped cells there are many oblong, thin-walled cells running at right angles to the direction of growth. Occasionally they are found singly, but more often there are several united, forming a chain which often reaches across the medullary part (fig. 5, *a*). There is no difference in structure between the midrib and the rest of the blade. The greater thickness of the midrib is caused by an increase in the thickness of the medullary layer (fig. 2).

The reproduction of this plant is in no way different from the other species of the Laminariaceæ. Unicellular zoosporangia protected by paraphyses are borne in large irregular patches on every part of the blade. In some luxuriant individuals I have found the patches of zoospores extending upon or even across the midrib. The zoospores are evidently developed from the epidermal cells, for we find in cross-sections of fruiting specimens the outer row of small hypodermal cells just beneath the zoosporangia (comp. figs. 3 and 4, *i*).

A study of the stipe reveals an entirely different structure. It is very tough and rigid, and is composed entirely of cells which are about twice as long as broad, and much smaller in the hypodermal than the medullary region. In fact in many of the sections there seems to be, especially in the hypodermal region, little or no space between the cell walls. The epidermis of the stipe is composed of very irregular thick walled cells, the walls of which are of a brownish color (fig. 6).

In the rootlets, especially towards the apex, the cell walls are much thinner, the cells larger and longer (fig. 7).

NOMENCLATURE.—In looking up the descriptions of the two recognized species of *Costaria* I find that the names of the two have been changed several times without right or reason for so doing. As we are gradually approaching a stable nomenclature, it seems proper that at this time we should restore to these plants the names which rightfully belong to them.

The common species on the Californian coast has been called *Costaria Turneri* Grev. It is not, however, *Costaria Turneri* Grev., but *Costaria Mertensii* J. Ag.[2]

[2] Species, genera et ordines Algarum 1: 140. 1848.—Neither should the name be written *Costaria Mertensii* (Mert.) Post & Rupr. as Kjellman has done in Engler & Prantl's Pflanzenfamilien 1[2]: 257.

The other species, *Costaria Turneri* Grev., was named *Fucus costatus* by Turner in 1819,[3] but Greville in 1830 changed it to *Costaria Turneri* Grev.[4]

Under the present rules of nomenclature we must then return to Turner's specific name which results in *Costaria costata* (Turn.).

Since the two species have been somewhat confused and the genus will have to be broadened somewhat to include the new species, the following synopsis may not be amiss.

To some it may seem that the possession of a single broad rib ought to be considered as a generic distinction, but after a careful comparative study of the structure of this plant with *Costaria Mertensii* J. Ag., I prefer to broaden the generic description enough to include this plant.

COSTARIA, Greville. Alg. Brit., Syn. p. XXXIX. 1830.

Plant undivided, *one* to five-ribbed; ribs when more than one, radiating from a simple, plain stipe. Fruit as in Laminaria, indefinite brown spots on any part of the plant.

§ I. *Plant 5-ribbed.*

COSTARIA MERTENSII, J. Ag. Spec. gen. et ordin. Alg. **1:** 140. 1848.

Fucus costatus Mert. Jun. Lim. 4:—. 1829.
Costaria Turneri Post & Rupr. Illust. Alg. 12. *pl. 24.*

Plant from five inches to a foot broad; stipe expanding from the base into a plain undivided reticulate blade. Rootlets dichotomously branched.

Common on the Californian coast.

Costaria costata (Turn.), nom. nov.

Fucus costatus Turn. Fuci, etc. *pl. 226.*
Costaria Turneri Grev. Alg. Brit., Syn. p. XXXIX.

Plant seldom over two inches broad; lanceolate, two feet long. Rootlets nearly simple.

As far as I can discover, this plant has never been reported for the Californian coast before. The information I have been able to obtain in reference to its distribution is from Agardh (Species, Genera et Ordines Algarum, 139–140). He says of its habitat, "On the Pacific shores of Central America or ? North America." The interrogation mark before North America is explained by a sentence a few lines further on

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[3] Turner, Fuci, etc. **4**:—. *pl. 226.*
[4] Alg. Brit., Synopsis p. XXXIX.

where he says, "In one place in Turner's work, the native country of this plant is said to be Central America, in another place, North America." I have two complete specimens, one in fruit, that I collected a short distance from Pacific Grove, Cal., which are unquestionably this plant.

§ II. *Plant 1-ribbed.*

Costaria reticulata, n. sp.—PLATE VII.

Plant thin, olive green, two feet or more in length, two to ten inches broad; stipe short, ½–1½ inches in diameter, furnished with numerous dichotomously branched rootlets. Plant furnished with a broad central midrib twice the thickness of the remainder of the blade; midrib one-half to two inches in width; the surface, except the midrib, covered with coarse reticulations which gradually diminish in size towards the union of blade and stipe. Zoosporangial areas, dark brown patches of olive brown spores scattered over the surface of the blade, often covering midrib; sporangia indistinguishable from those of *Costaria Mertensii* J. Ag.—Habitat south shore of Monterey Bay, near Pacific Grove, Cal.

Lincoln, Neb.

EXPLANATION OF PLATE VII.

Fig. 1. *Costaria reticulata*, n. sp. Reduced one-half.—Fig. 2. Transection, showing union of body and midrib, and the zoosporangia. × 70.—Fig. 3. Longisection of midrib. × 70.—Fig. 4. Transection showing zoosporangia. × 330.—Fig. 5. Longisection of midrib, showing *c*, *h*, and *m*, of fig. 3. × 330.—Fig. 6. Transection of stipe. × 330.—Fig. 7. Transection of rootlet near tip.

Notes on our Hepaticæ. III.[1]

The distribution of the North American Marchantiaceæ.

LUCIEN M. UNDERWOOD.

The genus hitherto known as *Fimbriaria*, one of the largest of the genera of marchantiaceous hepatics, has to suffer now for the failure in the past to recognize the rights of priority; and strangely enough there seems to be considerable difference of opinion still as to the proper name of the genus. The case is as follows: In 1810 Palisot de Beauvais established the genus Asterella with two species, *A. tenella* (*Marchantia tenella* L.) and *A. hemisphaerica* (*Marchantia hemisphaerica* L.). These are now recognized as belonging to two diverse genera. In 1818 Raddi established the genus *Rebouillia* for the latter species and in 1820 Nees established the genus *Fimbriaria* (by error *Fimbraria*) for the group which now includes the former, though that species was not included in *Fimbriaria* until 1838[2]. In 1829 Corda established the genus *Hypenantron* which is the equivalent of *Fimbriaria*. The genus *Rhacotheca* Bischoff (1844), and the genus *Octoskepos* Griffith (1849), were founded on species that will also be included in the same genus.

The case as we see it now is perfectly clear, and yet Lindberg (1868) complicated the matter by adopting the genus *Asterella* for *Rebouillia*, in which he was followed by Dumortier and many others, including recent American writers. Trevisan was the first to clear up the matter, but in his later work he fell from the estate he had reached and again wrote *Asterella* for *Rebouillia*. In his earlier position he was followed by Lindberg (in his later writings commencing with 1879), by Massalongo and by many others. Trevisan in his later work (1877) was the first to adopt *Hypenantron* for *Fimbriaria* and in this he has been followed by Kuntze and Schiffner.

It is clear that the genus *Asterella* in 1818, after Raddi had

[1] Preceding numbers of this series are in this journal (1) **14**: 191–198. 1888.—(2) **19**: 273–278. 1894.

[2] *Marchantia tenella* L. had the further misfortune to be for a long time confused with one or more European species.

established *Rebouillia*, contained what was left in the genus after the one species was taken from it. That Nees established *Fimbriaria* without recognizing the fact that one of its most typical species already stood as the sole representative of a genus does not alter the case. Since *Fimbriaria* Nees cannot possibly stand, as there is an earlier *Fimbriaria* Stackh. (1809) among the algæ, there is no possible excuse for using *Hypenantron* when there is already an appropriate generic name nineteen years older. There is even much less excuse for the adoption of *Asterella* for *Rebouillia* since the latter name was the first to be separated from the former. The fact that *Asterella* has been used for another genus will make a little confusion for a time, but that would not warrant the cancellation of such an appropriate name as has been done by Schiffner in Die natürlichen Pflanzenfamilien (Engler-Prantl).

The American species under their new names are as follows:—

1. ASTERELLA TENELLA Pal. de Beauv. Encyc. Meth., Bot. **3:** 110. 1810.

Marchantia tenella L. Sp. Pl. 1137. 1753.
Fimbriaria nigripes Bisch. MS. in Lehm. Pug. Pl. **6**: 19. 1834.
Fimbriaria tenella Nees, Europ. Leberm. **4**: 271. 1838.
Fimbriaria mollis Tayl. Lond. Jour. Bot. **5**: 411. 1846.

This species is very widely distributed throughout Eastern America. Specimens have been received as follows: Massachusetts, *Cummings*, *Crocker*, *Underwood;* New York, *Fischer;* Ontario, *Macoun;* Ohio, *Werner*, *Herrick;* Indiana, *Underwood;* Illinois, *Seymour;* Pennsylvania, (hb. Taylor, type of *F. mollis*), Delaware, *Commons;* Virginia, (ex hb. James); South Carolina, *DuBois;* Georgia, *Underwood;* Tennessee, *Bain;* Missouri, *Demetrio.* Sterile forms collected in Nebraska, *Webber*, and in Minnesota, *Holzinger*, have been hitherto referred to this species but these need the confirmation of mature specimens as they differ in being dark purple beneath, and the Nebraska specimens at least possess whitish scales.

2. **Asterella Californica** (Hampe), nom. nov.

Fimbriaria Californica Hampe MS. *n. n.* in Aust. Hep. Bor.-Am. *135;* Undw. Bull. Ill. State Lab. Nat. Hist. 2: 41. 1884.

This species is found throughout California from San Francisco southward to San Diego and Guadeloupe Island, having been sent by various collectors. Sterile specimens have also been sent from British Columbia by Macoun, and it will be found doubtless throughout the entire Pacific region.

3. **Asterella Bolanderi** (Aust.), nom. nov.

Fimbriaria Bolanderi Aust. Proc. Phila. Acad. **1869**: 230. 1869.

California: San Rafael, *Bolander;* Auburn, *Bolander;* Mill Valley, *Howe.*

The specimens collected by Coville on the Death Valley Expedition and referred by me to this species are rather *A. gracilis.*

4. **Asterella violacea** (Aust.), nom. nov.

Fimbriaria violacea Aust. Bull. Torr. Bot. Club **3**: 17. 1872.

Central California, *Bolander, Coulter, Howe.*

5. **Asterella nudata** (M. A. Howe), nom. nov.

Fimbriaria nudata M. A. Howe, Erythea **1**: 112. 1893.

Central and Southern California: Mill Valley, Marin co., *Howe*; Jackson, Amador co., *Howe;* Pasadena, Los Angeles co., *McClatchie.* A very well marked species.

6. ASTERELLA FRAGRANS (Nees) Trevis. Rend. R. Ist. Lomb. Sc. II. **7**: 10. 1874.

Marchantia fragrans Schleich. *n. n.* in Exsicc. cent. III. *64.*
Fimbriaria fragrans Nees, Hor. Phys. Berol. 45. 1820.

New Mexico, *Fendler;* Idaho, *Leiberg;* Telegraph Creek, near Alaska, *Dawson.* Remarkable for its profuse white scales that extend far beyond the margin.

7. **Asterella gracilis** (Web. f.), nom. nov.

Marchantia pilosa Wahl. Fl. Lapp. 339. 1812; not *M. pilosa* Horn. Fl. Dan. **8**: *pl. 1426.* 1810.
Marchantia gracilis Web. f. Hist. Musc. Hepat. Prodr. 105. 1815.
Fimbriaria gracilis Lindb. Not. pro Fauna et Flora Fenn. **10**: 282. 1868.
Fimbriaria pilosa Tayl. Trans. Linn. Soc. **17**: 386. 1837.
Asterella pilosa Trevis. Rend. R. Ist. Lomb. Sc. II. **7**: 10. 1874.

The synonymy of this species presents a complicated tangle, and the species has had the misfortune to be over much named. Limpricht asserts that *Marchantia Ludwigii* Schwaegr. Hist. Musc. Hepat. Prodr. 33. 1814 is identical with this species, as had been suggested before by Lindberg. If this proves true, then the name of the species will be *Asterella Ludwigii* (Schwaegr.). Until this can be determined the name will have to be as above, since the specific name *pilosa* is untenable as a homonym.

British Columbia, *Macoun;* Vancouver Island, *Macoun;*

Washington, *Brandegee;* Tulare co., California, *Coville.* The specimens distributed as *Fimbriaria tenella* in Canadian Hepaticæ no. 73 are of this species, at least in the sets in my herbarium and in the herbarium of Columbia College.

8. **Asterella echinella** (Gottsche), nom. nov.

Fimbriaria echinella Gottsche Mex. Leverm. 271. 1863.

Orizaba, Mexico, *Müller;* Texas, *C. Wright*, 1849. Clearly marked by the prominent papillæ on the upper surface of the ♀ receptacle.

This includes all the species which I have seen from the limits of our flora.

In Austin's Hep. Bor.-Am. *136 c*, the habitat of the species included under that number (*Fimbriaria elegans*) is given as "Texas and Cuba, *Wright.*" The specimens in my herbarium and those in the Gray herbarium are both accompanied by fragments of a *Selaginella* which to my knowledge does not occur in Texas. It is extremely probable that the specimens were collected in Cuba by Charles Wright, and that the reference to Texas was based on the specimens of the above named species which are in the Sullivant collection labeled "*Fimbriaria elegans.*" Now here we have a double error, for neither Wright's Texan specimens nor those distributed in the Hep. Bor.-Am. belong to the species to which they have been referred. The former are clearly *A. echinella*, and the latter are described later in this paper. This double error and the lack until recently of suitable material for comparison has made it impossible to co-ordinate our species from Mexico and the southwest. It is hoped that the present paper will assist in straightening out the tangle.

The genuine *Asterella elegans* has not to my knowledge been found within the limits of the United States but is to be looked for in the Sonoran region from western Texas to southern California as it is found on both sides of the continent at a little lower latitude. We append a description that it may be recognized if found. Other Mexican and West Indian species follow.

9. ASTERELLA ELEGANS (Spreng.) Trevis. Rend. R. Ist. Lomb. Sc. II. **7:** 10. 1874.

Fimbriaria elegans Spreng. Syst. Veg. 4: 235. 1828.

Gametophyte 0.5–1.5^{cm} long, 1–2^{mm} wide, thalloid, dark green above with a wide purplish crispy margin, dark purple beneath and much thickened at the midrib; ♀ branch 1–1.5^{cm}

high, purple, often paler above, pilose especially at the apex; receptacle convex with 2–4 involucres; inner involucres white or tinged with pink, 8–12-cleft, the divisions coherent at the apices. Sporophyte dark, sessile; spores dark purple or nearly black, with a reddish border, reticulate when immature, opaque at maturity, 100–135μ in diameter; elaters dark, almost opaque, slender, 2–3 times as long as the diameter of the spores, bispiral.

On the earth among mosses, Lower California, *Brandegee*, Orizaba, *Müller*, 1853. To this species I would also refer a specimen in my herbarium from San Luis Potosi, Mexico, *Schaffner*, though it lacks the purple border; also immature specimens collected at Cordoba, *Farlow*. This species also occurs in South America and Europe.

A form occurs in Cuba which has been referred to the preceding species but evidently deserves specific rank. It has already a specific name but may be more fully characterized as follows:

10. **Asterella Cubensis** (Lehm.), nom. nov.

Fimbriaria Cubanensis Lehm. in Ramon de la Sagra, Hist. fis. pol. y nat. de la Isla de Cuba 9: 489. *pl. 19. fig. 3.* 1845.
F. elegans, var. *Cubensis* G. L. N. Syn. Hep. 566. 1846.

Gametophyte 1.5–2.5^{cm} long, 1.5–2^{mm} wide, pale green, thalloid, simple or rarely once forked, plane above or rarely grooved near the base, the margins occasionally purple; greenish or sometimes purplish beneath with a prominent midrib and copious root hairs; ♀ branch 1^{cm} or more high, slender, purple, slightly hairy; receptacle globose-conic, tuberculate, with one or rarely two involucres beneath interspersed with a few slender hairs; inner involucre brownish white, 8–9 cleft, the divisions coherent at their apices. Sporophyte dark colored, sessile; spores brown or purplish brown, opaque, with a paler brown margin, 95–105μ in diameter; elaters dark brown, about twice as long as the diameter of the spores, bispiral.

On hillsides, growing among mosses, Matanzas, Cuba, *Underwood*, Feb. 1891. To this species I also refer the immature specimens distributed in Hepaticæ Cubenses Wrightianæ as *Fimbriaria elegans.*

11. **Asterella Palmeri** (Aust.), nom. nov.

Fimbriaria Palmeri Aust. Bull. Torr. Bot. Club 6: 47. 1875.

Guadeloupe Island, off Lower California, *Palmer*. This appears to be a good species though all the specimens I have seen have immature spores.

12. **Asterella Pringlei,** n. sp.

Gametophyte 1–1.5^{cm} long, 2–4^{mm} wide, bright green, fleshy, thalloid, closely adherent to the soil, depressed along the center, the margins thin, areolate-veiny, irregularly crenate-undulate, greenish below with a few slender whitish lanceolate scales, and numerous root hairs along the midrib; ♀ branch slender, 1–1.5^{cm} high, brownish, lighter above, naked throughout; receptacle subglobose, much wrinkled when dry, with one or two somewhat divergent involucres; inner involucre white, about 12-cleft, the divisions cohering at their apices. Sporophyte sessile, with large brown or almost black spores that are tetrahedral, 118–135μ in diameter, narrowly winged and covered with narrow reticulations; elaters about two and a half times as long as the diameter of the spores, with 2–3 spiral fibers.

Wet cliffs near Gaudalajara, Mexico, *Pringle* (Sept. 11 1890).

13. **Asterella Austini,** n. sp.

Gametophyte 1–2^{cm} long, 2–3 wide, thalloid, plane, thin, green above and beneath with here and there occasional spots of purple, with narrow brownish scales and more or less copious root-hairs near the midrib beneath; ♀ branch 1^{cm} or more high, brownish, sparingly pilose but the hairs becoming more abundant at the apex; receptacle somewhat tuberculate above with 1–3 more or less divergent involucres; inner involucre brownish or dirty white, about 8-cleft, the divisions coherent at their apices. Sporophyte a sessile yellowish capsule; spores yellow, 110–118μ in diameter, broadly winged and distinctly reticulated; elaters about twice as long as the diameter of the spores with two irregularly coiled spirals.

Cuba, *C. Wright.* Distributed by Austin as *Fimbriaria elegans* (Hep. Bor.-Am. *136 c*) which (as represented in my herbarium) forms the type of this species. The specimen of this number in the Gray Herbarium agrees with mine except that it lacks mature spores. The set in the Herbarium of Columbia College lacks this number. I should be pleased to have others who possess sets of Austin's exsiccatæ compare their specimens with the above statements.

14. **Asterella Wrightii,** n. sp.

Gametophyte 1–2^{cm} long, 2–3^{mm} wide, thalloid, deeply grooved, slender, light green above with crispy or deeply undulate margins, deep purple beneath with abundant narrow purple scales which often extend beyond the apex; ♀ branch purple, rather stout, 1^{cm} or less high, pilose throughout, with usually a dense mass of tomentum beneath the involucres; receptacle somewhat tuberculate above, with 3–4 somewhat divergent involucres; inner involucre short, brownish or often purplish, 8-cleft, the divisions coherent at their apices. Sporophyte sessile, spores (dark yellow) and elaters much as in *A. Austini* to which it is evidently closely related.

Cuba, *C. Wright.* Distributed in Hepaticæ Cubenses Wrightianæ as *Fimbriaria tenella* to which it bears little resemblance.

There are certain data that can best be collected in the field that we much desire to add to our knowledge of the species of *Asterella.* These are the characters of the antheridia which develop at a different time from the ♀ branch; most herbarium specimens are collected when this is mature and leave the ♂ receptacles largely to be conjectured. The genus was formerly regarded as monoicous but it is certain that *A. Californica* is dioicous and possibly other species are. Another feature to be studied where growing material can be had in quantity is the development of the ♀ branch. In his studies on *A. Californica* Dr. Campbell writes me that he finds that it differs from the account of *Fimbriaria* as given by Leitgeb; instead of having one growing point and thus forming a single branch, this species has four distinct apices and thus corresponds to Leitgeb's division "Compositæ" of which *Marchantia* is the type. The Pacific coast is the peculiar home of the genus in America and it is hoped that light will be thrown on other species of this interesting genus by workers in that region.

AYTONIA appears to be the original orthography of the genus established by Forster (1776) which has been further christened *Rupinia* Linn. f. (1780), *Otiona* Corda (1829), *Plagiochasma* L. et L. (1832), *Sedgwickia* Bisch. (1835), *Antrocephalus* Lehm. (1838), and *Otionia* Mitten (1885).

Two species are known from our borders which represent two very distinct types of structure. In the first species named the epidermal cells form a compact palisade structure, the cells being fully twice as high as wide; the air cavities are small and the entire thallus is compact and adapted to an environment which includes a dry season. In the second species the air cavities are very extensive so that the shoot on drying becomes roughened, and the epidermal cells are isodiametric. So far as we have seen the Mexican species, they are of the first type.

15. AYTONIA WRIGHTII (Sulliv.) Undw. Bull. Ill. State Lab. Nat. Hist. 2: 43. 1884.

Texas, *C. Wright.* Known only from its original specimen.

16. AYTONIA ERYTHROSPERMA (Sulliv.) Undw. l. c. 43. 1884.

Rocky Mountains, *E. Hall;* Eagle Pass, British Columbia, *Macoun;* Almota, Washington, *Piper;* Lake Pend d'Oreille, Idaho, *Leiberg;* Montana: Sand Coulee, *Anderson,* Great Falls, *R. S. Williams;* California: Tulare co., *Coville,* Pasadena, *McClatchie.*

Four additional species are known from Mexico:

17. **Aytonia crenulata** (Gottsche), nom. nov.

Plagiochasma crenulatum Gottsche, De Mex. Leverm. 266. 1863.

Orizaba, Mexico, *Farlow!*

18. **Aytonia elongata** (L. et G.), nom. nov.

Plagiochasma elongatum L. et G. Syn. Hep. 513. 1847.—Gottsche, De Mex. Leverm. 265. 1863.

19. **Aytonia intermedia** (L. et G.), nom. nov.

Plagiochasma intermedium L. et G. Syn. Hep. 513. 1847.—Gottsche, De Mex. Leverm. 264. 1863.

Guadalajara, Mexico, *Pringle!* Guatemala, *J. Donnell Smith!*

20. **Aytonia Mexicana** (L. et G.), nom. nov.

Plagiochasma Mexicanum L. et G. Syn. Hep. 519. 1847.—Gottsche, De Mex. Leverm. 267. 1863.

Since the publication of my Descriptive Catalogue, a genus entirely new to America has been discovered in British Columbia by Mr. J. Macoun. It is the genus *Clevea,* generally distributed in the northern parts of the eastern hemisphere.

21. CLEVEA HYALINA (Somm.) Lindb.

Under rocks, Lake Agnes, alt. 7,000ft, *Macoun;* also reported by Berggren from Greenland. The specimens distributed in Canadian Hepaticæ no. 75 belong (in my set) to *Aytonia erythrosperma.*

CONOCEPHALUM[3] Wiggers, Prim. Fl. Hols. 82. 1780, appears to be the oldest available name for what was called *Conocephalus* by Necker (1790), and *Fegatella* by Raddi (1818), since the earliest name, *Hepatica* Micheli (1729), is excluded by the Code. Our only species is

22. **Conocephalum conicum** (L.), nom. nov.

Marchantia conica L. Sp. Pl. 1138. 1753.

Widely distributed from Tennessee to California and northward.

I have specimens from Newfoundland, New Brunswick, Maine, New Hampshire, Vermont, Massachusetts, Connecticut, New York, New Jersey, Delaware, Virginia, Tennessee, Ohio, Indiana, Illinois, Wisconsin, Minnesota, Missouri, Nebraska, Idaho, California, Washington, British Columbia, Ontario and Alaska.

23. CRYPTOMITRIUM TENERUM (Hook.) Aust.

Central California: Palo Alto, *Campbell;* San Bernardino, *Parish;* Pasadena, *McClatchie.* Also reported from Mexico by *Gottsche.* Hitherto this has been very rare but Prof. McClatchie has recently collected it in considerable abundance.

It becomes necessary to make another change for the genus which has always been known in America under the name of *Preissia.* CYATHOPHORA S. F. Gray (1821) appears to be the oldest name, though Lindberg rejected it because of the moss genus *Cyathophorum* Pal. de Beauv (1805). It is a little singular that both Lindberg and Schiffner adopted *Chomiocarpon* Corda over *Preissia* Corda, for while both have the same date of publication the latter has priority of place. There has been fully as much difficulty with the specific name and there has consequently arisen an extensive list of synonyms. This has been aggravated by the attempt in Europe to maintain the autoicous form as a distinct species from the dioicous form. There seems to be no further reason for maintaining this distinction. If we have one species it will be known as

24. CYATHOPHORA QUADRATA (Scop.) Trevis Mem. R. Ist. Lomb. di Sci. Lett. III. **4**: 438. 1877.

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[3] By typographical error this was printed *Cynocephalum*, which form was adopted by Lindberg before he took up the Michelian name *Hepatica*. Schiffner (in Engler-Prantl 1^3: 34. 1893), makes the singular error of citing *Conocephalus* Neck. with the date *1759*. Necker's *Elementa Botanica* was printed in 1790 and this genus is numbered 1759 in the third volume (p. 344)!

Marchantia quadrata Scop. Fl. carn. **2**: 355. 1772. [ed. 2].
Marchantia hemisphaerica Auct. div. non L. Sp. Pl. 1138. 1753.
Marchantia commutata Lindenb. Syn. Hep. Europ. 101. 1829.

Widely distributed from New Jersey to Idaho and northward to Alaska and Greenland. I have specimens from Newfoundland, New Brunswick, Maine, New Hampshire, Vermont, Massachusetts, New York, New Jersey, Michigan, Wisconsin, Minnesota, Idaho, Ontario, British Columbia and Alaska.

25. **Cyathophora Mexicana** (Steph.), nom. nov.

Preissia Mexicana Steph. Hedw. **22**: 49. 1883.

Mexico.

26. DUMORTIERA HIRSUTA (Swz.) R.Bl. et N.

Easton, Pennsylvania, *Porter* (seemingly its northern limit); East Tennessee, *Ruth, Scoville;* North Carolina, *Sullivant;* Georgia, *Underwood;* South Carolina, *Ravenel;* Florida, *Underwood;* Alabama, *Mohr;* Missouri ?, *Shepard;* Arkansas, *Coville;* Mexico, *Pringle;* Cuba, *Wright;* St. Domingo, *Eggers;* Trinidad, *Fendler;* and generally distributed throughout tropical regions.

27. GRIMALDIA FRAGRANS (Balb.) Corda.

G. barbifrons Bisch.
G. sessilis Sulliv.

Connecticut, *Evans;* New York, *Peck;* New Jersey, *Austin;* Pennsylvania, *Porter;* Missouri, *Weller;* Wisconsin, *Cheney;* Minnesota, *Holzinger;* Texas, *Wright;* New Mexico, *Fendler;* also reported by Austin from Illinois and Iowa. Seemingly widely distributed but rarely collected and probably local.

28. GRIMALDIA CALIFORNICA Gottsche.

California: Yosemite Valley, *Bolander;* Pasadena, *McClatchie.*

29. GRIMALDIA RUPESTRIS (Nees) Lindenb.

Mt. Albert, Gaspe co., Quebec, *Allen;* Belleville, Ontario, *Macoun;* Springfield, Ohio, *Spence.* Austin also reported it from New York, and Prof. Peck writes me that the State Herbarium at Albany has it from three localities.

The last species is often regarded as generically distinct from the other Grimaldiæ. It has formerly been placed in the genus *Duvallia* Nees (1817) but as there is an earlier *Duvallia* Haworth (1812). Schiffner has erected a new genus *Neesiella*[4] for its reception.

[4] Engler-Prantl, Die natürl. Pflanzenf. 1^3: 32. 1893.

30. LUNULARIA CRUCIATA (L.) Dumort. Comm. Bot. 116. 1822.

L. vulgaris Auct. plur.

Always sterile in greenhouses; probably widely distributed but I have specimens only from Massachusetts, New York, and California.

There are three species of *Marchantia* now reported from our limits:

31. MARCHANTIA DISJUNCTA Sulliv.

Claiborne, Alabama, *Sullivant* (the original locality); Fayetteville, Arkansas, *Harvey;* Fort Worth, Texas, *Thomson;* also Orizaba, Mexico, *Müller*, *Stone;* Cuba, *C. Wright;* Jamaica, *Wilson.*

32. MARCHANTIA OREGONENSIS Steph. Bot. Centralb. **45:** 203. 1891.—Hedwigia **32:** 399. 1893.

Mt. Hood, Oregon, *Röll.* I am indebted to Herr Stephani for an original specimen of this species.

33. MARCHANTIA POLYMORPHA L.

Almost universally distributed throughout our borders as in all parts of the world. It appears to be more abundant in limestone regions but is by no means confined to them. We have specimens from Labrador, Newfoundland, N. S., Me., Mass., Ct., N. Y., Va., Tenn., Ind., Ill., Minn., Neb., Col., Ariz., Calif., Ore., Wash., Idaho, Mon., Br. Col., and Alaska.

A number of additional species are found south of our limits; so far as specimens exist in my collection I append a mark of exclamation.

34. MARCHANTIA CARTILAGINEA L. et L.

St. Vincent.

35. MARCHANTIA CHENOPODA L.

Orizaba, Mexico, *Stone!* Guatemala, *J. Donnell Smith!* Cuba, *C. Wright!* Martinique, *Husnot!* Also Porto Rico, Jamaica and Guadeloupe.

36. MARCHANTIA DOMINGENSIS L. et L.

Cuba, *C. Wright!* Also St. Domingo and Martinique.

37. MARCHANTIA INFLEXA M. et N.

St. Domingo; Martinique.

38. MARCHANTIA LINEARIS L. et L.

Cuba, *C. Wright!* Guatemala, *Watson!* Also St. Domingo, Guadeloupe, Martinique, St. Vincent, St. Christopher.

39. MARCHANTIA PAPILLATA Raddi.
Martinique.

40. MARCHANTIA THOLOPHORA Bisch.
Cordoba, Mexico, *Farlow!*

The transfer of the name *Asterella* to *Fimbriaria* has already been stated above. It is only worth noting that Raddi's name, originally *Rebouillia*, was amended by Nees in 1846 to its correct form *Reboulia;* the only species is

41. REBOULIA HEMISPHÆRICA (L.) Raddi.
Asterella hemisphærica Pal. de Beauv.

Widely distributed from Massachusetts and Ohio westward to British Columbia and southward to Mexico. We have specimens from Massachusetts, New York, New Jersey, Virginia, Georgia, Ohio, Indiana, Illinois, Wisconsin, Minnesota, British Columbia, Nebraska, Missouri, Arkansas, Louisiana, Texas, New Mexico, Arizona, California, and Lower California.

In *Die natürlichen Pflanzenfamilien*, Schiffner throws doubt upon the occurrence of *Sauteria* in America. The solitary specimen of our only species of this genus (a sterile one) was carefully reviewed, as the determination of sterile material has been found to be rather uncertain. This examination reveals the undoubted thallus structure of *Sauteria*, together with the peculiar stellate stomata which are caused by the thickening of the radial walls of the cells bounding the stoma. The air cavities in the shoot are also different from any other of our genera; they are large and deep and extend in a radiating series from the midrib outward. The original specimen is, I suppose, in the Austin collection. So far as I know it has been collected but once since.

42. SAUTERIA LIMBATA Aust.
Tulare Co., California, *Coville.*

The next genus shares with *Marchantia* the honor of being the only ones recognized in Linnaeus' Species Plantarum.

43. TARGIONIA HYPOPHYLLA L.
Vancouver Island, *Macoun;* California throughout, *Parish, McClatchie, Coville, Howe, Underwood.*

Two other species are found in Mexico:

44. TARGIONIA CONVOLUTA L. et G.
Oajaca.

45. TARGIONIA MEXICANA L. et G.
Jalapa.

The above represents all that is known of the distribution of the most conspicuous and most generally recognized forms of hepatics in North America. It will clearly be seen that there is still much to do, particularly in the west, southwest and south to determine with more definiteness the range of most of our species. Particularly is the state of Texas an excellent field for the enlargement of our knowledge concerning distribution. The fact that several species have not been recollected since Charles Wright explored that region in 1849 does not speak well for field work in that commonwealth.

Greencastle, Indiana.

The flora of Mt.. Mansfield.

W. W. EGGLESTON.

Mt. Mansfield is on the western branch of the Green mountain "Y" about twenty miles to the northeast of Burlington. It is a long range of four peaks separated from Sterling mountain on the northeast by Smuggler's Notch, a narrow pass about three miles long, enclosed by tremendous cliffs. Looking from the east or west the Mansfield peaks present an excellent profile of the human face, for one sees distinctly marked the forehead, nose, lips and chin.

Mansfield is the second peak of the Green mountain range, the Chin having an elevation of 4,329 feet (Killington 4,380 feet); but as far as alpine botanizing is concerned it completely overshadows them all, even far famed Willoughby, for there have been but two plants (*Sisymbrium humile* and *Aster polyphyllus*) found at Willoughby not duplicated at Mansfield; while Mansfield has thirty and more not found at Willoughby. The early botanical history of the mountain principally clusters around the two alpine peaks, the Nose and the Chin, although Pursh, the first botanist of whom we have an account as visiting the mountain, found *Aspidium aculeatum Braunii* for the first time, in the base of Smuggler's Notch, on his trip through the New England mountains in 1807. In July or August, 1829, Dr. J. W. Robbins on his second trip through Vermont visited Mansfield and found a number of alpine plants. In 1839 it was visited by Edward Tuckerman and W. F. Macrae, and a few years later by Prof. Jos. Torrey and Prof. Wood, but it remained for Mr. C. G. Pringle to find some of the rarer plants on the peaks and to discover the wonderful alpine gardens in Smuggler's Notch.

His researches were commenced in the early '70's and were the means of adding several species to the flora of the eastern United States, as well as new stations for many plants found before only at Willoughby or the White mountains.

Since Pringle commenced his discoveries, Smuggler's Notch has been visited by several of our good botanists, including Dr. Morong, Ezra Brainerd, the Faxons, F. H. Horsford, G. H. Perkins, J. A. Bates, A. J. Grout and others.

To Dr. Morong we owe the discovery on the Sterling side of the Notch of *Primula Mistassinica*, found there only by him. Although the mountain and Notch have been so thoroughly explored by Pringle and others there still remains opportunity for new discoveries and plenty of work for an enthusiast in the relocation of old stations. For instance; Prof. Torrey found *Deschampsia atropurpurea*, specimens of which he has left in the university herbarium at Burlington, Vermont, but it has been found by no one else. Besides, the peaks are covered with ledges which have never been thoroughly explored, and to the south is a small pass, Underhill Notch, in which there are cliffs quite similar to Smuggler's Notch and which have been visited, I think, only by Pringle, Horsford and myself, and by no one for more than an hour or two. I went through this notch July 11th, 1894 and found new stations for *Aspidium fragrans*, *Woodsia glabella*, *Pellæa gracilis* and *Habenaria fimbriata*.

The complete flora of the mountain would probably comprise three or four hundred species about ninety of which are mountain plants, and about forty of these of especial interest. A few of these plants can be found both on the peaks and in the Notch. Among them are *Alnus viridis* DC., *Pyrus sambucifolia* C. & S., *Amelanchier oligocarpa* Roem., *Aspidium aculeatum Braunii* Koch, *Aspidium fragrans* Sw., and *Woodsia hyperborea* B. Br. and *glabella* R. Br. These, however, are exceptions, as the floras of the Notch and of the peaks show a wide difference and very little resemblance.

The peaks from the distance look like great mountain pastures, but after one has spent a day climbing the ledges he will conclude that they are goat pastures, if any.

The rocks are carpeted with *Arenaria Groenlandica* Sp. and *Vaccinium uliginosum* L., along with great quantities of *Vaccinium Vitis-Idæa* L. and *V. Pennsylvanicum angustifolium* Gray, *Carex rigida Bigelovii* Tuck. and *C. debilis Rudgei* Bailey, *Juncus trifidus* L., *Hierochloa alpina* R. & S., *Agrostis canina alpina* Oakes and *Lycopodium Selago* L. The sphagnum bogs with which the summits are dotted are filled with *Empetrum nigrum* L., *Vaccinium Oxycoccus* L., *Carex Magellanica* Lam. and *C. pauciflora* Lightf. Among the more local or rarer plants are *Prenanthes Boottii* Gray and *Diapensia Lapponica* L., found upon the bleak exposed summits; *Vaccinium cæspitosum* Mx. found in less exposed places;

Polygonum viviparum L. in the dry cold clefts; *Viburnum pauciflorum* Pyl., *Carex Michauxiana* Bœckl. and *Salix phylicifolia* L. in moist alpine ravines; *Salix Uva-ursi* Pursh, *S. balsamifera* Barrett, and *Betula papyrifera minor* Tuck. among the alpine rocks; and *Comandra livida*, Rich., a shy, rare habitant of sphagnum, evergreen-shaded bogs; but the greatest surprise in your plant discoveries on the peak is to find *Rumex Patientia* L., though this is one of the products of civilization found near the Summit House.

From the base of the Notch one is as badly deceived as by the peaks, for the cliffs look like pastures, only fresher and greener; but beware of the Smuggler's Notch pastures unless you enjoy dangerous cliff climbing, for when, after over a thousand foot climb you reach the pastures, they prove to be cliffs of the worst kind, covered with *Alnus viridis* DC. and *Scirpus caespitosus* L., the ladder and anchor of the Notch.

Upon reaching this altitude you can commence your successful work, for here in these massive cliffs is the place where Pringle made most of his discoveries. Probably the first plant you will notice will be *Saxifraga aizoides* L., along the little rivulets; higher up in the moist places, *Saxifraga oppositifolia* L., and in the moist, more exposed cliffs, *Saxifraga Aizoon* Jacq.; in the rich bottoms and sides of the ravines, *Astragalus Robbinsii* Gray, long mistaken for *A. alpinus* L., *Hedysarum boreale* Nutt., *Castilleia pallida septentrionalis* Gray, and *Erigeron hyssopifolius* Mx.; higher up in more exposed places *Artemisia Canadensis* Mx.; in the lower cliffs *Solidago Virgaurea Randii* Porter; near the top of the cliffs, *Solidago Virgaurea monticola* Porter, with a perplexing gradation between them everywhere; in the moist, cold cliffs, *Aster Novi-Belgii* L., *Calamagrostis stricta* Trin., *Carex scirpoidea* Mx., and *Conioselinum Canadense* T. & G. If you come upon a bit of cliff which is rotten and slimy from the dripping water, there you will find *Pinguicula vulgaris* L. Striking out from the ravines into the main cliffs, you will find on the wet, mossy, shaded ledges, *Woodsia glabella* R. Br.; in the moist, deeply shaded clefts, *Asplenium viride* Hud.; on the moist, shaded cliffs, *Pellæa gracilis* Hook.; and lucky is the botanist who, on dry, exposed cliffs finds the *Woodsia hyperborea* R. Br., or the *Aspidium fragrans* Sw. A peculiarity of the latter is that it always grows in dry clefts, sheltered from the rain. One of the rarest of the Smuggler's

Notch plants is *Draba incana* L.; C. G. Pringle says, "I once found a patch that I could have covered with my hat." I found a similar patch in 1893. Before this Willoughby was the only eastern station. The variety *arabisans* Watson is rather common in the moist cliffs. Another great variety is *Arenaria verna hirta* Watson, of which Pringle only found a small patch. This grows in the coldest alpine localities, in moist, gravelly soil, where also you will probably find *Gentiana Amarella acuta* Hook. f., *Luzula spicata* Des., and *Festuca ovina brevifolia* (new to Gray's Manual), L., plants equally rare. You may also find *Carex atrata ovata* Boott.; in the base of the Notch, the type station for *Aspidium aculeatum Braunii* Koch, one can also find *Pyrola minor* L.

The pleasure of the mountain climb is enhanced by the marvelously beautiful views, as well as by the feeling that one may collect, among these wild heights, plants which many others can know only from the dried specimens.

Rutland, Vermont.

BRIEFER ARTICLES.

The origin of the sexual organs of the Pteridophyta.—One of the greatest difficulties encountered in attempting to determine the homologies existing between bryophytes and pteridophytes has been the apparently radical differences in the structure of the sexual organs, especially the archegonium. The latter in all pteridophytes is remarkably constant in structure and always has the venter completely immersed and the neck composed of four rows of cells. In the bryophytes the venter is usually free, and the neck composed of six (sometimes five) rows of cells. These differences are especially noticeable when the leptosporangiate ferns are compared with the bryophytes, and so long as the former were regarded as primitive forms it made all attempts to connect them with any group of bryophytes seem hopeless.

When, however, the eusporangiate pteridophytes are examined, it is seen that they show certain points of resemblance in the structure of the sexual organs to one order of the Hepaticæ, the Anthoceroteæ, which has long been admitted to have the greatest affinity to the pteridophytes in the structure of the sporogonium. An examination of several members of this order in connection with the study of the development of *Marattia*, one of the eusporangiate ferns, led the writer to venture on a possible explanation of the origin of the archegonium of the latter from forms resembling the Anthoceroteæ. A further examination of other eusporangiate ferns, as well as *Equisetum* and the Lycopodineæ, makes it seem likely that the statements made with reference to *Marattia* are applicable to all pteridophytes, and that homologies in the antheridium of the eusporangiate pteridophytes and Anthoceroteæ can also be assumed with much probability.

In all bryophytes there are formed in the archegonium mother-cell three nearly vertical walls which intersect so as to enclose an axial cell from which are formed the egg and canal-cells, as well as a terminal cell, the cover cell. This latter in the Hepaticæ always divides by cross-walls into four cells which may occasionally undergo one or two further divisions. The axial row of cells is surrounded by three peripheral cells, which divide usually once by a vertical wall. Sometimes one of these fails to divide so that there are but five in all. These six (or five) cells are the initials for the corresponding rows of cells in the neck of the mature archegonium.

One group, the Anthoceroteæ, as is well known, differs very much in the appearance of the archegonium from the other Hepaticæ. Instead of projecting above the thallus it is completely sunk in it, and the limits of the neck cells are extremely obscure, while only the cover cells of the neck, or the uppermost cells of the axial row are free. A comparison of the earlier stages with the corresponding ones of the pteridophytes shows a striking resemblance, and renders the conclusion irresistible that the so-called mother cell of the archegonium of the latter is really homologous only with the axial row of cells of the bryophytic archegonium. It is equally evident that the four-rowed neck of the pteridophytic archegonium is a development of the four cap cells of the liverwort archegonium and cannot be properly compared to the six rows of neck cells in the latter. These are no longer clearly discernible but are more or less completely suppressed as in *Anthoceros.* As might be expected the departure from the bryophytic type is least marked in the Eusporangiatæ which in other respects come nearer to the Hepaticæ.

The Anthoceroteæ differ from all the other bryophytes in having the antheridium of endogenous origin. The antheridium (or antheridia) is covered by two layers of cells and the cavity within which it lies is completely closed from the first. The antheridial cell may give rise to a single antheridium, or more commonly, to a group of antheridia varying much in number even in the same species.

A study of the earlier stages, as was the case with the archegonium, shows very significant resemblances to the corresponding stages of the eusporangiate pteridophytes, and at once suggests that by a suppression of the wall and stalk of the antheridium of some form with a single antheridium, the type found in all the eusporangiate pteridophytes may have been at once formed. In the latter, the cell which in the Anthoceroteæ gives rise to the outer wall of the cavity containing the antheridia becomes at once the outer wall of the antheridium itself, while the inner one develops directly the mass of sperm cells. It is to be noted that this wall is double in some of the eusporangiate ferns, while in those that approach the Leptosporangiatæ it is single, and not infrequently projects somewhat so that the antheridium approaches the free condition found in normal Leptosporangiatæ. The greatest difficulty that remains is the origin of the multi-ciliate spermatozoids of the Filicineæ and Equisetineæ, to which, as yet, there is absolutely no clue.

In conclusion then, it seems probable that the origin of the pteridophytes is to be looked for from forms which, like *Anthoceros,* had the sexual organs completely submersed, and that the elongated archegonium neck and projecting antheridia of the Leptosporangiatæ are secondary developments.—DOUGLAS HOUGHTON CAMPBELL, *Berlin, Germany.*

Botanical notes (WITH PLATE VIII). — I. *The spreading of raspberry bushes by a system of natural "layering." Rubus occidentalis.*—A few observations, apparently not hitherto recorded, gave rise to the following more complete account of a process, the more general facts of which were already well known. The internodes formed by the raspberry in later summer are considerably longer than those produced earlier in the season, and bear but few prickles. This later growth becomes recurved and seeks the ground, the newer internodes being very long. After the stem has developed to a certain length in this downward direction, the newer internodes are very rapidly shortened, and the prickles become very numerous as compared with their frequency elsewhere on the stem. It was very interesting to see that when the plant grew on the sides of cliffs this shortening of internodes took place, even when the ground had not been reached, and when the growing ends of the descending branches were fully illuminated by the sun. The habit of terminating the branches at a certain length by means of the shortened internodes covered with prickles seems to have become so strong that the branches go through the process even where, owing to their growth on the side of cliffs, the normal conditions, which must have given origin to this habit—the shade and dampness formed by leaves along the ground, and the presence of loose earth into which the branches could penetrate—do not exist. The prickles towards the tips of the branches are strongly curved backwards, in decided contrast to the ordinary prickles of the plant which are fairly straight, and are placed nearly at right angles to the stem. On reaching the ground the shortened internodes curve forwards and enter it obliquely. The recurved prickles prevent the tips which are just starting root from being readily torn out of the ground, catching hold of the underbrush and weeds among which they have rooted, and hooking into the ground itself.

As the joints began to lengthen during summer, the leaves grew smaller, and by the time the newer internodes were strongly shortened, preparatory to rooting, the leaves were reduced to small scales, subtending small scaly buds. Indeed, this reduction to scales takes place even in the open air, before the ground has been reached, but is universal on the rooting part of the stem.

Towards the tip of the branches, among the shortened internodes, the stem sends out rootlets. These do not come out at any point on the stem, but occur in two pairs, at each node, just below the base of

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the scales representing the leaves at this point, as shown in the figure (figs. 6, *c*, *b*, *a*). It was observed that these rootlets began to grow as soon as the branches reached the shade, but often before they touched the ground. At the very tip of the descending branches, where the internodes were the most shortened, all of the nodes developed roots, and in case these reached the earth the tips of the branches were soon rooted fast, and that leverage was secured which enabled the growing tips to penetrate the soil.

Soon after securing a firm hold in the soil, the tip turns rapidly upwards and forms a scaly winter bud. About four to eight inches behind the rooting end of the branch, the stem is usually very brittle, breaking readily when cattle or other large animals pass through the raspberry bushes, thus giving rise to independent plants.

II. *Notes on superposed buds and leaf scars.* 1. *Rubus villosus.*—The blackberry presents excellent cases of superposed buds, the upper being the older and stronger. Three are quite common. The common raspberry also shows superposed buds.

2. *Cephalanthus occidentalis.* In the button-bush, the tips of almost all branches were terminated by inflorescences, a part of which had never developed their flowers. The few tips not thus terminated showed shriveled up leaves and ends of branches, dying back before the arrival of frost. The general growth of the stem is therefore sympodial. The bush has commonly two or three superposed buds in the axils of the leaves. In the autumn the tip of the upper bud is often not visible, but its position is indicated by a low protuberance where the tip of the bud presses up the epidermis of the bark (figs. 1, *a*, *b*). When the bud penetrates the epidermis, it appears only as a very tiny point. The lower one or two buds are not visible usually on the exterior of the bark at this time of the year, being hidden beneath the leaf scar. The fibrovascular bundles form a semi-lunate figure in the scar, entering the same obliquely and usually leaving a vertical median partition above; the general appearance of the scar is, however, quite variable (figs. 1, *c–g*). The leaves often occur in whorls of three. The pith is lightly tinged with brown.

3. *Ilex verticillata* (figs. 2, *a–c*). Three or four buds, and consequently as many leaves, are clustered around the larger terminal bud of the branch. The leaves with short and rather few serrations are arranged on the two-fifths phyllotaxy. The berries are bright red, several seeded, and occur in a sort of raceme. The leaf scar with a raised semi-circular fascicle of fibrovascular cells entering the scar obliquely, are characteristic. Occasionally superposed buds are observed.

4. *Euonymus atropurpureus.*—Branches round, greenish tinged with

brown; pith white, tinged with green. Fibrovascular bundle forms a semi-circular marking on the leaf scar (figs. 3, *a*, *b*). The scaly bud and the opposite leaves also serve to distinguish this shrub. It forms a terminal bud.

5. *Magnolia Umbrella.*—The buds are covered with close villous hairs, and short hairs are also found at the tips of the branches. In the leaf scars the fibrovascular bundles appear as dots, arranged in two series, often confused and not readily distinguished in case the leaf scar is narrow (figs. 4, *a*, *b*). The exterior set of dots is the larger. In the scaly winter buds, the flowers in October show petals 7^{mm} long; the sepals are very distinct; the stamens are 2.5^{mm} long; the styles are very distinctly visible. The fruiting pedicel includes a node bearing occasionally a leaf (fig. 4 *c*), but usually only a sheathing scale, morphologically the sheathing petiole (fig. 4 *d*). The bark is greenish; tinged with brown. The characteristic sympodial growth of a large part of the branch is due to the abundant flowering tips, which later fall off. Sometimes two seeds occur in the cell (fig. 4 *e*).

6. *Liriodendron Tulipifera.*—In the leaf scar the outer series of fibrovascular bundles appears as five dots of larger size, arranged at approximately equal distances apart (figs. 5 *a*, *b*, *c*). The inner set of fibrovascular bundles varies in number and size. The pith is solid, and is composed of portions with large cells, separated by cross-portions composed of finer cells.—AUGUST F. FOERSTE, *Dayton, O.*

Tillæa simplex.—The re-discovery of Dr. Gray's shortia and of Audubon's Florida lily are familiar stories to botanists; other plants too, belong in the list, though not lost for so long; *Potamogeton Niagarensis*, for instance, detected by no one after its discovery by Professor Tuckerman, till the late Dr. Morong found it again in the same waters.

I write to put on record that after a lapse of sixty-five years *Tillæa simplex* Nutt. has come to light once more in Nantucket, Mass., where Oakes found it in 1829. It has been remembered and sought for in the course of these years, by diligent and ambitious collectors, natives of the island and visitors, as they had opportunity, and Mrs. Mabel F. Robinson of Elizabeth, N. J., is at last the fortunate discoverer. We shall never know where Oakes collected his plants as he said nothing more than "on the dried borders of small ponds," but as that most accurate botanist used "pond" in the plural number, we hope that new localities may yet be found for this rare little thing, of which only the gigantic specimens reach two inches in height.

Mrs. Robinson spends her summers in Nantucket with her family, and her interest in the island flora has led to this fine discovery.

And while writing I will mention that two species of *Picris* still rare in America, have in their travels reached this place; *P. hieracioides* and *P. echioides* have both been found this last season within our city limits, and also *Alyssum incanum* has appeared for the first time. *Azolla Caroliniana* has surprised us too, in our largest park, but as the pond which it covers with its fronds is full of lotus plants (*Nelumbo*), it is pretty certain that it came in with their roots. It shows that it is not quite at home in our northern waters by being of slender growth and producing no fruit.—MARIA L. OWEN, *Springfield, Mass.*

Leucoplasts.—It may be of interest to some to know that first-class material for starch formers, showing all stages of the formation of starch grains, may be obtained from the petioles of *Musa Ensete*, the Abyssinian banana. The oblong horizontal diaphragms separating the large intercellular spaces of the petiole are composed of from two to six layers of parenchymatous cells. The superficial layers are stellate in form and contain no leucoplasts or very few, but usually a large number of beautiful crystals. The cells of the deeper layers generally contain a considerable number of comparatively large leucoplasts, either clustered about the nucleus or scattered throughout the cytoplasm. For study it is only necessary to remove the diaphragm with a scalpel, pocket knife, or other similar instrument, mount and treat with reagent to suit the occasion. The lower eight to twelve inches of the petiole furnishes the best material. The botanical department of the University of Wisconsin can furnish a limited amount of this material to institutions not having access to the growing banana plants, at the cost of transportation.—L. S. CHENEY, *University of Wisconsin, Madison.*

Formulæ for life histories.—By an oversight the signs following S in the second, third, and fourth formulae printed on page 31 of the January number were o (representing gametes) instead of O (representing spores). Readers should make the correction.—J. M. C.

EDITORIAL.

IN LOOKING somewhat carefully into the methods of botanical instruction prevalent in our colleges it seems to us that there is a dangerous tendency that demands consideration. We do not refer to those colleges in which botany receives but little attention, but to those in which there is an attempt to develop it in a full and modern way. In the recoil from the old time methods, the college has gone to the other extreme and seeks to become a place of research, a sort of undergraduate university. The teachers who are fit to teach have either just come from great botanical centers where research is in the very air, or they are intensely occupied with their own investigations. The consequence is that raw young men and women, after a year or two of the study of "types," are assigned original problems, and their uncertain results, with more or less revision on the part of the instructor, are published in some periodical or bulletin. These callow productions have come upon us in swarms and they are richer in annoyance than in information. We do not blame the young authors in the least, but we do blame instructors for encouraging poorly prepared students to undertake original investigation. The science of botany is an enormous thing, with a long history and a rapidly increasing volume, and a year or two of preparation cannot fit any one to conduct a creditable research in any part of it. The different departments of it are so interdependent that it needs long training to bring the perspective and the grasp that make any independent investigation profitable. To interpret, and to fit results upon the great body of accumulated knowledge is not within the capacity of an undergraduate. We are perfectly aware that many ambitious students desire a "problem" almost as soon as they enter the laboratory, but it should no more be granted to them than solid food to a sucking babe. We are pleading for a longer devotion to the elements of botany in all their wide range, a patient preparation, year after year, of a suitable background upon which individual work may presently be projected, an abolition of independent undergraduate investigation. If the instructor be carrying on investigations in which students may be of service it is profitable and inspiring to allow such service, but this is training, not original research. Those students are fortunate who are held back from precocious research and publication, and those are to be pitied who are spurred into doing that for which they are in no way prepared.

CURRENT LITERATURE.

A new laboratory guide.

Since in these days no teacher of botany finds any entirely satisfactory helps until he himself writes a text-book or laboratory guide, it is not to be wondered at that the schools of pharmacy feel the same needs. Although the new book from the laboratory of Professor Bastin[1] is announced for "colleges and other schools," it is evident that its chief purpose is to meet the needs of students of pharmacy who have no time to study botany as a science, but must be led directly to the essential structures of those plants with which their business will have to do. For such students the book will prove to be a very useful guide in laboratory work. From the college standpoint, however, the usefulness of the book will depend entirely upon the training of the teacher. For students well grounded in a general survey of the plant kingdom, and in the doctrines of modern morphology, the book will be a useful collateral aid in the study of flowering plants. We fear that the pendulum has swung too far from the older botany, and in our eagerness to show that phanerogams represent only one group of plants we are in danger of an almost equally lop-sided cultivation of the lower groups. The phanerogams are still with us, and deserve a more careful study than they often recive in the modern laboratory. Such studies as Professor Bastin indicates are extremely valuable at the end of an elementary course, when the morphology of phanerogams has been approached by way of the lower groups and their variously modified structures become proper objects of study. The general purpose of the book is commendable, and its usefulness has been indicated, but in our judgment its usefulness would have been much enhanced by making it consistent with the universally accepted views of morphology. These views are not any more recondite to a beginner than are the older ones, as we have had abundant opportunity to know. The plates, especially the flower dissections, are to be criticised from the teacher's standpoint as encouraging small and indistinct sketches, the most persistent fault of the beginner. As a matter of personal preference, perhaps, we think that laboratory guides should be small and inexpensive and "handy" books, in which the typographer's pride in paper and margins and binding is inappro-

[1]BASTIN, EDSON S.—Laboratory exercises in botany, designed for the use of colleges and other schools in which botany is taught by laboratory methods. 8vo. pp. 540, plates 87. Philadelphia, W. B. Saunders, 1895. $2.50.

priate. We would raise the question, also, as to the wisdom of the numerous "forms for study." It smacks too much of the swarm of schemes for "plant analysis," which seek to compel the student to observe and think within rigid lines. Our objection is the pedagogical one that the student cannot be compelled too early to cultivate the habit of independence. The criticisms offered are all of minor importance excepting the fundamental one concerning modern morphology, and we cannot but think that even pharmacists would be the better of breathing the air of the modern laboratory, even if they handled no other structures than those indicated.

Mosses of France.

The Muscologia Gallica[1] has been completed by the issue of part 14. We have from time to time commented upon this very useful work as it appeared. The fourteen parts have averaged over thirty-two pages of text and nine plates, and have been appearing at irregular intervals since 1884. It is greatly to be regretted that Mr. Husnot did not give us the date of publication of each part, and we hope he will supply this information in the *Revue Bryologique*. The keys accompanying each genus seem good, and are certainly useful; but the want of classification beyond the genera and suborders Acrocarpæ and Pleurocarpæ is unfortunate. The author certainly ought to have given the orders and families a place.

The genus Orthotrichum, treated by Venturi, and the § Harpidium of Hypnum, by Renauld, go far outside the limits of France, or even the *contrées voisines*, and contain much that applies to our own species. This is particularly the case with the latter, which is really a monograph of the group.

The high price of the book will somewhat limit its sale we fear, but its author, lithographer, and publisher in one deserves much credit for his enterprise and financial reward for his labor.

On geographical distribution.

Dr. C. Hart Merriam, in a recent address, distributed as a reprint from *Nat. Geog. Mag.* 6: 229, has given an account of the laws of temperature control of the geographic distribution of terrestrial animals and plants. Dr. Merriam for several years has been investigating, under the Department of Agriculture, the subject of geographic distribution, and the present address is an abstract of the principal results. It

[1] Husnot, Th.—Muscologia Gallica; descriptions et figures des mousses de France et des contrées voisines. Roy. 8vo. pp. 458. pl. 125. Cahan: published by the author. 1884–1894. 70 fr.

is remarked that the question is not one of spreading over all available areas, but how this tendency to spread has been checked. The circumpolar belts of distribution in the northern hemisphere are primarily three: boreal, austral, tropical. These have subdivisions of various rank, the austral, for example, having the transition, upper austral, lower austral subdivisions. The most remarkable case of overlapping is that found on the Pacific coast, where the 1,000 miles from southern California to Puget sound belongs to the transition zone, elsewhere narrow, in which boreal and austral forms freely mingle, and which must account for that wonderfully varied flora. The limitation of these life zones Dr. Merriam finds to be due to temperature as the great primary cause. The two fundamental laws worked out are formulated as follows: (1) the northward distribution of animals and plants is determined by the total quantity of heat, the sum of the effective temperatures (that is, those above the assumed minimum); (2) the southward distribution of boreal, transition, and upper austral species is determined by the mean temperature of the hottest part of the year. The application of these laws to the Pacific coast strip will serve both as an illustration and as an explanation of that remarkable region. The data at hand demonstrate: (1) that the temperature of the summer season is phenomenally low for the latitude and altitude, so low as to enable boreal types to push south to latitude 35°; (2) that the total quantity of heat for the entire season is phenomenally high for the latitude, so high as to enable austral types to push north to Puget sound. It should be said that the minimum temperature of 6°C. (43°F.), has been assumed as marking the inception of the period of physiological activity in plants and of reproductive activity among animals, and that the total quantity of heat is obtained by adding temperatures above this minimum. Some of the temperature limits made out are as follows: *boreal*, southern boundary, isotherm of 18°C. (64.°4F.), for the six hottest consecutive weeks; *transition*, northern boundary, isotherm with a sum of normal positive temperatures of 5,500°C. (10,000°F.), southern boundary, isotherm of 22°C. (71.°6F.) for the six hottest consecutive weeks; *upper austral*, northern boundary, isotherm with a sum of 6,400°C. (11,500°F.), southern boundary, isotherm of 26°C. (78.°8F.) for the six hottest consecutive weeks; *lower austral*, northern boundary, isotherm with a sum of 10,000°C. (18,000°F.); *tropical*, northern and southern boundaries marked by isotherm showing a sum of 14,400°C. (26,000°F.). The most prominent secondary cause affecting distribution is said to be humidity. Three colored maps of the United States show distribution of total quantity of heat, mean temperature of six hottest consecutive weeks, and life zones. The close resemblance of the maps is remarkable.

OPEN LETTERS.

Unfair criticism.

Two thoroughly bad kinds of criticism are prevalent in scientific literature and frequently enough crop out in American journals. One is the indiscriminate and fulsome praise of books and papers written by one's personal friends, or by official superiors, or by people with whom one wishes to curry favor. The other is the malicious detraction, or misrepresentation, or damning by faint praise of articles written by individuals personally disagreeable to the reviewer. The latter is carried to such an extent by some persons both in America and Europe that, if the reader is not personally acquainted with the subject-matter, he must find out the personal relations of reviewer to writer before deciding what weight to give the review. This is all wrong. It injures the writer, makes the reviewer ridiculous, and to a certain extent impedes the progress of science. A good rule is never to review the writings of one's avowed enemies or warm personal friends. The strict adherence to this rule would result in reviews of a much higher order. What botanical science in this country needs most of all is *honest* and *fearless* criticism from which personal likes and dislikes have been eliminated. Nothing else would so tend to repress the flood of foolish writings, and to stimulate good work.—ERWIN F. SMITH, *Washington, D. C.*

The editorial committee of "Science."

In an editorial note in the January issue of the BOTANICAL GAZETTE you criticise *Science* for having several editors for zoology and only one for botany. The Editorial Committee of *Science* is composed of those who took the most active part in the reorganization of the journal. It so happens that in zoology and in anthropology there are two representatives, whereas for equally important subjects, such as physics and botany, there is only one representative. We trust, however, that botany in all its departments will be fully represented in the contents of the journal.—J. McK. CATTELL, *Columbia College, Jan. 26, 1895.*

NOTES AND NEWS.

THE EDITORSHIP of Pringsheim's *Jahrbücher für wissenschaftliche Botanik* has been taken by Professors Pfeffer and Strasburger.

MACMILLAN & CO. announce a rural science series to be edited by Prof. L. H. Bailey of Cornell University. The first number will appear shortly.

MEEHAN'S MONTHLY will add hereafter four pages to its monthly issue. The fine colored plates, executed by Prang & Co., will be continued, which alone are worth the subscription price.

APPLIED BOTANY takes on many forms. It is announced that a society composed of students of the American Brewing Academy of Chicago numbers 200 members. The society has the unique name, SACCHAROMYCES CEREVISIÆ.

THE BACTERIAL DISEASE of sugar beets, first described in 1892 by J. C. Arthur and Katherine E. Golden, has been detected in Germany by Paul Sorauer. It is considered a similar disease to "sereh," a destructive disease of sugar cane.

FAVORABLE RESULTS in spraying to prevent black knot of plum trees have deen obtained by Mr. E. G. Lodeman (*Garden and Forest* 7: 508). His work seems to show, however, that the life-history of the fungus still presents much that needs elucidating, or at least verifying.

ELLIS AND EVERHART have recently published in the Proceedings of the Philadelphia Academy of Sciences descriptions of 241 new species of fungi, distributed among the following orders: Hymenomycetes 10, Pyrenomycetes 71, Discomycetes 22, Sphæropsideæ 92, and Hyphomycetes 46.

AMERICAN BOTANISTS should not let the opportunity pass to secure sets of both European and North American mosses put up by Messrs. Renauld and Cardot of France, and distributed in this country through Mr. J. M. Holzinger of Winona, Minn. The price is moderate, and the specimens very desirable.

THE LAST NUMBER of *Agricultural Science*, which recently appeared, is given as June–September, 1894. It is mostly occupied with the proceedings of the Society for the Promotion of Agricultural Science. This journal, although an excellent one, and occupying a place not filled by any other, is evidently having a struggle to keep alive.

THE ACETIC ACID ORGANISM, heretofore known as Mycoderma aceti, has been separated by Hansen in a recent publication from the Carlsberg Laboratory into two forms, which are called Bacterium aceti and B. Pasteurianum. The former is colored yellow by iodine and the latter blue. The transfer to the genus Bacterium was suggested by Zopf.

ADDITIONAL DESCRIPTIONS of species of Ravenelia are given in the last issue of Hedwigia (33: 367), by Dr. P. Dietel, to supplement his account of the genus in a former number (*l. c.* 22). The form on Acacia anisophylla and A. crassifolia from Mexico is separated under the name *R. Farlowiana*, n. sp., from *R. versatilis* (Pk.) on A. Greggii. Two other new species from Mexico are described, *R. Indigoferæ* on Indigofera Palmeri, and *R. Mexicana* on Calliandra. The *Uromyces deciduus* on Prosopis from California, described by Peck, is identified as the uredoform of *R. Holwayi* Diet., necessitating a change in the name to *R. decidua* (Pk.) Holw.

MR. J. REYNOLDS GREEN communicated to the British Association for the Advancement of Science at its last meeting the results of some experiments to determine the effect of light on diastase. He found that "light, whether solar or electric, exercises a destructive effect on diastase. The deleterious effect is confined to the rays of the violet end of the spectrum, the others being slightly favorable instead of destructive. . . . The destructive effect continues after exposure to light is discontinued, the exposed solution getting weaker and weaker till it had no diastatic property. The part of the solution kept in darkness maintained its diastatic power unimpaired for more than a month, by which time the exposed part, kept in darkness after its period of exposure, possessed no power to act upon starch."[1]

BULLETINS from the Experiment Stations of botanical interest, received since the last mention, are as follows: Grasses of Tennessee by F. L. Scribner (Tenn. 7: no. 1) is a very complete handbook of the grasses of the state, each species described and illustrated by an original drawing; Seed testing by Gerald McCarthy (N. C., no. 108), a rather extended treatise well illustrated; Millet by A. A. Crozier (Mich., no. 117) contains much information upon the history of the races and usage of the name, beside practical matters; Grafting of grapes by E. G. Lodeman (Cornell, no. 77) includes some account of the cell structure; Smuts of wheat, oats and barley by Luther Foster (Mont., no. 2); Spraying apple trees by Chas. A. Keffer (Mo., no. 27); and Some grape troubles of western New York by E. G. Lodeman (Cornell, no. 77) containing new observations, with good illustrations.

THE SEARCH for sexual organs in connection with the æcidia and spermogonia of the Uredineæ seems likely to prove futile, in spite of the supposed discovery of them by Massee. Careful work has been done by Rudolf Neumann (Hedwigia 33: 346), under the direction of Prof. Reess of Erlangen. He used alcoholic material, imbedded in paraffin, and cut with the microtome, and fresh material cut by hand. The examination of thousands of sections with oil immersion lens and otherwise, disclosed no trace of sexual organs. Both æcidia and spermogonia arise directly from the unchanged hyphæ. The forms examined grew upon Ficaria ranunculoides, Allium ursinum, Euphorbia Cyparissias, Falcaria Rivini, Sagittaria sagittifolia, Tragopogon pratensis and Berberis vulgaris. The hyphæ in the first two may be traced with ease at all stages, in the others with some difficulty, especially so in the last. The form on Ficaria was the one studied by Massee.

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[1]Annals of Botany **8**: 373. S 1894.

BOTANICAL GAZETTE

MARCH, 1895.

Apparatus for physiological botany.

W. C. STEVENS.

WITH PLATES IX–XII.

I propose to describe in detail some apparatus for physiological botany which I have found very useful in my laboratory. The description may at least serve as a useful suggestion here and there for those wishing to equip a physiological laboratory, but with scanty funds for the purpose.

The apparatus here described is made almost entirely of white pine and with ordinary wood working tools, including a lathe and scroll saw.

The table to which the apparatus is attached when in use consists of a single board one and one-half inches thick, seventeen inches wide and sixteen feet long, fastened by means of iron brackets on a level with the bases of two south windows, and twenty-eight inches from the floor. The table is set out on the brackets two and one-half inches from the wall. See plate X, figure 1.

CENTRIFUGAL MACHINE. Plate IX, fig. 5.—This consists of a wheel *a*, seventeen inches in diameter, which serves as a base for the pan containing the seedlings, and as a pulley for slow motion in other experiments; a small pulley *b*, two and one-half inches in diameter, to carry the belt from the motor when rapid motion is desired; an upright shaft *c*, one and one-half inches in diameter and fourteen and three-fourths inches in length exclusive of the steel cores; and a frame *d*, for mounting the pulleys and shaft as shown in the figures. Steel cores three-eighths inch in diameter are sunk into the two ends of the shaft. The upper core has its exposed end countersunk to admit the point of a large screw that has been tapered with a file while held in the lathe chuck. The core in the lower end of the shaft has been tapered in the same manner as the screw, and fits into an iron piece, seven-eighths inch square and three-eighths inch thick, that has first been slightly hollowed with a five-eighths inch drill to form an oil cup, and then countersunk to receive the point of the core.

The construction of the frame which holds the shaft and pulley is made sufficiently clear by the figures of plate IX and by details *a*, *b*, *c* and *d* of plate X. The steps in the construction of the shaft and pulleys, however, need to be given. A pine stick 2×2 inches is sawed the proper length for the shaft; the centers of the ends are determined by crossing diagonals from the four corners; holes are bored in the center, and the steel cores are driven in, the upper flush with the surface and the lower protruding five-eighths of an inch. The stick is then fastened in the lathe by grasping the end of the lower core in the lathe chuck and bringing the dead center of the lathe into the depression countersunk in the upper core. The ultimate diameter of the shaft is to be one and one-half inches. The stick is now turned to a diameter slightly larger than this; a block is cut two and three-fourths inches square from two inch stuff; a hole one and one-half inches in diameter is bored through its center, and then the shaft is carefully trimmed with the turning gouge, or brought down with coarse sand paper until the block can be crowded on firmly. Then the block, in position flush with the end of the shaft, is turned to two and one-half inches in diameter. Then beginning three-fourths of an inch from what is to be its lower face the block is tapered down to the diameter of the shaft as shown in plate IX, figure 5, *b*. The upper face is made slightly concave, and a V-shaped groove is turned on the edge for the belt.

The pulley is now to be taken off, and after applying glue evenly over the space to be occupied on the shaft it is crowded into its position again. It is advised that the pulley be turned in position before gluing as above described because of the possibility of the block chipping too deeply while roughing off.

To make the large pulley, two pieces slightly over seventeen inches square are cut from one-half inch boards and screwed together with the grains crossing to prevent warping; the two surfaces are dressed true; the center is determined by crossing the diagonals; a circle is marked out from the center seventeen inches in diameter, and a one and one-half inch hole is bored through the center to fit the shaft.

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The circle is now sawed out as accurately as possible on the scroll saw, and then trimmed if necessary with a spoke shave. A V-shaped groove for the belt may be cut on a former machine or with a hand beader. The pulley is now slipped on the shaft, crowded firmly against the small pulley and screwed to it. If the work has been carefully done it will be found when the shaft is adjusted in the frame that the apparatus revolves with perfect ease and accuracy.

A circular zinc pan is made of the diameter of the large pulley and six inches deep, with a tubular opening in the center one and one-half inches in diameter to fit over the pulley shaft. This can be seen in section in plate X, figures 2 and 2′, and in position on the clinostat table, to be described further on, in plate IX, figure 2.

To clamp the apparatus to the table it is placed with its base across the table with the ends of the base projecting on either side. A piece of the same size as the base of the frame, namely 3×22 inches, is passed under the table and the table is clamped between these two pieces by bolt and thumbscrew at either end as shown in plate X, figure 1.

To use the apparatus as a centrifugal machine for germinating seeds, the zinc pan is placed over the shaft so that it rests on the large pulley. It will be noticed that the shaft and pulleys can be removed for this purpose by simply unscrewing the large screw (*e*) fitting the upper end of the shaft. Fine white pine sawdust is put into the pan to the depth of four inches, and seeds of beans, peas, corn, etc., planted to a depth of two inches, about five inches from the center. The sawdust is thoroughly moistened and pressed firmly over the seeds; mosquito bar is then spread over the saw dust, and over this is placed wire netting with one inch meshes, so cut as to press snugly against the central zinc tube and the outer wall of the pan. This keeps the sawdust from heaping up against the sides of the pan while revolving rapidly, but does not press too hard against the seedlings, for the whole mass of sawdust loosens up to a considerable extent after the pan is set in motion. If any of the seedlings grow to the surface it is an easy matter to cut away the mosquito bar or even to separate the wire of the netting if this should happen to be in the way. A rubber tube connected with a siphon from a jar of water standing on a shelf above the apparatus is so clamped between two sticks screwed together as to allow a slow dripping of water close against the central zinc tube. Here the centrifugal force is slight and the water has opportunity to soak in while slowly moving to the periphery. After a short time the water supply can be so adjusted as to compensate evaporation without sufficient excess to be thrown out around the side of the pan.

Seedlings of peas, beans and corn have been grown in sawdust in this manner for several days, revolving constantly at a rate of 180 revolutions per minute.

HORIZONTAL CLINOSTAT. Plate IX, figure 3, and details *e, f, g, h, i, j, k, l, m*, of plate X.—A wooden shaft, *e*, is turned 30¾ inches long and 1½ inches in diameter, after a steel core has been inserted and then clamped in the lathe chuck in the manner previously described. A pulley, *g*, 2½ inches in diameter, serving also as a shoulder for the larger pulley and table of the clinostat, *h*, is turned on the shaft in the manner previously described so that its upper face stands ¾ of an inch below the upper end of the shaft. The upper face is hollowed slightly. The table of the clinostat is made of the same size and in the same manner as that of the centrifugal machine, except that the central opening, 1½ inches in diameter, extends only ¾ of an inch deep from the lower surface. This is crowded on the shaft against the small pulley and screwed to it. The core in the lower end of the shaft revolves in an iron bearing similar to the one described for the centrifugal machine. The bearing for the upper end of the shaft, shown in figure *i* of plate X, is made in the following manner: a piece is cut from ⅞ inch stuff 3 inches wide and 27 inches long. Two inches from one end a hole is bored of the diameter of the shaft and a block is cut out through the middle of the hole as shown in the figure. When this is replaced with long screws it serves as an adjustable box for the shaft. To set up the clinostat, the last mentioned piece is laid across the table with the box end projecting inwards. Another piece seven-eighths inch by three inches by twenty-two inches is placed beneath the table and the two pieces are then clamped against the table by means of a bolt and thumbscrew, *k*, at each end of the two pieces. This method of clamping apparatus to the table is easy of execution and insures rigidity; it also affords a simple method of tightening belts by loosening the thumbscrew and slipping the apparatus along the table. The iron cup which receives the core

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at the base of the shaft is adjustable along a groove in the block *m*, which is screwed to the floor. It will be seen that a wedge extends the full length of the groove and by driving in a screw at each end of the wedge the iron cup may be clamped in any position along the groove. I find that ordinary common twine makes an efficient belt. When the ends are tied the knot is so small as to be of no consequence. The slow motion for the clinostat is obtained by running a belt from the water motor to the large pulley on the centrifugal machine, and from the small pulley of the latter to the large pulley of the clinostat. The apparatus is shown harnessed in this way in plate IX. The zinc pan of the centrifugal machine may be put on the table of the clinostat as in plate IX, figure 2, and will there serve for imbedding the pots of the plants used in the experiments in moist sawdust to prevent rapid drying.

A support for inverted plants is shown on the clinostat in plate IX, figure 1, and in detail plate X, figures *n*, *o*, and *p*.

The method of adjusting the height of the belt from the water motor is shown in plate IX, figure 6. The standard carrying the pulleys is held at the desired height by means of a screw pressing against a strip of spring brass set into the block *f*, through which the standard passes. See plate X, details *q*, *r*, *s*, *t*, and *u*. The pulleys of figure 6 are shown set at the proper angle for the large pulley of figure 5. When the belt runs over the small pulley of figure 5 the pulleys of figure 6 are unscrewed and set nearly parallel and closer together.

In the preceding pages the methods of making the shafts and pulleys and of inserting the metal cores have been given in detail. It is now necessary to describe only the parts and manner of working of the following apparatus.

Vertical Clinostat.—Plate XI, figs. 1 and 2 show the vertical clinostat set up for experiments with seedlings growing in a moist atmosphere. The base plate *a* is clamped to the table in the manner described on page 91. To the plate *b* are fastened the standards *c*, *d*, and the cross-plate *e*, to which the pulleys *f*, *g*, are fixed. The whole apparatus is bolted to the plate *a*, and may be turned about this at any angle to the light. The wooden shaft *h* has a steel core inserted in one end which bears in the iron box *i*. A depression is turned into the shaft five and one half inches from the core-bearing end, to serve as a track for the small wooden wheels *j*. The shaft extends four and one half inches beyond the wheel bearings. Four pulleys, *k*, *l*, *m*, *n*, are fastened to the shaft in the manner already described (p. 91); the three smaller pulleys having been trued up on the lathe after being fastened to the shaft, and the large pulley, which is cut out on the scroll saw, being screwed to these. The pulleys *f*, *g*, which change the direction of the belt of the motor, can be adjusted along the plate *e* as desired. A zinc case, eighteen inches in diameter and eight inches deep, painted black on the inside, stands on the shelf *o*. A hole in the back of the case one and three-fourths inches in diameter permits the free end of the shaft to pass into the case. A narrow sleeve soldered to the opening shuts out the light. A light copper wire wheel *p*, twelve inches in diameter, is crowded upon the shaft and revolves with it inside the case. The case is water tight up to three inches from the bottom, and above this the whole of the front of the case is occupied by a door hinged at the base. Holes three-fourths inch in diameter and two inches apart are cut in the door in a circle of fourteen inches diameter. These holes may be opened and closed by a zinc strip placed behind them with corresponding holes, and operated by a knob.

Seedlings which have previously begun to germinate in moist white pine sawdust are fastened with two pins to large corks on the circumference of the wheel *p*. The seedlings are kept moist by passing through the water in the bottom of the case during a short period of their revolution.

With this apparatus the influence of light on the direction of growth of the stems and roots of seedlings may be studied with the influence of gravity eliminated.

When larger plants growing in pots are to be experimented with, the case and wire wheel are removed, and a zinc pan is put on the shaft. If it is desired to place a single plant with its long axis horizontal the pan shown in plate XI, fig. 3 is used. This is ten inches in diameter and eight inches deep. The tube *g*, soldered to the base of the pan and made rigid by brackets, fits over the shaft *h* and is held in position by a screw. The flower pot is imbedded in the pan in moist sawdust, and after fine excelsior has been placed over the sawdust and front of the pot the whole is bound in with a string passing over hooks soldered to the side of the pan. If several plants are needed in one experiment the pan shown in fig. 5 is used. This is fourteen inches in diameter and six inches deep, and has a tube passing through the center which fits over the shaft *h*. The pots are imbedded in moist sawdust in a circle near the periphery and bound in as before. If however it is desired to place the pots so that the plants stand perpendicular to the axis of rotation the pan shown in fig. 4 is employed. This consists of two circular sides perforated at their centers and connected by a tube which fits over the shaft *h*, and by four partitions extending radially from the tube. When the plants are imbedded in moist sawdust as above described they do not require watering for a week or more even in the dry atmosphere of the laboratory.

UNIVERSAL CLINOSTAT. Plate XII.—The movement in a horizontal plane is obtained by a clinostat similar to the one described in the first paper, except that the shaft *h*, fig. 3, reaching to the floor, has a hole extending from end to end through the center, through which a three-eighths inch steel rod extends. To make this shaft, two strips the length of the shaft are cut two inches wide from one-inch stuff. Extending to a distance of three inches from the lower end of the shaft a groove is cut longitudinally through the middle of each strip five-eighths inch broad and five-sixteenths inch deep. The strips are then glued together, with the grooves facing each other and forming an opening five-eighths inch square in cross section. When the glue is dry, the upper end having been temporarily plugged, the shaft is put into the lathe and turned to one and one-half inches diameter. Then a three-fouths inch hole is bored two inches deep in the lower end of the shaft, and with a five-eighths inch bit this hole is continued to meet the five-eighths inch opening through the center of the shaft. A steel core *l*, three-fourths inch in diameter and two and one-half inches long, with a one-half inch hole longitudinally through it is inserted in the lower end of the shaft, one-half inch of its length protruding. The iron bearing *k*, fig. 3, has a depression one-fourth inch deep to receive the core in the lower end of the shaft, and a three-eighths inch hole one-half inch deep into which fits and is made fast by a screw the steel rod extending through the shaft. It will be seen that the steel rod remains stationary while the horizontal clinostat revolves about it. The upper end of the rod is made square and the three wooden pulleys *i* are driven on and fastened with a screw. The base plate *a*, fig. 1, is screwed to the table of the horizontal clinostat, the steel rod playing through an opening in the plate. See figure 3. The uprights *b*, *c*, are made sufficiently rigid by the brackets *d*, *e*. Brass plates *m*, fig. 3, to serve as bearings for the steel cores of the shaft *f*, are mortised into the upper ends of the uprights and screwed fast. To put the shaft *f* in place the uprights are simply sprung apart.

A zinc pan similar to fig. 4, plate XI, is fastened upon the shaft *f* and the plants are bound in the manner already described.

Motion is communicated to the shaft *f* by a belt passing from the pulleys on the shaft to the pulleys of the stationary steel rod, so that the plants riding on the shaft *f* have a motion in a horizontal and a vertical plane at the same time.

With this apparatus the influence of both light and gravity is eliminated so far as they affect the direction of the growth of the plants.

The pieces of apparatus described are entirely efficient; they can be readily made by any one handy with tools, and the cost of the material used in their construction is merely nominal.

A water motor furnishes the best power for a botanical laboratory. An electric motor would be entirely satisfactory if one could connect with a dynamo running constantly night and day, or with reliable storage batteries, but a motor run by primary batteries is usually not desirable. Water motors furnishing sufficient power can be bought at very moderate prices.[1]

University of Kansas.

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[1] I use the Little Giant water motor made by John Bolgiano. Baltimore, Md. No. 1 costing $5.00 will answer where there is a good head of water. I have only twenty-five feet pressure and use No. 2, costing $10.

On the "List of Pteridophyta and Spermatophyta of North-eastern America," prepared by the Nomenclature Committee of the Botanical Club.

B. L. ROBINSON.

In the discussions of the botanical nomenclature at the Rochester meeting of the American Association there was a decided feeling upon the part of many that more exact data were requisite to any satisfactory action. A series of rules was provisionally adopted and it was wisely urged that before the merits of the code could be estimated it would be necessary to see its application to some considerable part of our flora. Prof. Britton, at much expense of time and trouble, with the assistance of some others, has prepared under the above title a list of the flowering plants of the eastern states and Canada, selecting the names according to the Rochester code and its modification at Madison. This list possesses considerable interest, as it contains the expression of the latest phase of nomenclature reform in America and affords a much more satisfactory basis for the decision of the questions at issue than has hitherto been gained from vague generalizations and isolated instances.

In estimating the system of nomenclature illustrated by this list all considerations of sentiment may be passed with brief mention. It is natural that every working botanist should greatly regret giving up names long associated with certain plants, but there would certainly be few who would not make all due concession in this regard if really assured of a stable nomenclature as a reward of their sacrifices. Before leaving the matter of sentiment, however, it may be noted that it has not been confined to the conservative botanist, who regrets the proposed displacement of established names. It is equally exhibited by the reforming botanist, who maintains that he is impelled to make these changes by justice to the earlier authors. For slight examination shows that this idea of justice is often of the sentimental rather than the practical sort. The revival of old and obscure names undoes in many instances the most careful work of subsequent authors, and this, too, from no fault of theirs, for the rules affecting their work were not invented until many years after its publication. Certainly this is a robbing Peter to pay Paul principle of justice. That there have been many cases of arbitrary change and consequent injustice in the past no one will deny, but it is very doubtful whether these injuries can be righted at present by making more arbitrary changes. Certainly the reform exhibited in the present list does not altogether tend to perpetuate the older combinations of the injured authors, but much more to the renaming of a considerable portion of our flora and the forming of a multiplicity of entirely new combinations with new authorities. But passing these considerations, which as they do not directly affect the practical side of nomenclature may perhaps be regarded as sentimental, we come to the more important question: Is the new system one which possesses the elements of permanency?

It is one of the principal arguments for the stability of the proposed code that it is a *rigid* one, which permits no exceptions and, to use an expression of a leader in nomenclature reform, "leaves nothing to individual judgment." It is well-known, however, to every working botanist that even the selection of the first specific name, after the still more difficult choice of the generic, involves a constant exercise of judgment of the most critical sort, both as regards the exact application of brief and unsatisfactory descriptions and the often doubtful priority of publications. Even the form of the name is sometimes subjected to individual judgment or arbitrary modification in the new system as well as the old, as an illustration will show. It has occurred to a number of writers that the sweet alyssum, common in cultivation, should be separated as a distinct genus. The history of its synonymy is as follows: Upon page 420 of his *Familles des Plantes*, in 1763, Adanson sets up the genus *Konig*, founded upon *Clypeola maritima* L. (*Alyssum maritimum* Lam.), with little description and largely by referring by number to the species of Linnæus. In 1814 Desvaux, also of the opinion that the Lamarckian *Alyssum maritimum* should be separated from the other alyssums, carefully described it under the correctly latinized name *Lobularia*. In 1826, Robert Brown revived the name *Konig*, modifying it to *Koniga* and dedicating the genus to a friend, then curator of the British Museum, whose name by a strange chance was Konig (anglicized from König). In 1891, Prof. Prantl, revising the CRUCIFERÆ for the *Nat. Pflanzenfamilien*, wisely selects as the correct designation of the genus the first properly latinized name *Lobularia*. Now Prof. Britton takes a rather singular course by pronouncing Adanson's *Konig* a misprint for *Koniga*. This action is entirely unwarranted by fact, both from the circumstance that *Konig* occurs in same form several times in Adanson's work and on account of that author's well-known disregard for latinization. Prof. Britton takes this as an entirely arbitrary expedient for setting up a name which would otherwise from its uncouth form be deservedly neglected. But what must be the outcome of such arbitrary actions as this? Is nothing here left to individual judgment? How can Prof. Britton be sure that *Konig* is a misprint for *Koniga* and not for *Konigus*, *Konigium* or *Koniganthus?* Is it likely that other authors will agree upon this point? But this is not all. If Prof. Britton may coin from an unlatinized word a generic name, how may an erratic writer be prevented from taking up any vernacular name from English or German, Dutch or Russian, if having discovered its use in some work of the last century he only pronounces it a misprint, and by the ready addition of an *us*, *a*, or *um* uses it to displace a later generic name? A system which upon the precedent of its chief exponent permits such vagaries as this is certainly not likely to have the desired stability.

The choice of *Koniga* as the earliest generic name is noteworthy as illustrating another point. It will be remembered that at Madison special legislation was demanded and secured to establish the so-called principle of priority by position, according to which if two genera or two species are published in the same work and subsequently united, the name standing first in the book is the authorized one, there being no difference in the time of publication. Now although *Konig* is used on the 420th page of Adanson's work to designate the sweet alyssum, that author states in an erratum that the reader is to substitute for *Konig*, *Aduseton*. A radical reformer might, it is true, refuse to Adanson the right to take back a name once published, but the peculiar feature of this case is that the errata of this work, while doubtless written after its completion, have been uniformly bound in front of the regularly numbered pages; at least such is the case in the three copies of the work accessible to the writer. Thus Adanson's correction, advocating *Aduseton*, has many pages of what Prof. Britton has termed priority of position over the description of *Konig*.

The case is interesting merely as a good instance of many in which zeal in searching for the earliest designation leads to the consideration of names so involved that several interpretations are equally possible. In passing it may also be noted that Prof. Britton's *Koniga maritima* is long antedated by the same combination by Robert Brown, a writer whose works the reforming botanists can scarcely afford to overlook.

It will be generally admitted that a system of nomenclature is unsatisfactory in which the botanist who characterizes and names a new species with all due care that he is not duplicating an existing name, nevertheless can not be at all sure but that the name so carefully chosen may at once be displaced through no fault of his. Yet such is the case under the Rochester and Madison rules. When Nuttall made the combination *Chrysopsis pilosa*, it was a new binomial applied to a good new species evidently belonging to the genus under which it was placed, and never before described in this or any other genus. Can any author hope in describing a species in the future to do better than this? Under the long established usage of conservative botanists such a name would be inviolable; under the Madison rules, however, Prof. Britton is able to displace it by combining the same specific name to the same generic but to designate an entirely different plant, namely *Chrysopsis pilosa* Britton (*Erigeron pilosa* Walt.), making thereby a most useless and pernicious synonym of Nuttall's name, which has every right to stand.

It is not the special case that is here important, but the general principle, which permits such changes and will continue to permit them in the future. The upheaval of nomenclature under this law will not cease even when most of the obscure names of the past have been sought out. It will always be possible for a botanist through perfectly conscientious work to readjust generic lines so that species of the same specific name are thrown together. In such cases under the prevalent usage that species which was already under the genus retained stands fast. But according to the Madison rule, as we have just seen, if the species brought into the genus chances to have an older specific name than the species already in the genus, both plants are to be re-named instead of only one. It does not seem to have occurred to the reformers that this ruling, far from being conducive to stability, would, especially when combined with another of their dicta, give perpetual opportunity for change, since it will always be possible for an erratic botanist to throw together large genera like *Aster* and *Erigeron*, *Bidens* and *Coreopsis*, *Panicum* and *Paspalum*, thereby displacing many specific names which according to the rule of "once a synonym always a synonym" can never be revived! This outcome seems so preposterous that it must be stated that it is not merely the writer's own unauthorized interpretation but the distinctly expressed although unpublished view of one of the compilers of the list, who has been among the foremost in the cause of nomenclature reform.

It is impossible here to criticise in detail the bibliographical work in the list. It is well known that it has been done gratuitously by those who, pressed with other duties, could ill afford the time, so that slips may well be overlooked. Nevertheless it must be confessed that it is disappointing to find such obvious evidences of haste, not to say carelessness, in this regard. Why, for instance, should *Iodanthus pinnatifidus* be ascribed to Prantl when it was used long ago in Steudel's *Nomenclator* (with synonym), again by Gray in the Proceedings of the American Academy, again by Watson in the Botany of the King Expedition? The fact that Prantl himself was ignorant of these earlier publications is but a poor excuse for an American botanist well armed with Watson's *Bibliographical Index* or the recently issued *Index Kewensis*, in both of which the combination is cited. Or why should the place of publication of Celokowski's genus *Stenophragma* be given as Œsterr. Bot. Zeitschr. **27:** 177, where there is merely a review by Dichtl of Celokowski's *Flora von Böhmen*, while the publication of the genus was not even in this latter work, but some years before in the *Regensburg Flora?* However, every one should be aware of the great difficulty of freeing such a list from errors of this kind.

A more significant fact in regard to the work is the number of changes of name which have resulted from readjustments of generic lines and from a modified conception of the dignity of the species. It cannot fail to strike the botanist who glances over this list that many of its species are founded upon plants which by such experienced botanists as Hooker, Gray, Watson, and others have generally been regarded as varieties. Of course it is not denied that the reverse case often obtains. A corresponding change (and here a distinct depreciation) in the dignity of the variety is shown by Prof.

Britton's many "albifloras," covering forms of which Dr. Gray, in a letter recently published, wrote: "When the new edition of the Manual comes out it will have a *nota bene:* Expect a white-flowered state of every colored species. They are sure to turn up sooner or later. And I find it no good therefore to say var. *alba* over and over." If it should be urged that, upon the basis of former publications, *Gerardia purpurea albiflora* Britton, *G. tenuiflora albiflora* Britton, *Gentiana Andrewsii albiflora* Britton, etc., are to be regarded merely as forms and not as varieties, it may be asked whether the trinomial system adopted in the list has not a considerable defect if it cannot indicate the difference between a well-marked variety and a mere form. Whether the naming of forms is at present desirable may well remain an open question, but there can be no doubt that such a course is a general tendency of exhaustive systematic study, and accordingly a style of nomenclature in which there is no distinction between subspecific, varietal, and formal differences is likely to appear to future botanists a rather clumsy tool. However, to return to the interpretation of groups, I would not be taken as even hinting that every botanist has not a perfect right to put his own construction upon the limits of genera, species, and varieties. But it should be apparent to those sanguine supporters of reform, who hope to derive stability from it, that here again everything depends upon individual judgment and must always do so.

In the light of what has been said, it seems sufficiently evident that the new system, far from furnishing a satisfactory solution to the nomenclature question, fails even to offer such substantial advantages over the existing system as greater clearness and prospect of permanency, for which alone working botanists could afford to make such sweeping changes in their language. It is readily granted that the Rochester and Madison rules were formed with care, and with earnest hope of securing uniformity. But they represent what may be expected of rigid codes. Exact rules cannot be consistently applied to such varying circumstances without leading to many incongruities, especially when such action is made retrogressive. It is worthy of note that even Dr. Kuntze, who has certainly made the greatest effort to be consistent, has recently objected strenuously to the principle of "once a synonym always a synonym," expressing grave doubts whether after all several hundred genera and some thousands of species should be renamed on account of rules invented long after their publication.

Uniformity, consistency and stability of nomenclature are in the opinion of the writer unattainable. The sanction of particular associations will never make rules able to control all authors. There will, it is true, be those whose sanguine ideas lead them to follow with conscientious zeal a proposed new system; there will also be those who, however unpopular they may make themselves, will hesitate to change to what they are confident cannot be permanent; and there will always be a third class, who at once set about modifying and improving the measures proposed. This third element is of course the serious obstacle to successful reform, since its existence dispels all hope of a permanent system. It will be remembered in this connection that within a year after the Madison convention a prominent radical member, who assisted in framing the Madison rules, was publishing extensively upon an entirely different system.

While this view of nomenclature may seem unduly pessimistic it may be said in its justification that there is a much more important quality of nomenclature than stability and consistency, namely that of ready intelligibility. It has of late been the fashion among the reforming botanists to decry the existing nomenclature as hopelessly involved and confused. Strangely enough this cry comes quite as often from the physiologist and anatomist as the systematist. It arises, however, in great part at least, from a misapprehension, since the working monographer, who is studying the plants themselves, is seldom seriously troubled in understanding the nomenclature of former writers. The difficulties which confront him are much more those of variation in plants, fragmentary types or insufficient description, etc., and not those of nomenclature pure and simple. Nor has the writer of today any difficulty in conveying accurately his ideas of plant relationship through the medium of the existing nomenclature. For instance no writer using the well established name *Calycanthus* could be misunderstood, while the names *Beurera*, *Butnera*, and *Büttnera*, recently advanced for the genus, never can be more intelligible than the one in use, and the very fact that these three names have within as many years been successively brought forward, each as the only correct designation of the genus, affords little encouragement to think that any one of them is likely long to replace the old and familiar name.

Cambridge, Mass.

Flowers and insects. XIII.[1]

CHARLES ROBERTSON.

DODECATHEON MEADIA L.—American cowslip, shooting-star. In his arrangement of floral mechanisms Delpino (2) recognizes a class of pendulous nodding or horizontal flowers upon which the visitors cling (apparrecchi prensili), which he divides into the borrage and the verbascum types (tipo borragineo, tipo verbascino). The former includes such flowers as *Dodecatheon*, *Cyclamen*, and *Solanum*, which the bees clasp in such a way as to receive the pollen upon the undersides of their bodies, and the latter contains flowers like *Verbascum* and *Tradescantia*, which are provided with hairs which afford a foot-hold.

Kerner (1) regards the reflexed petals as facilitating access to nectar and pollen, and this is true as regards the legitimate visitors. Intruders are much more effectually excluded than would be the case if the petals were less strongly reflexed, as in the flowers of *Erythronium.*[2] The approximation of the anthers in a compact cone also gives the flower a signal advantage over such a flower as *Ribes gracile*,[3] whose stamens being of the ordinary form permit the visits of a number of insects which the flower cannot utilize. The reflexed petals also render the nodding flowers much more conspicuous and attractive than they would be if the expanded petals faced the ground.

Loew (3) has figured and thoroughly described *Dodecatheon integrifolium* Michx. (=*D. Meadia* L.), *D. Jeffreyi* Moore (=*D. Meadia* var. *lancifolium* Gray), and an unnamed species from material growing in the Berlin Garden. To this I shall add an account of *D. Meadia* as observed under natural conditions in Illinois.. The plant is common in prairies and open woods, where it grows in rather large patches. The scapes rise from 3 to 6^{dm} and bear numerous, handsome flowers, which are white or rose color. The corolla has a short tube, which for

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[1] Contributions to an account of the ecological relations of the entomophilous flora and the anthophilous insect fauna of the neighborhood of Carlinville, Illinois.

[2] Bot. Gaz. **17**:69. 1892.

[3] Ibid., 270.

about 3^{mm} is united with a tube formed by the monadelphous filaments. After separating from the stamen tube it is bent upon itself, and its lobes are strongly reflexed. At the flexure it is strongly thickened and marked with dark reddish purple. This portion of the corolla forms a foot-hold for the bees to cling to while sucking. The tube formed by the united filaments is about 5^{mm} long. The anthers are very rigid and are so closely approximated that they form a cone from 8 to 10^{mm} long. Exteriorly the stamen-tube is yellow, but the base of each anther is swollen and marked with dark purple. This part also serves as a foot-hold and as a pathfinder. The stamen-tube with its cone of rigid anthers serves to conceal the nectar and to render it quite deep seated, for to reach the sweets the bees must force their proboscides between the anther tips.

The flowers are homogamous. Cross-pollination is secured by the stigma being 2 or 3^{mm} in advance of the anthers and having its surface directed away from them. According to Loew (3) spontaneous self-pollination may occur when the corolla falls.

During the blooming season, April 24 to May 24, the plant is in competition more or less severe with the following flowers, which are also adapted to bumblebees, no mention being made of those whose seasons overlap for only a short time with the first or last part of the season of *Dodecatheon:*

Delphinium tricorne, Geranium maculatum, Aesculus glabra, Astragalus Mexicanus, Baptisia leucophaea, Pyrus coronaria, Rubus villosus, R. Canadensis, Triosteum perfoliatum, Hydrophyllum Virginicum, Mertensia Virginica, Pentstemon pubescens, Monarda Bradburiana, Orchis spectabilis, Uvularia grandiflora and the introduced Trifolium pratense, Robinia Pseudacacia and Nepeta Glechoma.

The phaenological position of *Dodecatheon* exposes its flowers to bumblebee females, the workers only beginning to appear as the blooming time expires. It coincides pretty nearly with the flight of *Anthophora ursina,* and later overlaps with the early part of the flight of *A. abrupta. Synhalonia speciosa* and *S. belfragei* and *Osmia bucephala* fly throughout the period. These are the only long-tongued bees which could be expected to visit the flowers in my neighborhood. May 2, 5 and 8 I saw the flowers visited by the following:

Hymenoptera—*Apidæ:* (1) Bombus americanorum F. ♀, s., ab.; (2) Anthophora ursina Cr. ♀, s. and c. p.; (3) Synhalonia speciosa Cr. ♂, s., *Andrenidæ:* (4) Augochlora pura Say ♀, c. p., one.

Lepidoptera—*Rhopalocera:* (5) Colias philodice Gdt., s.

On the literature of *Dodecatheon* see:—

(1) Kerner, Die Schutzmittel des Pollens gegen die Nachtheile vorzeitiger Dislocation und gegen die Nachtheile vorzeitiger Befruchtung 38. 1873. Sep. a. d. Berichten des naturw. med. Vereines zu Innsbruck 2 and 3:—.1872.—(2) Delpino, Ulteriori osservazioni sulla dicogamia nel regno vegetale Pt. 2. fasc. 2: 295. 1875. Estratto dagli Atti della Soc. Ital. delle Sci. Nat. in Milano 16 and 17:—.1873–1874.—(3) Loew, Blüthenbiologische Beiträge I, 17–21. Sep. aus Pringsheim's Jahrbucher 22:—.1891. (Abstract in Just's Bot. Jahresbericht 19[1]: 416.)

STEIRONEMA CILIATUM Raf.—The observations which have been recorded seem to show that the adaptation for cross-pollination in *Lysimachia* and *Steironema* consists in the stigma being so far advanced above the anthers that self-pollination never or rarely occurs, as in Müller's large form of *L. vulgaris* (3, 16), or from proterogyny, as in *L. thyrsiflora* (Warming 10 and MacLeod 24) and in our *S. lanceolatum, longifolium* (23) and *ciliatum*. A less conspicuous form of *L. vulgaris*, which grows in situations unfavorable for insect visits is regularly self-fertile. Other species are homogamous and self-pollinating, as *L. nummularia* (Warming 10) and *nemorum* (Kerner 22).

According to Bonnier (11) in *L. vulgaris* nectar is secreted by the ovary and escapes through stomata in the epidermis, but in most cases it is wanting, or exists in quantity imperceptible by ordinary means, though the visits of male bees seem to indicate its presence (3, 16, 23). The part played by the papillæ in the attraction of insects (Kerner 22) is even more doubtful. I have seen no evidence of this in our species. The pollen is by far the most important, for by attracting the females of *Macropis* it has given rise to an interesting case of mutual economic correlation. Our species of *Steironema* (23) and the European *L. vulgaris* (3, 16, 24, 27) and *punctata* (4) are visited almost exclusively by bees of this

[4] As a substitute for a more extended review it is proposed to give an index to the literature of each genus, arranged chronologically, and it is hoped that the index will contain at least the principal references. Use has been made of the Bibliography compiled by D'Arcy W. Thompson, published in the translation of Müller's Befruchtung der Blumen, and giving the titles of books, etc. published up to 1883; of MacLeod's continuation of Thompson's list for the period 1883-1889, Bot. Jaarboek, 1890; of the abstracts by Müller and Dalla Torre in Just's Bot. Jahresbericht and those of Ludwig and others in the Bot. Centralblatt. I am under obligations to Prof. Wm. Trelease for access to the literature contained in the library of the Missouri Botanical Garden.

Abstracts are not cited unless they contain information on the genus being indexed. Information about contents of papers, etc., when given in the text, is not repeated in the index.

genus. I have mentioned (23) the flowers on which species of *Macropis* have been observed. Patton (12) states that Dufour found both sexes of *M. labiata* on flowers of *Alisma plantago*, and Schenk one or both on *Bryonia*, *Rubus caesius*, *Cirsium arvense* and *Picris*, but no one has seen a female *Macropis* collecting pollen of any flower except *Lysimachia* and *Steironema*.

Steironema ciliatum agrees in all essential particulars with *S. lanceolatum* (23). It grows taller and has larger flowers. In Connecticut Patton (13) saw the flowers visited by *Macropis ciliata* Pttn. ♀ and by *M. patellata* Pttn. ♂. In Illinois I have seen them visited by *M. steironematis* Rob. ♂♀, the female collecting pollen. The latter bee does not seem to have a decided preference for yellow, for all of the other flowers I have taken it on are white (23).

On the literature of *Lysimachia and Steironema* see:—

(1) Sprengel, Das entdeckte Geheimniss der Natur im Bau und in der Befruchtung der Blumen. 1793. *L. quadrifolia* and *vulgaris*, 104. —(2) Kerner, Die Schutzmittel des Pollens 27. 1873.—(3) Müller, Befruchtung der Blumen durch Insekten. 1873. *L. vulgaris* and *nummularia*, 348–9.—(4) Delpino, Ulteriori osservazioni nel sulla dicogamia regno vegetale Pt. 2. fasc: 1: 212, 321. Estr. dagli Atti della Soc. Ital. d. Sci. Nat. 17:—.1874. Visits of *Macropis* to *L. vulgaris* and *punctata* observed by Piccioli, Müller and Delpino in Westfalia, at Firenze and Vallombrosa.—(5) Lubbock, British wild flowers considered in relation to insects. 1875. *L. vulgaris*, visits of *Macropis*, 21; Müller's two forms, 126.—(6) Darwin, The variation of animals and plants under domestication 2: 154. 1876. 2d edit. *L. nummularia*, sterility.—(7) Darwin, The different forms of flowers on plants of the same species. 1877. *L. vulgaris*, Müller's two forms, 4, 342.—(8) Müller, Das Variiren der Grösse gefärbter Blüthenhüllen und sein Einfluss auf die Naturzüchtung der Blumen. Kosmos 2: 11–25, 128–139. 1877. *L. vulgaris*. (Abstract in Just's Bot. Jahresbericht 5¹: 740.)—(9) Henslow, On the self-fertilization of plants. Trans. Linn. Soc. II. Bot. 1: 328, 377. *L. vulgaris*, Müller's two forms. 1877.—(10) Warming, Smaa biologiske og morfologiske bidrag. Bot. Tidsskrift III. 2: 108–130. 1877. (Just's Bot. Jahresbericht 5¹: 745–6.)—(11) Bonnier, Les Nectaires. Extrait des Ann. des Sci. Nat. Bot. VI. 8: 140. 1879. (Just's Bot. Jahresbericht 7¹: 120.)—(12) Patton, Observations on the genus Macropis. Am. Journ. Sci. and Arts. III. 18: 211–14. 1879. *L. vulgaris* and *S. ciliatum*. (Just's Bot. Jahresbericht 7¹: 145.)—(13) Patton, Description of the species of Macropis. Ent. Monthly Magazine 17: 32–33. 1880.—(14) Dufour, Existence de tensions chez certaines fleurs. Etude d'anatomie et de physiologie végétales, dessertation inaugurale, 42–46. 1882. (Just's Bot. Jahresbericht 9¹: 500.)—(15) Müller, Weitere Beobachtungen über Befruchtung der Blumen durch-Insecten 3: 65. 1882. Scp. aus dem Verh. des naturhist. Ver. der. preuss. Rheinl. u. Westf. *L. vulgaris*, visitors.—(16) Müller, The fertilization of flowers

389–390. 1883. *L. vulgaris*, pollination, *L. nummularia* and *thyrsiflora*, ref. (6) and (10).—(17) MacLeod, Untersuchungen über die Befruchtung einiger phanerogamen Pflanzen der Belgischen Flora. Bot. Centralblatt **23**: 366. 1885. *L. vulgaris*, autogamy. (Just's Bot. Jahresbericht **13**¹: 740.)—(18) MacLeod, Nouvelles recherches sur la fertilisation de quelques plantes phanérogames. Arch. de Biol. **7**: 156. 1886. *L. vulgaris*.—(19) Kirchner, Neue Beobachtungen über die Bestäubungseinrichtungen einheimischer Pflanzen. Progr. des 68 Jahresfeier der kgl. Württemb. landwirtsch. Akademie Hohenheim. 1886. *L. nemorum*, no nectar. (Just's Bot. Jahresbericht **14**¹: 791.)—(20) Jordan, Die Stellung der Honigbehälter und die Befruchtungswerkzeuge in den Blumen 51. Sep. aus Flora **69**: 1886. *L. punctata*, nectar receptacles of doubtful occurrence.—(21) Halsted, Observations upon pollen measurements. Bull. Torr. Bot. Club **16**: 135. 1889. *S. lanceolatum*, (Just's Bot. Jahresbericht **17**¹: 523.)—(22) Kerner, Pflanzenleben. **2**:—. 1891. (Just's Bot. Jahresbericht **17**¹: 528. **18**: 484.) *L. ciliata* Protection of pollen by nodding of fls., 118. *L. thyrsiflora*, *ciliata*, attraction by papillæ, 166. *L. nemorum*, spontaneous self-pollination, 338. *L. nummularia*, 398.—(23) Robertson, Flowers and insects. X. Bot. Gaz. 18 47–48. 1893. *S. lanceolatum*, *longifolium*, *ciliatum*, *L. quadrifolia*, *vulgaris*, *nemorum*, *nummularia*. (Bot. Centralblatt **55**: 101.)—(24) MacLeod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek **5**: 443–444. 1893. *L. vulgaris*, *nemorum*, *nummularia*, *thyrsiflora*. (Bot. Centralblatt **56**: 177.) —(25) Knuth, Blumen und Insekten auf den Nordfriesischen Inseln 120. 1894. *L. vulgaris*, autogamous form on Sylt.—(26) Loew, Blütenbiologische Floristik des mittleren und nördlichen Europa sowie Grönlands. 1894. *L. vulgaris*, 161. *L. nummularia*, *nemorum*, *thyrsiflora*, *ciliata*, 319.—(27) Knuth, Weitere Beobactungen über Blumen und Insecten auf den Nordfriesischen Inseln. Schr. d. Nat. V. f. Schleswig-Holstein **10**: 229, 239. 1895? Correlated presence or absence of *Macropis* and *Lysimachia* on certain islands, etc.

ENSLENIA ALBIDA Nutt.—The plants are common on creek-banks, often climbing high, and blooming from July 12th to August 22. The flowers are white and are arranged in small umbel-like clusters. The petals are erect, and their tips are bent aside, out of the way of the passage leading to the nectar. The divisions of the crown are petal-like and erect, the central portion being produced above into two long appendages. On each side there is a wing-like portion which is grooved on the inner face, where the nectar is secreted and lodged. Each wing-like part, with the one of the next division forms a more or less well defined passage, which guides the bee's proboscis to the nectar. This is situated so near the angles of the wings of the approximated anthers that, when the proboscis is withdrawn, some slender appendage is quite likely to be caught between the divergent angles of the anther wings and guided by them into the cleft of the little black corpusculum which lies at the top of the slit. The gynostegium is quite slender and is tipped by five white appendages. These, with the ten flexuous tips of the crown divisions and the five erect petals, give the flower a soft, white appearance and conceal the complicated mechanism within, while they also render a little more evident the passage which leads to the nectar.

When a corpusculum with its pair of pollinia is withdrawn, it shows an unusually short retinaculum, which from its attachment to the corpusculum curves outward and a little downward and is inserted a little below the apex of the pollinium. The apex of the pollinium thus forms a very conspicuous knee, which stands at right angles to the axis of the corpusculum, and this knee is the part which is caught by the anther wings and thus causes the insertion of the pollinium. I find no evidence whatever that the original appendage to which the corpusculum becomes attached ever again enters the slit, or that the pollinia are introduced in pairs. When the pollinia are thoroughly dried, their planes are commonly perpendicular to each other, or they sometimes lie in nearly the same plane. The knees, therefore, project in different directions, and this increases the chances of one of the pollinia being inserted into the stigmatic chamber. There is nothing to render it probable that the bee's proboscis will be introduced in the same relative position, and so there is no advantage in both of the knees, or either of them, turning to the same side. In *Asclepias* and *Acerates*, in which the corpuscula are usually attached to short hairs on the legs, or other parts of the body, as in *Acerates longifolia*,[5] it is important that the knees should turn away from the part to which they are attached, for this is the only side on which they are likely to be caught by the anther wings. In large flowers, like *Asclepias Sullivantii*, in which the corpuscula are attached to the bee's claws, the bees commonly clasp the flowers so that the legs are guided upwards between the hoods. The movement of the knees which brings them near together results in turning them inwards, in which position they are more likely to be brought to the stigma. In *Enslenia* the corpuscula are attached so near to the end of the proboscis that there does not seem to be any advantage in turning in any particular direction, though they are slightly turned towards the side on which the corpusculum is attached.

Müller and Corry erroneously supposed that the movement

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[5] Bot. Gaz. **12:** 245. 1887.

of the pollinia of *Asclepias*, which approximates them, is intended to facilitate the introduction of both pollinia into the same stigmatic chamber. In *Cynanchum vincetoxicum*,[6] whose mechanism in a general way resembles that of *Enslenia*, Müller states that the retinacula bend so that the pollinia come close together. The flowers are adapted to carrion flies, Muscidæ, Sarcophagidæ, etc., and I suspect that the movement is merely to turn the knees away from the proboscis. Müller's account of the pollination of *Cynanchum* seems to me to be just as erroneous as that of *Asclepias Cornuti*. In the normal pollination of any asclepiad I doubt if it can be shown either that the part to which the corpusculum is attached is again caught by the wings, that the corpusculum ever enters the slit, or that both pollinia together are ever introduced into the same stigmatic chamber.

The flowers of *Enslenia* are visited principally by bees of the genus *Halictus*. These insects readily remove the corpuscula, which are found attached to the palpi, the tips of the laminæ, or other fine divisions of the proboscis. *Myzine sexcincta* was abundant on the flowers, but I could find no examples bearing corpuscula. The following list was taken on July 14th, 20th, and August 22d; the insects bearing corpuscula are indicated by !

Hymenoptera—*Andrenidæ:* (1) Prosopis pygmaea Cr. ♂; (2) P. modestus Say ♀, !; (3) Halictus confusus Sm. ♂♀, ab., !; (4) H. zephyrus Sm. ♂♀, ab., !; (5) H. stultus Cr. ♂♀, ab., !; (6) H. tegularis Rob. ♂♀, !; (7) H. cephalicus Rob. ♀; (8) H. platyparius Rob. ♀; (9) Augochlora viridula Sm. ♂♀; *Eumenidæ:* (10) Odynerus sp.; *Scoliidæ:* (11) Myzine sexcincta F., ab.

Diptera—*Empidæ:* (12) Empis clausa Rob. MS; *Bombylidæ:* (13) Anthrax fulvohirta Wd., !

Carlinville, Ills.

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[6] Müller, Alpenblumen, 350. Fertilization of Flowers, 401.

Noteworthy anatomical and physiological researches.

Anatomy of Vellozieae.[1]

The *Vellozieae*, a tribe of *Amaryllidaceae*, are known from South America and Africa, but have their largest distribution in Brazil. Only two genera, *Vellozia* and *Barbacenia*, constitute the tribe, and these are all perennial, with erect stems, branching dichotomously. The leaves are long, erect and linear, more or less carinate, are provided with large sheaths, and form fascicles at the upper part of the branches. The height of certain species averages two meters. The most characteristic feature, however, is the thick coating of roots in *Vellozia*, which develop from the stem and proceed within the leaf-sheaths towards the ground. The roots are thus only visible at the base of the trunk, when the old sheaths have faded away.

A transverse section of the trunk of *Vellozia* is round and shows a few relatively thin and triangular branches, surrounded by a huge mass of roots. The anatomical structure of these roots is identical with that of a normal monocotyledonous root, but the vessels are often filled with a brown or yellow substance, probably a kind of resin, especially abundant in *Vellozia*. The central part of the root is occupied by a heavy layer of exceedingly thick walled stereome. The endodermis is thin walled, sometimes starch bearing. The inner bark has an open, loose structure, and is surrounded by the outer bark, which is here composed of a cylindric layer of stereomatic tissue.

Outside these tissues is a hypoderm of a single stratum of thin-walled cells and finally the epidermis, which sometimes develops root-hairs. The hypoderm is stained blue by iodine and sulphuric acid.

The peculiar feature of the roots extending along the stem within the leaf-sheaths seems to be common in the genus *Vellozia*, but is as yet unknown in *Barbacenia*. The function of this fibrous coat of roots seems to be to gather moisture from fogs and rains. This explanation is the more evidently correct when we consider the localities in which the

[1] WARMING, Eug. Note sur la biologie et l'anatomie de la feuille des Vellosiacées. (Extrait du Bull. l'Acad. roy. d. Sc. Copenhague 1893).

plants grow. They are largely inhabitants of stony, sunny places with but little earth for the penetration of their roots. They are, therefore, protected against excessive drought by a fibrous coating, consisting not only of the roots but also of the remaining fibers of the leaf-sheaths. The author has observed that this fibrous coat absorbs water very rapidly and in large quantities. It is also probable that the erect and more or less carinate leaves serve the same purpose, viz., for a centripetal absorption of water. The stem is thus protected against excessive evaporation rather than against the frequent fires of the campos.

The structure of the leaf shows several peculiarities. The author has studied this especially from sections of the median portion of the blade, since it was observed that there exist certain differences between the structure of the basal and the median portion of the same blade. *Vellozia compacta*, for instance, shows at the leaf-base a tissue which reminds one very much of the thin-walled, transparent tissue so characteristic of Gramineæ, Cyperaceæ, Juncaceæ, etc., while this tissue was not observed higher up on the same leaf.

The subepidermal tissue of the blade shows above the carene a development corresponding to the bulliform cells described by Duval Jouve for several monocotyledonous families. These cells have undoubtedly the same mechanical function in the Vellozieæ as in those families, serving for involution of the blade in a dry atmosphere. The stomata are arranged in longitudinal rows. *Vellozia* has a distinct palisade-tissue, which is almost lacking in *Barbacenia*, and the structure thus becomes nearly isolateral. In the genus *Barbacenia* certain cells of the mesophyll were observed to contain water. Similar water-storing cells were also observed in *Vellozia*, but in this case they belonged to the hypoderm.

There is a certain distinction between the development of the various tissues of the leaf not only within these genera, but also within their species. These differences appear to the author to be of value in the anatomical characterization of the species of the tribe. THEO. HOLM.

Ombrophilous and ombrophobic organs of plants.[1]

Although this treatise on the adaptation of plants to extreme amounts of rain is only preliminary, it nevertheless

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[1] J. WIESNER: Ueber ombrophile und ombrophobe Pflanzenorgane. Sitzungsberichte d. kais. Akad. d. Wissensch. Wien. **102:** —. 1893.

contains results of great interest and valuable suggestions for further investigations. It was a problem the author undertook to investigate in the moist climate of Java, but in order to prepare himself for this, he made some experiments in Austria and the results are recorded in the present paper. The relation between leaf-shape and rain-fall in tropical regions, where moisture and heat prevail, has already been studied by Stahl, Jungner and others. But the direct mechanical effect of rain upon the plants and the power of resistance possessed by them against this factor has so far not been taken into consideration.

It is well-known to cultivators that many plants are only able to thrive when they obtain a certain amount of water, and that several species die if they get too much. The full-grown leaves of the potato-plant decay and young leaves on autumnal shoots of certain trees are destroyed, when exposed to excessive rain-fall. We know, however, from amphibious plants, that there is a great difference in regard to the ability of plants to withstand the effects of water. We have, also, learned by water-cultures that the roots of terrestrial plants thrive in water, while the aerial parts of these same plants die when they become submersed. In order to test this varying power of resistance against water, the author made the following experiments:

Shoots cut from various plants were placed upon a sieve and continuously sprinkled with artificial rain day and night, the temperature of the water being between 16 and 20° C. The power of resistance of these plants was shown by this experiment to be very different. The shoots of Solanum tuberosum decayed within a few days, while those of Lysimachia Nummularia and Tradescantia zebrina kept fresh for four weeks, and some hot-house Selaginellæ were healthy even after an exposure to eight weeks steady rain. It was observed during the same experiment that the youngest leaves decayed first and then the oldest, while those which were in their greatest vigor were the last ones to decay. Solanum tuberosum was an exception, the very youngest leaves showing the greatest power of resistance. A similar result was obtained by submersing shoots in basins where a constant current of water was flowing. Shoots of the same plants died much sooner if they were submersed in stagnant water. There was also observed to be a great difference in regard to the time of decay, when the experiments were made in daylight and in a dark room. The decay set in much earlier in the dark, evidently due to the fact that many bacteria are arrested in their development and propagation when exposed to light.

It appears from these experiments that the best way to form a correct judgment regarding the resistance of plant-organs against the influence of water is to keep them in stagnant water. In these experiments the full-grown leaves were the first to lose their turgescence. They became soft and soon decayed. Fresh shoots of Lysimachia Nummularia were placed in the decayed liquid resulting from this experiment, and they kept fresh for fourteen days. Pieces of marchantia thallus lived about eight days.

Another kind of experiment was made with potted plants. These were exposed to continuous rain, but in such a way that the water was prevented from saturating the earth. A plant of Phaseolus multiflorus, 80^{cm} in height, died entirely after thirty-two days, Tradescantia zebrina after forty-five, while T. guyanensis on the contrary was still healthy after sixty-two days.

The same was the case with Begonia magnifica and various hot-house Selaginellæ. These results show that various plants possess an unequal power of resistance against a continuous rain and the presence of water. The author believes himself justified in distinguishing two categories of plant-organs: the "ombrophilous," or such as love or rather tolerate the rain; the "ombrophobic," which dread the rain. These terms are, of course, only to be applied to organs above ground. The underground roots are evidently always hydrophilous, even in plants which have ombrophobic foliage, as for instance Impatiens noli-tangere.

We might now at the first glance think that these two categories of organs belong to plants which are limited to distinct localities, say to dry or moist places, and that the ombrophilous foliage should characterize the hygrophytes and the ombrophobic the xerophytes. But this conclusion is not a valid one since there are some plants whose foliage is ombrophobic, and yet which can not be considered as xerophytes, as for instance Solanum tuberosum. So too there are hygrophytes which are decidedly ombrophobic, like Impatiens noli-tangere.

Impatiens grows in moist and shaded places and requires a large supply of water for its existence. But the leaves of this plant do not get wet by rain, and it, therefore, obtains the necessary amount of water exclusively through the roots. In contrast to Impatiens is Sanicula Europæa from similar situations. This is decidedly ombrophilous, and the leaves become easily wetted by rain. This fact was also proved by submerging leaves of both plants in stagnant water, where those of Impatiens decayed in three days, and those of Sanicula only after eleven days.

The xerophytes are, according to the author's experience, often ombrophobic in a greater or less degree. It would appear that those with rather dry leaves do not withstand the effects of rain as those with thick succulent leaves, as for instance sempervivum and echeveria. The hygrophytes contain, as already mentioned, representatives with foliage of both categories, although the majority are very likely ombrophilous, but those with ombrophobic foliage are protected not only by the locality (shaded places) but also, and quite especially, by the waxy covering of their foliage.

The aquatics are hydrophilous as are also the underground roots, which are constantly exposed to the influence of water.

Another question arises as to the power of plants to resist the injurious effect of an excess of water, by which they might become thoroughly soaked. We have here to do with a mechanical and chemical power of resistance. The mechanical power may be in the "bloom" that covers the leaves of many plants, and which prevents them from being wetted unless exposed to an excessive rainfall. But those leaves that while easily wetted by rain are still able to preserve their vitality must possess a purely chemical power. The author believes this to consist in the presence of antiseptic substances. He has shown by experiments that ombrophilous shoots of Lysimachia Nummularia, Selaginella spp., begonia, tradescantia, etc., are able to keep fresh for a long time in a decayed liquid. He has, also, observed that the presence of such ombrophilous organs delays the decomposition of ombrophobic organs, when exposed together to a continuous shower of water. It would appear therefore that ombrophobic foliage is protected in a purely mechanical way, while the ombrophilous is protected by the presence of antiseptic substances.

THEO. HOLM.

. BRIEFER ARTICLES.

Relationship of Cæoma nitens and Puccinia Peckiana.—*Cæoma interstitiale* Schl., or as it is better known, *Cæoma nitens* Schw., has been regarded by different botanists as the probable æcidio-stage of several species of Uredineæ. Dr. Burrill was the first to suggest that it might be an earlier stage of *Puccinia Peckiana* Howe. It was from this suggestion that during the past three years a careful study of these two forms was made, the results being published in bulletin no. 29 of the Illinois Agricultural Experiment Station. Although not successful in a preliminary attempt to produce the Puccinia from the Caeoma by artificial infection, there was sufficient evidence gathered to conclude that the two were only stages of one fungus. After having written this bulletin, but before publication, an article by Tranzschel[1] was received, in which he gave an account of a successful experiment where he produced *Puccinia Peckiana* by sowing spores of *Cæoma nitens* on young shoots of *Rubus saxatilis.*

Last spring infetion experiments were again undertaken by myself with more satisfactory results. Early in the winter underground parts of *Rubus villosus* and *Rubus occidentalis* were removed from the University forest and placed in crocks in the greenhouse. These plants had not been affected the preceeding summer by either the Caeoma or the Puccinia. In the spring the plants started to grow fairly well, and are yet alive. On June 9th fresh spores of Caeoma nitens were placed on the young leaves of both a blackberry and a raspberry, and on June 14th two more raspberries and another blackberry were likewise treated. In each case spores from a corresponding plant were used, save in one of the latter raspberries where spores from a blackberry were used. Besides the foregoing plants several were kept free from spores to serve as checks. On July 26th, forty-seven days after sowing spores, mature sori of Puccinia Peckiana were found on one of the blackberries, and a few days later, on the other also. In Tranzschel's experiment but twenty-four days intervened between the sowing of spores and the finding of teleuto-sori. The infection while not abundant was quite apparent on several leaves. No sori appeared on the three test raspberries or on the checks. As raspberries are much better protected by hairs on the lower surface of their leaves, infection of such plants is no doubt much harder to accomplish than that of the blackberry. The time between sowing and apparent

[1] Hedwigia **32**: 257. 1893.

infection, six or seven weeks, coincides quite well with the time that elapses between the first appearance of the Caeoma and that of the Puccinia out of doors. As these experiments were carefully conducted there seems no doubt that these forms are related. Experiments producing the Caeoma from the Puccinia would be much more difficult, as infection in this case no doubt takes place through the very young basal shoots.

The connecting of these forms brings up an interesting point of nomenclature. In the bulletin referred to I accepted *Puccinia Peckiana* Howe as the name of the fungus, while Tranzschel re-named it *Puccinia interstitiale* (Schl.) Tranz. The question is merely whether the rule of priority shall apply to the very first name given or whether to the first name given to the mature form. The latter method seems to me the much more rational as it does away with needless confusion and increase of synonyms. As a matter of curiosity on this point, I submitted the data to five of the best botanists of this country, four of whom have favored me with their opinions. All stated that it was a mootable question, but one that should be settled. Two were inclined to believe that, as now interpreted, priority would be carried to the first name given to any stage, while two decided that the priority rule should apply to the first name given to the mature form.—G. P. CLINTON, *University of Illinois.*

Some field notes.—While searching for some fungi on *Ulmus Americana* leaves, two were found on a young tree which present a strange and interesting departure. The petiole, one-third of an inch above where it becomes a midrib, bifurcates so as to make an angle of about fifty degrees between the two subdivisions. Each of the subdivisions becomes a midrib to a leaf whose outer edge is normal, and the inner edge is also normal down to about an half or two-thirds of an inch above the bifurcation. Here the two leaflets join together, making a compound leaf.

In laboratory pressed specimens of *Viburnum acerifolium* a superficial observer will be mystified by apparent petioles that bifurcate and at each end of the bifurcations will be found a normal leaf. Careful observation will prove the apparently bifurcated petiole to be a stem with a terminal bud, and in the axil of last year's fallen leaf. The terminal bud is best made out from fruiting specimens.

In 1889 while botanizing in the mountains near Elliston, Montana, I passed a low specimen of *Acer glabrum*, whose appearance was such as to strike one as strange, and yet as *Acer glabrum* is the only Acer I had found in eight years of Montana work, I passed it by; after going several rods, its curious, indescribable appearance caused me to return and make a closer examination, when I was astonished to find its peculiar appearance was caused by *dissected* leaves! Every leaf on the whole shrub was dissected. I call it a shrub, for in the mountains, *Acer glabrum* is hardly worthy of any other name. The dissection was such as to make the compound leaf trifoliate palmate.

A young student in Oberlin college, a practical and intelligent farmer, has brought me two carrots which have grown together in a peculiar manner. The leaves were gone, but he testifies emphatically that both component parts are carrots. One is flesh color and the other white. They crossed each other near their tops, grew together at the point of intersection in such a manner that the red bottom had a white top, and the white bottom a red top. Longitudinal section showed that the vascular systems had also grafted into each other so that the chief sustenance of the white top came from the red bottom, and *vice versa.* The original connections of red to red, and white to white were kept up, but in an evidently great reduction. The outer appearance was like Siamese twins, but the longitudinal section showed it to be a case of grafting and adoption.—F. D. KELSEY, *Oberlin College, Oberlin, O.*

EDITORIAL.

IT IS REALLY a serious question how properly to make that combination known as a "biological course," a course which is becoming more and more common as an introduction to both botany and zoology. We might as well state in the outset that we do not believe in it, any more than in a common introductory course for chemistry and physics, but this has nothing to do with the present writing. Having a prevalent custom, however, the question is how to make the best of it. In the first place, we decidedly object to the continued appearance of combination laboratory guides prepared by zoologists. If botanists had the temerity to produce such books we should make the same objection. The very best of these "biological guides" lies before us, a book admirable in its spirit and in its presentation of late views, but a botanist must be well trained to keep from losing his way in the midst of the zoological terminology and atmosphere; and when the phanerogams are reached, the book breaks down entirely, and the *denouèment* of the botanical story is omitted. While it may be very desirable to have a uniform terminology for plant and animal morphology, the fact remains that we do not yet possess it, and such "combination guides" introduce students to botanical literature with an uncertain and confused terminology, to say nothing of a dubious morphology. When at the last meeting of the "American Morphological Society," which, by the way, means animal morphologists, one of its most distinguished representatives presented a paper on a "Fundamental difference between animals and plants," which consisted in the fact that "animals feed typically upon solids, and plants always procure their food in a gaseous or liquid form," the idea is emphasized that there is need of a botanist when plants are being discussed.

In the second place, even if the book which treats of zoological botany be discarded, we also object to such a course being conducted by a zoologist. We should make the same objection were botanists inclined to undertake it. Any laboratory guide is useful to the student only in so far as the author has been over the ground himself and has kept abreast with the advance in knowledge. If botanical researches to-day were dealing only with the etceteras of botanical doctrine, it might be true that a zoologist could take time enough to make himself sufficiently proficient to present the fundamentals of botany. But the fact is that the researches of to-day are attacking the foundations, and the very body of botanical doctrine is being rapidly modified.

CURRENT LITERATURE.

A life of Rafinesque.

The Filson Club of Louisville has published in sumptuous form[1] an account of the life and writings of Rafinesque, prepared by Dr. R. Ellsworth Call. This Club is devoted to the history of Kentucky, and its interest in Rafinesque arises from the fact that he was the first "resident professor-naturalist" in the state. Dr. Call is a student of our fresh-water shells, especially the *Unionidæ*, and the devious trail of synonymy led him into the papers of Rafinesque, with the publication of the present memoir as a result. The figure presented to us has always been a picturesque one in the annals of American science, whose work and character have always been a puzzle, possibly because too little is known of either. The BOTANICAL GAZETTE (8: 149) once published a sketch of him, in a series of early botanists, but it was merely a compilation of current opinions, and while recognizing his ability did scant justice to his work and spirit. Dr. Call has done well with the material at his command, and seems to have spared no pains in collecting and verifying it. The current notion as to the personality of Rafinesque has been largely drawn, doubtless, from the caricature for which Audubon was responsible. We are very glad to have this corrected by letters, published here for the first time, of persons who had personal relations with Rafinesque as students or friends. He stands forth as eccentric in every testimony, but not as the bedraggled figure in yellow nankeen, with neglected hair and beard, that has been our only description. "Small and slender, with delicate and refined hands and small feet; good features and handsome dark eyes, with long hair, dark and silky; going into society, and a good dancer," is the description of one who knew him while a professor at Transylvania University, Lexington, Ky. Other descriptions accord with this, and add touches which go to show that Rafinesque, although a very absorbed and absent-minded man, was a gentleman in appearance and deportment.

The explanation of his wide and restless roving through almost every department of human activity, culminating as it did in the monomania of his later years, is offered in his early lack of any master to guide him and to direct his impetuous genius into habits of concen-

[1] CALL, RICHARD ELLSWORTH.—The life and writings of Rafinesque: Filson Club Publications No. 10. 4to pp. 227, with two portraits and certain reproduced pages. John P. Morton & Co., Louisville, Ky. 1895. $2.50.

tration, and in his many misfortunes. With no training, no contact with scientific men, and a mind wonderfully self-opinionated, his career is not to be wondered at. He surely was the personification of honesty, and the scientific blunders into which he was led were due either to his implicit confidence in the representations of others, or his exaggerated notions as to the importance of minor variations. When one looks at the bibliography that has been so carefully worked out by Dr. Call, and sees no less than 420 titles, he wonders at the prodigious activity that was possible under so many disadvantages. Opinions as to the value of Rafinesque's work will always differ, but he is none the less a most interesting figure, and, with all his excursions into other fields, was first and foremost a botanist.

Minor Notices.

CONTRIBUTION No. 9, from the U. S. National Herbarium, completes the first volume of this series, and is a report by the assistant botanist, Dr. J. N. Rose, upon a collection of plants made in Sonora and Colima in 1890 and 1891, by Dr. Edward Palmer. The report has been long delayed in publication, and it shows what was expected from such a region as Mexico, and such a collector as Dr. Palmer. As the collections of Pringle, Palmer and others increase in number we begin to appreciate the vast and varied flora which lies just to the south of us, a flora which we will presently have to include in our North American treatises. In the present instance Dr. Rose has wisely sought the aid of recent specialists in various more critical groups. In addition to some very useful illustrations printed in the text, such as leaves, pods, etc., there are twelve Meisel plates, besides the frontispiece. Seventy new species are described, but many other numbers are described without names, a practice which has no advantage and serves to make trouble in reference lists. One must keep track of these described and unnamed forms, but there is nothing by which to distinguish them and they are easily lost sight of. The report is a valuable contribution to our knowledge of the Mexican flora, and contains no less than sixty additions to Hemsley's list, besides the seventy new species.

A CONTRIBUTION to our literature of Arctic plants has just been distributed as a separate from Engler's Bot. Jahrb. **19**: 4. 1894. It consists of two papers by Dr. F. Kurtz, one dealing with the flora of the Chilcat region in S. E. Alaska, the other with the region of the "Tchuktchies," a people inhabiting the easternmost peninsula of Siberia opposite Alaska. The collections were made by the Krause brothers in 1882, upon an expedition made under the auspices of the Bremen Geographical Society. The paper contains a description of the regions, and discusses zones of vegetation, trees and shrubs, food-giving plants, introduced species, and local plant names. The lists of plants are full, and evidently fairly representative, accompanied by critical notes. To the American botanist it would be evident at once that Dr. Kurtz has not had access to the more recent monographs published in this country.

A NEAT SOUVENIR[1] of a botanizing trip in the vicinity of Black Barren Mineral Springs, Lancaster co., Pa., has been issued primarily for distribution among friends of the writer. Only the common flowers are mentioned, and their mostly prosaic names rather detract than add to the slight poetical effulgence of the measured lines and rhymes. As a souvenir it is neat and attractive; as poetry it does not strongly impress the unbiased reader.

THE EXCELLENT SERIES of illustrated articles by Dr. W. G. Farlow in *Garden and Forest*, under the heading: "Notes for mushroom-eaters," have been republished in pamphlet form. It makes a convenient popular account of the best and most common edible fungi.

A HANDY ANALYTICAL KEY to the suborders, families and genera of N. A. Pyrenomycetes, recently distributed by Mr. J. B. Ellis, furnishes a much needed assistance in using Ellis and Everhart's work on these plants.

THE PAPER on electricity in plant-growing, by Prof. L. H. Bailey, read before the Massachusetts Horticultural Society, has been distributed as a separate pamphlet.

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[1]S. M. H. The golden rod and other flowers. 12mo. Geo. W. Richards & Co., Philadelphia, 1894. pp. 20. 25cts.

NOTES AND NEWS.

CAPTAIN JOHN DONNELL SMITH has gone to Europe, for an absence of three months, in connection with his work on the Central American flora.

DR. GEO. A. REX, the leading student of Myxomycetes in this country, died recently at his home in Philadelphia. We have received no particulars.

MR. M. S. BEBB has been compelled again to go to Florida to spend the winter on account of his health. He carries with him some "willow work" and also our best wishes.

THE CURRENT CATALOGUE of Harvard University reports the herbarium as containing more than 200,000 sheets, and the botanical library over 9,000 volumes and pamphlets.

DR. W. J. BEAL has published in full his "Sugar maples of Central Michigan," read at the A. A. A. S. last summer, in the annual report of the Mich. State Board of Agriculture, vol. 33.

IN THE *J. H. U. Circular* for January (14: 25) is an account of "some rare ferns found near Baltimore," by Mr. C. E. Waters, in which is described a new variety of *Equisetum arvense* L.

M. A. FRANCHET, in continuation of his studies of the plants of Western China, publishes in *Journal de Botanique* (Nov.) four more new species of *Saussurea*, and eighteen new species of *Senecio*, twelve of which are of the Cacalia group.

IN A RECENT PAPER (Proc. Amer. Acad. 1894: 396) on variability in the spores of *Uredo Polypodii* (Pers.) DC., Mr. B. M. Duggar shows that the thick walled and thin walled spores simply represent different stages of maturity, the latter being the immature form.

IN MR. J. W. TOUMEY's very interesting series of notes on the flora of the Chiricahua Mountains (Arizona), appearing in *Garden and Forest*, the second installment (Jan. 16) is accompanied by two beautiful photographic reproductions of Pinus Chihuahuana, and P. latifolia, standing in the midst of their native topography.

THE COMMITTEE of Section G, A. A. A. S. on Bibliography of American botany recommend that persons recording in a monograph or memoir a list of papers consulted repeat the author's name with each article listed, for the convenience of any who may wish to cut up the pages and make cards (either electros or prints).

PARTS 109 AND 110 of *Die natürlichen Pflanzenfamilien* are devoted to the Bignoniaceæ by K. Schumann, and the Mucorineæ, Entomophthorineæ, Hemiascineæ, Protoascineæ, Protodiscineæ, Helvellineæ, Pezizineæ, by J. Schröter. The rapidity with which this great work is appearing is a matter of congratulation to all botanists.

MR. MERRITT LYNDON FERNALD, of the Gray Herbarium, Cambridge, Mass., proposes to continue his distribution of Maine plants during the coming season. Sets will be collected to continue the series started in 1893. Collections will be made chiefly in central and southern Penobscot and Piscataquis counties, which contain hundreds of lakes, and the highest mountains of Maine.

AMONG VARIOUS notes upon *Labiatæ*, published in *Bull. l'Herb. Boissier* (Dec.), M. John Briquet describes some new forms of *Mentha*. The great amount of variation of some of the species is shown by the fact that of the new forms described ten are varieties of *M. rotundifolia*, twenty-one of *M. longifolia*, nine of *M. arvensis*, six of *M. viridis*, five of *M. piperita*, and in the whole list of sixty-five new forms but eleven species are concerned.

USTILAGO MEDIANS is a new parasitic fungus occurring on barley, discovered by Herm. Biedenkopf in the neighborhood of Halle, Germany. In external characteristics, this species resembles *U. Hordei*, between which and *U. Jensenii* it occupies an intermediate position. A partial description of this fungus appears in Zeitschrift für Pflanzenkrankheiten 4: 321. 1894. A complete description will appear as soon as the species is thoroughly studied.—L. S. C.

IN THE December number of *Forstlichnaturwissenschaftliche Zeitschrift*, "Investigation of the morphology and anatomy of malformation upon shoots and leaves caused by the Exoasci," by W. G. Smith, is finished, and Dr. Robert Hartig has another paper on the investigations of wood entitled, "Investigations on the course of growth in oak in the Guttenberg and Grauschatz forests near Würzburg, and in the forest district Freising and Starnberg, near Munich."—L. S. C.

FASCICULUS I of a distribution of Russian fungi under the title *Jaczewski, Komarov, Tranzschel, Fungi Rossiæ Exsiccati* has just appeared. It contains 50 specimens with printed labels, mounted on quarto sheets, after the manner of Thuemen's Mycotheca. Among the Uredineæ are such interesting specimens as *Puccinia Fergussoni* Berk. et Br., *Puccinia Eremuri* W. Kom., *Puccinia Rosæ* Barclay, *Puccinia plicata* W. Kom., *Phragmidium devastator* Sorokin, *Phragmidium circumvallatum* P. Magnus.—E. W. D. H.

MR. M. C. COOKE publishes in *Gardeners' Chronicle* (Dec. 22) an account of blindness caused by eating the fruit of a Rhodomyrtus in Queensland (Australia). The fruit has the botanical reputation of being not unwholesome and Mr. Cooke discovers that the probable cause of this singular effect is the presence of a Gloeosporium, which he describes as new. As this genus attacks many fruits it will be of interest to follow up this suggestion.

In *Hedwigia* (33: 307–337. 1894) C. Warnstorf gives a complete descriptive synopsis of all North, Central and South American species of *Sphagnum*, with the geographical distribution of each. He recognizes 15 N. Am. species of §I. ACUTIFOLIA; 2 of §II. SQUARROSA; 10 of §III. CUSPIDATA; 1 of §IV. POLCLADA; 3 of §V. RIGIDA; 14 of §VI. SUBSECUNDA; and 7 of §VII. CYMYIFOLIA; 52 species in all. Twenty-five species are found in South America only (on this continent) and

7 in Central America. Only 5 species are known from Europe not found also in America.

MR. BRADLEY M. DAVIS, in *Annals of Botany* (Dec.), describes, with colored plate, a new and very interesting alga-like organism, to which he gives the generic name *Euglenopsis*, from a certain resemblance to Euglena. It was found in the salt marshes near Cambridge, Mass., clinging to marsh grass and other objects on or near the surface of the water. Although not readily apparent why this organism should be considered a plant rather than an animal, Mr. Davis remarks its close affinities to certain genera usually considered as plants, and so feels justified in presenting the paper to botanists.

THE CAMBRIDGE BOTANICAL SUPPLY COMPANY, 1284 Massachusetts Ave., Cambridge, Mass., wishes early correspondence with any who are interested in an edition of the Bibliography of American Botany on cards of their own choosing, any special size or kind; an edition by subjects; an edition from which cards may be selected on special topics. The Company is also considering a plan for searching botanical literature and reporting to subscribers references on any special topic. This would be of great service to those who live out of reach of great botanical libraries and we hope help of this kind may be made available.

AT A SPECIAL meeting of the Council of the A. A. A. S., held on January 26th, it was decided to postpone the proposed meeting in San Francisco. An invitation from Springfield, Mass., to hold the meeting of 1895 in that city, was accepted. The date of the meeting was fixed as follows: Council meeting, Wednesday, August 28th, at noon; general sessions, Thursday, August 29th, at 10 A. M. Special efforts will be made by the officers of the sections to prepare programs for the sections in advance of the meeting and for this purpose members are requested to send abstracts of their papers, as early as possible, to the Permanent Secretary, or to the Secretaries of the Sections.

BOTANY at the German universities is described by Dr. George J. Peirce in *Educational Review* (Jan.). The American college for general elementary training, and the German university for training as an investigator, seems to be the approved combination. "The logically related courses in botany at our best colleges furnish a better preparation for subsequent investigation than the unarranged courses at the German universities, but in Germany the professors are able, because they are not overburdened with elementary work, to give much attention to their own researches and to the investigators under them."

MACMILLAN & Co. announce a translation of the new Strasburger, Noll, Schenck, and Schimper *Lehrbuch der Botanik*. The completeness with which the whole subject of botanical study is treated and the reputation of the authors make the announcement of this book one of unusual importance. The illustrations, some 570 in number, have been made a special feature of the book, and by arrangement with the German publishers, Macmillan & Co. are enabled to offer illustrations of the same degree of excellence as those in the German edition. The translation will be made by Dr. A. C. Porter, assistant instructor in botany, University of Pennsylvania. Dr. Porter has been a student of Strasburger, and his long studies in Germany and personal acquaintance with all the authors of the book render him especially fitted for the work.

MR. D. M. MOTTIER has published in *Annals of Botany* (Dec.) an account of his study of the life history of Notothylas, N. orbicularis being the species used. His conclusions are: (1) the capsules possess a columella varying in size with that of the capsule; (2) the columella originates, as in Anthoceros, primarily in the young sporogonium with the archesporium, and independently of it, and consequently it is not a secondary differentiation within the spore-chamber; (3) the archegonium resembles more closely that of the eusporangiate ferns than does the archegonium of Anthoceros; (4) the antheridium arises from a hypodermal cell, a process occurring nowhere else in the whole group of bryophytes.

MESSRS. FRANK S. COLLINS, ISAAC HOLDEN, and W. A. SETCHELL announce the issue of a series of fascicles of North American algæ under the title *Phycotheca Boreali-Americana.* The fascicles will be in book form, containing fifty species each. Two fascicles will be issued this winter, of which the first has already appeared, and two or more a year will be distributed hereafter. The work will include all families of algæ, both fresh water and marine, except that no provision has yet been made for diatoms, desmids or charads; they may, however, be included later. In geographical range it will cover North America entire, from the Arctic Ocean to the Isthmus of Panama, and will include the West Indies. The edition is limited to eighty copies and subscriptions will be taken only for the series, which should find ready sale. All correspondence on the subject should be addressed to Frank S. Collins, 97 Dexter St., Malden, Mass., U. S. A.

THE *Bulletin Torr. Bot. Club* for January is devoted to taxonomy as follows: Mr. J. H. Barnhart presents an extended paper on "family nomenclature," in which the laws of priority that have been adopted for genera and species are applied, the uniform termination *aceæ* appended to the name of a recognized genus is urged, and certain limitations as to priority suggested, a list of the family names of phanerogams constructed in accordance with these suggestions being given, with full synonymy; Miss Anna Murray Vail gives a revision of the North American species of the genus *Cracca* (Tephrosia), fourteen in number, one of which is proposed as new; Mrs. Britton revises *Scouleria* and describes a new species (with plate); Mr. John K. Small continues his studies of the flora of the S. E. United States, describing three new species (Juncus, Monniera, and Coreopsis); and Mr. L. F. Henderson describes two new plants from Idaho (Phacelia and Claytonia).

PROFESSOR E. L. GREENE has given an interesting historical account of *Mimulus luteus* in the *Journal of Botany* (Jan.). It seems that the original M. luteus is a South American plant, and that it was unknown for a long time except through its description and figure. In the meantime a yellow Mimulus from North America came into notice, which by some botanists was regarded as identical with the South

American plant, by more as a distinct species, being described by De-Candolle as *M. guttatus.* In Bentham's revision of the order for the Prodromus, however, both forms were referred to M. luteus, and in the Synoptical Flora this same reference was retained by Dr. Gray, several other North American forms also being included in it, but which were set apart later in the Supplement as distinct. Professor Greene finds the North and South American plants sufficiently distinct, and also discovers that *M. Lansgdorfii* Don is the oldest name for the North American plant. The name M. luteus, therefore disappears from our flora, and M. Langsdorfii remains as the name of the somewhat polymorphous aggregate.

MR. J. C. WILLIS published his third paper on "gynodiœcism" in *Proc. Cambridge* (England) *Phil. Soc.*, Nov. 1893, a paper which has just come to our hands. His further experiments indicate that the strong tendency to gynodiœcism and gynomonœcism shown by many plants, notably the Labiatæ, seems to be a natural outcome of dichogamy, and has to do with differences of nutrition. He considers that diœcism in angiosperms is descended from hermaphroditism, and "that the sex of a seedling can to some extent be determined in advance by its conditions of nutrition." Androdiœcism is found to be very rare, and seems to be certainly due to lack of nourishment of the "male plant." Cleistogamy is found to be sporadic in some plants, constant in others, varying with all sorts of external conditions. It is noteworthy that cleistogamy does not usually occur in plants that are dichogamous, or in gynodiœcious genera (excepting Salvia). The experiments are very interesting, but it might be well to express the hope that in view of our present knowledge of morphology the constant use of sex terms in connection with sporophytic structures will be abandoned.

THE *Annals of Botany* for December might be styled an American number, as four of the six papers are by American botanists. The papers of Bradley M. Davis and D. M. Mottier are noticed elsewhere in this journal. In addition to these F. C. Newcombe writes concerning the cause and conditions of lysigenous cavity-formation, and V. M. Spalding on the traumatropic curvature of roots. Mr. Newcombe finds that the appearance of the cavity during primary growth or subsequently depends upon the retardation of extension in the tissues concerned relative to extension of more peripheral tissues; that the initial cavity-formation in primary growth is always schizogenous, and that there are always two factors concerned in cavity-formation, a schizogenous and a lysigenous; that cavity-formation during primary or secondary growth may occur in different individuals of the same species, dependent upon peripheral extension as stated above; and that the formation of a cavity during primary and secondary growth may be greatly deferred by preventing peripheral extension. Professor Spalding, in experimenting upon those phenomena following wounds to which the term traumatropism has been given, seeks to gain some definite information as to whether the phenomena are to be classed as mechanical or irritable movements. His conclusions are that the growing point of the root is sensitive, that induction follows irritation, and that traumatropic curvature is the result. All the facts in the case that have been recorded by other observers are shown to be consistent with this explanation.

THE DISENTANGLEMENT of *Quercus Texana* Buckley, by Dr. C. S. Sargent, is recorded in *Garden and Forest* (Dec. 26). Described first in the Mexican Boundary survey as a variety of *Q. coccinea*, then set apart as a species by Buckley, it was finally referred by Dr. Engelmann to *Q. rubra* as a variety, and then lost its identity completely in later writings as *Q. palustris*. At the same time a puzzling oak was known from near St. Louis and the Lower Wabash Valley, which seemed more nearly like *Q. palustris* than anything else. During a recent visit to the Lower Wabash Valley in connection with Dr. J. Schneck, Dr. Sargent recognized the form and then traced it on southwards into Texas. It seems, therefore, that *Q. Texana* is a very widely distributed oak, its range, as at present made out, extending from Minnesota, in the neighborhood of Minneapolis and St. Paul, southward through Iowa, Illinois, Indiana and Missouri, in which northern extension it is associated and confused with *Q. palustris*, and thence further southward to the Gulf, extending from Florida to Texas, and in this southern range all that has been called *Q. palustris* proves to be *Q. Texana*. In the absence of nuts the tree cannot well be distinguished from *Q. palustris*, but the nuts are more nearly those of *Q. rubra*. The bark and winter buds and leaves resemble those of *Q. coccinea*, but the leaves have the axillary tufts of hairs so characteristic of those of . *palustris*, a fact which doubtless explains the constant reference to that species. It would be well for botanists to look into the oaks of their vicinity and of their herbaria and see whether they do not recognize *Q. Texana*, chiefly masking as *Q. palustris*, and if so report at once to Dr. Sargent. The two plates in *Garden and Forest* will aid in ready recognition.

JUST AS THIS number is going to press we receive the sad announcement of the death on February 27th of Mr. John H. Redfield, the widely known curator of the Herbarium of the Philadelphia Academy of Sciences. Mr. Redfield was in his eightieth year. His remains were interred at Greenwood cemetery, Brooklyn.

BOTANICAL GAZETTE

APRIL, 1895.

Present problems in the anatomy, morphology, and biology of the Cactaceæ.

W. F. GANONG.

In this paper I purpose to discuss briefly the subject outlined by the above title, pointing out in particular those questions which can be settled only by study in the field, as well as those which require specially-collected field-material for their solution in the laboratory. The subject can be the more clearly understood and its importance the better judged if I give first a brief description of the anatomical, morphological, and biological characteristics of the family, and then add a short account of progress to our present state of knowledge.

The Cactaceæ form a sharply-defined, although phylogenetically very new, practically entirely American order, including some 1,000 usually badly-defined species grouped in some twenty worse-defined genera. Taken as a whole they exhibit a more extreme deviation from the normal in habits, and therefore in structure, than is to be found in any other large family of flowering plants; they offer in consequence many inviting problems, and as well an unusually favorable opportunity to test some of the great principles which are concerned with the nature of adaptation and the dynamics of development.

For the most part the Cactaceæ are dwellers in the desert and therefore economizers of water. To store water and to protect it from evaporating under the too-great power of the sun, requires a condensed form and this characteristic dominates throughout the order, showing its traces even in those species which have abandoned the desert habit. Containing often the only water-supply upon the desert, they are particularly liable to destruction by thirsting animals, and protection against them explains the presence of the nearly universal spines, the second marked characteristic of the order.

The roots, protected somewhat from the extreme conditions prevailing above ground, have not been found to show notable peculiarities. They often run very deep, are often tuberous for water-storage, are rarely aerial. But in the shoot the necessity for condensation, i. e., for surface reduction in proportion to bulk, has operated to lessen, even to the point of suppression, the branching and leaf-formation, has brought about very special form-conditions, probably unique relations of stem, leaf and axillary bud, and a very finely-adapted series of water-holding tissues.[1]

As to the tissues, it is enough here to say that the characteristic xerophilous appearances are a strong cuticle, thick epidermis, perfect cork, sunken stomata; collenchymatous hypoderma; deep palisade layers; great development of pith and cortex which consist of large round splendidly pitted water-storing cells, often containing mucilage; a fibro-vascular system in general simple in its make-up, lacking annual rings, composed as to its xylem part of strongly ringed and spiralled tracheids which are often collected into gland-like masses, the whole system conforming closely to the external form and following its morphological changes.

In external form, there is every variation from the leafy shrubby Peireskia to the ribbed columns of Cereus, the flat joints of the Platopuntiæ, the phyllocladia of Epiphyllum, or the tubercled spheres of Mamillaria, and everywhere are clusters of spines, in definite relation to which arise the flowers and new branches. How is this medley of structures to be brought into homology with the ordinary stem and leaf condition of other flowering plants? Happily these questions have been mostly solved. All Cactaceæ have leaves which show instead of the ordinary division into blade, petiole, etc., a division into blade and swollen base flattened to the stem.[2] The blade may persist for a season as in Peireskia, fall away early as is usual in Opuntia, remain very small as in Cereus, or microscopic as in Mamillaria. The axillary bud develops, not strictly in the axil, but upon the leaf-base, having been

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[1] I am in the agnostic stage on the subject of the nature of the development of adaptations, but I retain the teleological phraseology for its convenience. For the latter reason also I retain a distinction between anatomy, morphology, and biology, though I know they are not three branches of inquiry, but three phases of one, the first asking what a structure is, the second by what steps it has come to be what it is, and the third why it is what it is.

[2] A xerophilous characteristic, found also in Euphorbiaceæ and others.

forced to this position doubtless as a result of condensation of leaf-bases at the vegetative point. Leaf-base and axillary bud grow henceforth as one structure together and form the tubercle which attains its highest form in Mamillaria and Leuchtenbergia, and numbers of which merging together in vertical rows, sometimes with the cooperation of the stem added, form the ribs of the ribbed forms. Tubercle and rib physiologically replace the lost leaves, and varying in height and form allow of adaptive increase or decrease in spread of green surface, which is all in the xerophilously advantageous vertical direction. The spines are metamorphosed leaves, originating dorsiventrally on the sunken hair-protected axillary vegetative points, which may either be carried up entire by the growth of the tubercles and come to stand finally on their tips, as in Opuntia, Cereus, Echinopsis, Leuchtenbergia, etc., or they may split into two parts as in some divisions of Echinocactus and Mamillaria, one part going up on the tubercle and producing spines, the other remaining behind in or near the axil to produce a flower or a branch.[3] The flowers, produced rapidly during or at the close of the rainy season do not share the vicissitudes of the stem, and show no special adaptations to the dry climate. The ovary is deeply sunken in the flower-bearing stem, and the fruit, though often dry, is usually an edible berry, ensuring the best method of dispersal and conditions for germination in a dry climate. The seedlings are also succulent, with a spread of surface corresponding in a general way to that of the adult plants.

I have elsewhere traced briefly the steps by which this knowledge has been won.[4] The only work upon the comparative anatomy of the order is Schleiden's celebrated treatise of 1845,[5] which despite some errors peculiar to that time, clearly outlined the essential features of the subject. Von Mohl studied their bundle-systems, and many later students have gone to them for special points, all of which may be traced in the work of DeBary,[6] since which little of importance has appeared, for the golden age of anatomy is not in

[3] The full discussion of the points here outlined may be found in my paper, "Beiträge zur Kenntniss der Morphologie und Biologie der Cacteen" in Flora, Ergänzungsband, 1894.

[4] Flora, loc. cit.

[5] For titles, etc., see Flora, loc. cit.

[6] Comparative Anatomy of Phanerogams and Ferns.

these days. As to their morphology most systematists have given it some, though usually it has been scanty attention. De Candolle appears to have begun the attempt to determine the homologies of spine and tubercle and the other riddles of the group; various others, including Kauffmann, Vöchting, Schumann and Wetterwald, and above all Goebel, have debated point after point, and gradually won the truth. Finally I must be permitted to mention my own studies which in ground well prepared by my predecessors were made productive under the guidance of my teacher Goebel. It remains to mention the sources of our knowledge of their biology, and here we have but a single source to refer to, the groundwork for all future studies of this character, Goebel's discussion of their form, protection, and other conditions in his "Pflanzenbiologische Schilderungen."

So much for the characters of this attractive family and the pioneers in its study. What now remains for other explorers?

There is needed first and most important of all, an exact investigation into the meteorological and biological conditions under which the Cactaceæ live. An all the year round study of the amount and time of rainfall, dew-formation, dryness of the air, winds, extremes and means of day and night and seasonal temperature,[7] intensity and amount of light, the kinds and habits of enemies and of cross-pollinating and disseminating friends, the exact situations in which they grow and the nature of the soil, all these must be known about any given district before we can more than guess at the "adaptations" in the Cactaceæ which inhabit it. Excepting for some incidental study by Goebel in Venezuela and the work of Stahl in Mexico last summer, the results of which we have yet to learn, no trained biologist has worked upon them in the field.

Taking first the simpler problems, there are several in which additional evidence is to be expected. It has been clearly shown that the spines of the Cactaceæ are metamorphosed leaves, and not "emergences" as some have claimed. The evidence is drawn from the occurrence of normal transitional structures which are formed by the axillary vegetative points as they begin to sprout into branches, i. e., after they

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[7]The only data of this kind are those given by Coville (Contrib. Nat. Herb. **4**: 33-35. 1894), and these are scanty and for only one locality.

cease to form spines and before they begin to form leaves.[8] These transitions have been found in Opuntia and Echinopsis. Do they occur in other genera? Do they occur on the bases of flower-branches? Do any monstrosities, between leaf and spine, occur?

In the genus Opuntia and confined to it, in addition to the spines, occur the fine barbed bristles, produced on the inner side of the axillary vegetative point. Transitions between these and the spines are to be found on old sprouts of some Opuntias and the two are doubtless homologous. Are transitional forms elsewhere to be found?

The spines of many forms are white in color and weak in texture, even to becoming hair-like as in *Pilocereus senilis* and many others. The epidermal cells of such spines are usually provided with openings through which water may be seen under the microscope to be eagerly absorbed, the air causing the whiteness being expelled, but no trace of a tissue for conducting such water to the living parts has been found. Why do the epidermal cells absorb water? Is it conducted into the stem? The spines of Echinocactus species show a marked cross-banding, due to alternation of clearer and opaquer bands, the former being of larger diameter than the latter. The microscope shows that the cell-cavities in the darker bands contain air, while the clearer lack it. This seems to be an incidental growth condition. Upon what does it depend? What relation do the bands bear to the age of the spine? In the Cylindropuntiæ, each spine is commonly covered by a thin easily separable sheath. This has been found to consist morphologically of a layer of hairs grown together.[9] It cannot be necessary to protect the spine in its development, for others grow equally well without it. Is it of use or was it formerly of use? Is it a growth phenomenon? In some Mamillarias the epidermis of the spines extends out into hairs so that they become feather-like, and this is the common form for them in the seedlings throughout the family. Why are they of this form? Do they help to prevent evaporation?

Very little is known of the biology of the spines. It is assumed that the strong ones protect the plants against animals

[8]These may be found only when the branches are very young, indeed just as they first show signs of appearance, for the transitional leaf-spines wither and fall off very early.

[9]The discussion of this together with the other topics here mentioned may be found in my above cited paper in "Flora."

and that the bristles, easily separable, rankle in flesh the of an enemy and impress its memory with the dangerous character of that plant. But what purpose do the hooked ends of the spines so commonly found serve? Do they tear rather than prick an enemy? The spines show a great variety of arrangements; are these adaptive to the mode of attack of enemies? Very often there is a strong central spine pointing downwards, suggesting that it is to prevent a hoof from overturning the plant. In other cases, as in *Echinocactus hypacanthus* it points upward, suggesting that the plant may grow in hollows. In very many cases, as in Leuchtenbergia, species of Opuntia, and others, the spines become flat and papery and useless for protection. Of what use are they? In other cases they become flexible hairs. What useful end do they then serve? Is it possible that the strong protective spines occur upon the less extreme desert forms which live where large animals roam, and that these become hairs in the extreme deserts or elsewhere where enemies are rare and need for protection from loss of water is greater? In fact, do hairs and hair-like spines help materially to prevent such loss? Or may it not be that they reflect and refract the too intense rays of the sun and mitigate its force for the green tissues?[10] Can a line be drawn between the hair-like spines, and the morphologically very different multicellular hairs? In Peireskia, some of the spines serve as hooks for climbing. What other uses and forms of them are found? It is plain that Geddes' ebbing-vitality theory for the origin of spines does not apply in this vigorous group, nor is it likely that they are a direct result of dry climate as Lothelier would have us believe. Nowhere in nature is there a better place to test the dynamics of spine production than in this family.

In the genera Mamillaria, Cereus, Rhipsalis, and Opuntia, species[11] have been found which exude nectar in large clear drops from glands among the spines. These are particularly plain in *O. arborescens*. These glands have been proven to be spines more or less metamorphosed. Do they occur in other genera? The exudation takes place only while new parts are being formed. What is its use? Are ants attracted

[10] Or as Coville (op. cit.) suggests, they may permit too great radiation on the cold nights.

[11] A list of the known species is given in Flora, loc. cit. Nearly every species of Opuntia I have examined, eighteen in all, showed this nectar secretion.

by it which protect the young growing parts against some creeping tissue-eating enemy?

The spines are believed to originate always strictly dorsiventrally from the vegetative point, thus agreeing with one method of production of leaves. This has been proven only for *Opuntia arborescens*. It is desirable to investigate this point in other species and genera. In Peireskia however the spine-production is nearly radial; in Opuntia it becomes dorsiventral, the large spines being produced upon the outer or leaf side of the axillary vegetative point, and the bristles upon the inner or stem side. The dorsiventrality becomes still more marked in Cereus, etc., where nothing, or only some multicellular hairs, is produced upon the inner side; still more so in those species of Echinocactus where the point splits into two parts, and yet more in Mamillaria where it splits into two parts, which separate entirely. Is there any case in which the outer part of the point in Mamillaria produces its spines radially, or are they all laid down dorsiventrally? That a strong central spine closes the growth, as sometimes stated, is altogether improbable.

In *Peireskia aculeata* a very early splitting[12] of the axillary point has been found, one part remaining upon the leaf base, the other being carried up by the young stem in its growth, an exact reversal of the condition in Mamillaria where, after the splitting, one part remains in the axil and the other is carried out by the growing tubercle. Is this condition found in other species of Peireskia? The lower point normally produces the new branch, but when it is destroyed, the upper one does so. From the descriptions it seems as if the flowers are produced from the upper. Is this true? In *P. aculeata*, it is possible that the axillary bud does not at first stand upon the leaf base as in other genera, but in the axil in contact with both leaf and stem. Is this true? It is difficult to understand how otherwise a part of the axillary vegetative point could be carried up by growth of the stem. The transition from Peireskia to Opuntia is perfectly gradual and there can be no doubt that Peireskia is the nearest of all living Cactaceæ to the original stem-form. In *P. aculeata* and *P. bleo* a single large leaf often appears in the center of the spine mass. It seems impossible that this is formed in any other way than

[12] This splitting of the point so often referred to, is, I believe, unique in this family. It is not a branching nor a bifurcation, but a division into two parts by the going over of some of its central meristem into permanent tissue.

by the vegetative point forming it from a papilla homologous with those of the spines. If this be so, it is, as Goebel points out, additional evidence of the leaf-nature of the spines. Is it so? Are any intermediate forms between spines and leaf produced between the two, or is the transition sudden? Do these same axillary points, after producing the leaves, again produce spines? If so, the homology of the two would be clear. It is important to find a transition between the splitting points of Peireskia and the non-splitting point often carried up by the tubercle in Opuntia.

Epiphyllum shows phenomena in its flower and branch production which are best to be interpreted as due to a splitting of the axillary or the main points. Does this occur? In Rhipsalis a splitting of the axillary into several secondary points does take place. Splitting of the point is now known in Peireskia, Rhipsalis, Echinocactus, Mamillaria, Anhalonium. Does it occur in any other genera?

Leuchtenbergia principis is the most interesting species in the family. Its tubercles have become almost leaf-like, and its axillary points carried up upon their tips so that both spines (here papery) and flowers are produced there. This habit removes it from Mamillaria to that section of Echinocactus in which there is no splitting of the point, but the whole is carried up on the tubercle. Yet Leuchtenbergia is said to put out sprouts from the lower part of the stem. Whence do these come, from purely adventitious bud-formation, or in reality is there a very early splitting of the point, the axillary part remaining a long time latent? The latter is very improbable, but if it occurs it would restore Leuchtenbergia to relationship with Mamillaria. Are the tubercles shed like leaves? The development of this plant is unknown, and will give interesting results.

The tubercles seem generally to act as assimilating organs, and their spread of green surface is readily controlled in amount by varying their height. In Opuntia, as Goebel has lately proven,[13] the production of the tubercle is intimately dependent upon light, not forming at all upon sprouts grown in darkness. He has also shown elsewhere[14] that when the tubercles are protected by a cephalium as in Cephalocereus, and in lesser degree in Melocactus, the union of leaf and ax-

[13] Flora **80:** 96–116. 1895.
[14] Pflanzenbiologische Schilderungen 92, 93.

illary sprout is less extreme than in those which are exposed, but it is a question to just what this is due. Can other cases be found in which tubercles are partially protected or darkened, and what is then their behavior? In flat Rhipsalis species, and some Echinocacti, the backs of the tubercles grow out into papillæ or into wings increasing the spread of surface. In *Cereus rostratus*, these wings are bent backward so that they form hooks enabling the plant to climb, and *C. McDonaldiæ* shows an intermediate condition. Do the tubercles, or the wings from them, serve any other purposes in the family?

In some Echinocacti and Mamillariæ, a deep hair-filled groove unites the spine-bearing and the flower-bearing parts of the split axillary point. This groove is simply the greatly drawn-out sunken area in which the vegetative point is always protected. In the highest *Mamillariæ* however this groove is absent, which is because the splitting of the point occurs before the sunken area, or rather its raised walls, are formed, and each part of the point forms its own wall. *M. macrothele* seems to form an intermediate condition, for the groove is sometimes present, and sometimes not, but in reality it has a groove of which the edges grow together. Are there cases in which the groove persists as a sunken tube? Or are there other transitional forms? The genus Anhalonium though so small has both grooved (*A. fissuratum*) and ungrooved (*A. prismaticum*) forms, a curious case of "parallel-bildung" with Mamillaria, for we cannot suppose that the former came off from the grooved and the latter from grooveless Mamillariæ.[15]

[15]By a very natural mistake in the absence of a study of its embryology, Engelmann and (following him) Coulter have misunderstood the morphology of the tubercles in *Anhalonium*, and especially in that section of *Echinocactus* which the latter has elevated to generic rank under the name of *Lophophora* (Preliminary Revision of the North American species of Cactus, Anhalonium and Lophophora. United States Dept. of Agr. 1894). In the former, the areola near the tip of the tubercle does represent the spine-bearing areola, (indeed it contains small spines) and it is not simply the closed upper extremity of the tubercle groove. The true morphology of the groove shows that its upper extremity always is the spine-bearing areola. Comparing the forms *Echinocactus* (*Anhalonium*) *Williamsii* and var. *Lewinii* with *Anhalonium* he concludes naturally that the spine-bearing areolæ and entire upper part of the tubercle are gone. In reality spine-bearing and flower-bearing areolæ were never separated, but remain united as in all *Echinocacti* which lack the groove—as for example *E. horizonthalonius*. Moreover small spines are found in the areolæ, which latter of course also produce the flowers. If one simply imagines these spines to grow out and become large, he has a form exactly comparable with *E. horizonthalonius*—particularly with the young forms of the latter (see Engelmann, Collected Works, plate 32). These species of *Lophophora* therefore are *Echinocacti*.

In the formation of the ribs of the ribbed forms, parts of what would be morphologically surface of the main stem, seem to take part, so that the raised pieces between the successive spine-clusters may be stem and not tubercle in their nature. Where is this true and where not? Only the most careful study, as to whether or not the leaves are laid down in actual contact at the vegetative point, can settle the matter.

[*To be concluded.*]

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Flowers and insects. XIV.

CHARLES ROBERTSON.

GENTIANA PUBERULA Michx.—From the abundant observations on European species of *Gentiana* it appears that most of the species which have been investigated are proterandrous, though several are homogamous and a few proterogynous. Most of them are adapted to bumblebees, many to Lepidoptera, while quite a number are intermediate, being visited by both kinds of insects. One species, *G. lutea*, has exposed nectar, and is visited by a miscellaneous list. Nothing has been done with our species, except *G. crinita* and *Andrewsii*.

In the case of *G. Andrewsii*, Beal (6) observed that it was visited by bumblebees, but overlooked the proterandry, supposing that cross-pollination was favored by the stigma standing far above the anthers. A statement of Meehan, that the flower never opens, evidently taking it for granted that it is never visited by insects, is quoted by Henslow (12) in spite of Beal's observations. Vausenburg (10) objects to Beal's conclusions, and supposes that the stigma is pollinated as it passes the anthers. Kunze (18) regards the flower as cleistogamous, the nectar being of no significance. Bailey (17) records that nectar is secreted by the walls of the corolla. Gray (19, 21, 25) states that the flower opens a short time in sunshine, which I have never observed; notes the proterandry and that spontaneous self-pollination may finally occur by the lobes of the stigma curling back until they touch the anthers. Finally I have shown the adaptation to bumblebees and have recorded the abundant visits of *Bombus americanorum* F. ♂♀☿ (41). According to Beal (6) *G. crinita* is visited by bumblebees and resembles *G. Andrewsii*, of which, however, as we have noted, he had failed to recognize the proterandry.

G. Andrewsii and *puberula*, the only species I have found in my neighborhood, are the very latest of the bumblebee flowers, the former beginning to bloom by September 14th, and the latter on the 27th, both running nearly through October.

Gentiana puberula has the stem terminated by a cluster of handsome bright blue flowers. The corolla measures about 5^{cm}, and the lobes expand horizontally about 3.5^{cm}. The tube is narrowed for about 17^{mm}, the bases of the filaments being attached to the tube for that distance. The free ends of the filaments bend inwards, holding the anthers in a cluster around the style. Bees insert their proboscides between the filaments, and these organs must be 17^{mm} long to exhaust the nectar. The flowers are strongly proterandrous and are adapted to bumblebees. I have seen them visited by *Bombus americanorum* F. ♂☿.

While the flowers of this plant are more conspicuous than those of *G. Andrewsii*, their pollen is not so well protected. Small bees and flies may enter the corollas and remove the pollen without being of any service, but this is prevented in *G. Andrewsii* by the lobes remaining closed.

On the literature of Gentiana see:

(1) Sprengel, Das entdeckte Geheimniss, 150–2. 1793. *G. Pneumonanthe*, proterandry, etc.—(2) Axell, Om anordningarna för de fanerogama växternas befruktning. 1869. *G. Pneumonanthe*, 27, ref. (1). *G. nivalis, lingulata*, homogamous, etc., 101.—(3) Ricca, Osservazioni sulla fecondazione incrociata dei vegetali alpini e subalpini. Atta della Soc. Ital. di Scienze naturale **13**: 254–63. 1870. **14**: 245–64. 1871. *G. acaulis, germanica, verna*.—(4) Kerner, Schutzmittel des Pollens 26, 44. 1873.—(5) Müller, Befruchtung der Blumen 332–3. 1873. *G. Pneumonanthe, Amarella*, pollination.—(6) Beal, The fertilization of gentians by humblebees. Am. Nat. **8**: 180, 226. 1874.—(7) Meehan, Fertilization of Gentiana. Proc. Acad. Nat. Sci. Philad. **1874**: 160. Proterandry, closed fl. seems to make insect pollination difficult.—(8) Delpino, Ulteriori osservazioni, Pt. II. 2: 162, 173, 180. 1875. *G. acaulis, asclepiadea, ciliata, pannonica*, nectar receptacle and guides, proterandry, etc.—(9) Lubbock, British wild flowers in relation to insects, 29, 127. 1875. *G. Pneumonanthe, Amarella*.—(10) Vausenburg, Gentiana Andrewsii. Am. Nat. **9**: 310. 1875.—(11) Kerner, Die Schutzmittel der Blüthen gegen unberufene Gäste. Festschrift Zool.-Bot. Gesellsch. Wien. 1876. Several spp.—(12) Henslow, On the self-fertilization of plants. Trans. Linn. Soc. II. Bot. **1**: 326. 1877. Self-pollination by retention of corolla.—(13) Müller, Alpine species of Gentiana. Nature **15**: 317–19, 473–5. *f. 94–115*. 1877. Several spp.—(14) Müller, Geschichtliche Entwickelung der Gattung *Gentiana*. Kosmos **1**: 162–3. 1877. Abstract of (13)—(15) Müller, Fertilization of flowers by insects. Nature **16**: 265. 1877. *G. Bavarica, verna*, visits of Macroglossa.—(16) Burton, Gentiana asclepiadea and bees. Nature **17**: 201–2. 1877. Perforation.—(17) Bailey, Notes from Rhode Island. Bull. Torr. Bot. Club. **6**: 173. 1877.—(18) Kunze, Cleistogene flowers. ibid. 174. 1877.—(19) Gray, Gentiana Andrewsii. ibid. 179. 1877.—(20) Meehan, Gentiana Andrewsii. ibid. 189. 1877. Stigma receptive after becoming exposed above corolla, etc.—(21) Gray, Note to the review of Darwin's "Forms of Flowers." Am. Jour. Sci. and Arts. III. **15**: 221. Reply to (20).—

(22) Müller, Die Insekten als unbewusste Blumenzüchter. Kosmos **3**: 407, 425, 482. 1878. *G. Bavarica, excisa, lutea, verna.*—(23) Müller, Die Wechselbeziehungen zwischen den Blumen und den ihre Kreuzung vermittelden Insekten. Encycl. der Narturwiss. Breslau **5**: 62. 1879. *G.* subgen. *Cyclostigma*, change from bumblebee to butterfly fls. in Alps.—(24) Bonnier, Les Nectaires. 1879. *G.*, 116, *campestris*, 143.—(25) Gray, Structural Botany 240. 1880.—(26) Müller, Bombus mastrucatus, ein Dysteleolog unter den alpinen Blumensuchern. Kosmos **5**: 422–31. 1880. *G. acaulis, asclepiadea, campestris,* perforation.—(27) Müller, Die Falterblumen des Alpenfrühlings und ihre Liebesboten. Kosmos **6**: 446–56. 1880. *G. verna.*—(28) Thompson, Fertilization of New Zealand flowering plants. Trans. & Proc. New Zeal. Inst. **13**: 241–88. 1880. *G. montana*, proterandrous, etc.—(29) Müller, Die Alpenblumen, ihre Befruchtung durch Insekten, und ihre Anpassungen an dieselben 329–49. 1881. *G. acaulis, asclepiadea, Bavarica, campestris, ciliata, lutea, nana, nivalis, obtusifolia, punctata, tenella, verna,* with notes on others and review of genus.—(30) Müller, Die Entwickelung der Blumenthätigkeit der Insekten. Kosmos **9**: 258–72, 351–70. 1881. *G. acaulis, Bavarica, punctata, verna.*—(31) Müller, Fertilization of flowers, 402–6. 1883. *G. Pneumonanthe, Amarella,* notes on others and review of genus.—(32) Warming, Om Nogle Arktiske Vaexters Biologi. Bihang till K. Svenska Vet.-Acad. Handlingar **12**: 8–12. 1886. *G. nivalis, tenella, Pneumonanthe, involucrata, Amarella, campestris.*—(33) Loew, Weitere Beobachtungen über den Blumenbesuch von Insekten an Freilandpflanzen des botanischen Gartens zu Berlin. Jahrb. bot. Gartens Berlin **4**: 128–9. 1886. *G.*, Müller on development of.—(34) Huxley, The gentians. Notes and queries. Journ. Linn. Soc. **24**: 101–24. 1887. On the family.—(35) Lindman, Blühen und Bestäubungseinrichtungen im Skandinavischen Hochgebirge. Bot. Centralblatt **30**: 159. 1887. *G. campestris, nivalis,* self-pollination.—(36) Pammel, On the pollination of Phlomis tuberosa and the perforation of flowers. Trans. St. Louis Acad. Sci. **5**: 257–8, 474. 1888. Perforation.—(37) Schulz, Beiträge zur Kenntniss der Bestäubungeinrichtungen und Geschlechtsvertheilung bei den Pflanzen. I. 1888. II. 1890. Bibliotheca Botanica. I. *G. germanica, Amarella, ciliata,* II. *G. acaulis, excisa, verna, campestris, obtusifolia, ciliata,* also 14 spp. perforated by Bombus.—(38) Hansgirg, Ueber d. Verbreitung d. reizbaren Staubfäden u. Narben, sowie d. sich periodisch oder blos einmal öffenden u. schliessenden Blüten. Bot. Centralblatt **43**: 415. 1890. *G. acaulis, Saponaria,* opening and closing of fls.—(39) Kirchner, Beiträge zur Biologie der Blüthen. Progr. z. 72 Jahresfeier d. Kgl. Würtemb. landwirthschaftl. Akademie Hohenheim 47–49. 1890. *G. purpurea, tenella.*—(40) Kerner, Pflanzenleben **2**: 1891. Several spp.—(41) MacLeod, De Pyreneeënbloemen en hare bevruchting door insecten. 1891. *G. verna,* visitors, 343.—(41) Robertson, Flowers and insects. Asclepiadaceæ—Scrophulariaceæ. Trans. St. Louis Acad. Sci. **5**: 577. 1891.—(42) Hansgirg, Neue biologische Mittheilungen. Bot. Centralblatt **52**: 387. 1892. *G. phlogifolia, Fetisowii,* opening and closing of fls.—(43) Hansgirg, Biologische Fragmente. Bot. Centralblatt **56**: 258. 1893. *G. campestris,* opening and closing of fls.—(44) MacLeod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek **5**: 381. 1893. *G. Pneumonanthe.*—(45) Knuth, Blumen und In-

sekten auf den Nordfriesischen Inseln 105. 1894. *G. Pneumonanthe.*—(46) Loew, Blütenbiologische Floristik des mittleren und nördlichen Europa sowie Grönlands. Systematische Zusammenstellung des in den letzten zehn Jahren veröffentlichten Beobachtungsmaterials. 1894. 25 species.

FRASERA CAROLINENSIS Walt.—American columbo.—In the GAZETTE **18:** 48–9, the view was expressed that the hairy crest about the nectaries serves as a foothold, besides concealing the nectar. Its importance as a foothold, however, is not great. It was also supposed that bumblebees might prove to be the principal guests, though they had not been observed about the flowers at that time. In 1894 the flowers were in bloom from May 24th to June 22nd. On May 30th and June 1st, 4th, 8th and 12th the following visitors were noted:

Apidæ: (1) Apis mellifica L. ☿, ab.; (2) Bombus separatus Cr. ♀☿, the most abundant visitor; (3) B. americanorum F. ♀, one; (4) Anthophora abrupta Say ♂♀, freq.

Rhopalocera: (5) Eudamus pylades Scud.—all sucking.

Several species of Andrenidæ, principally *Halictus* and *Augochlora*, visit the flowers for nectar and pollen, but are too small to effect pollination.

PHLOX GLABERRIMA L.—This plant is rather rare. It grows on prairies and was noted in bloom from May 28th to July 30th. The stems grow from 4 to 8^{dm} high, bear handsome corymbs of purple flowers and are often collected in large patches. The border expands about 20^{mm}, and the tube is from 16 to 18^{mm} long. There is a slight appearance of proterandry, but I think that, in case insect visits fail, spontaneous self-pollination may occur by the stigma receiving pollen from the nearest anthers. There is a chance that an insect's proboscis may carry pollen from the long stamens back to the stigma, though the anthers of the long stamens dehisce first. This species agrees with all of the species of *Phlox* which have been observed in being adapted to butterflies. The anthers of the long stamens are so exposed at the mouth of the tube that their pollen is sometimes stolen by syrphids, *Syrphus americanus* Wd., etc. On seven days, between May 28th and July 18th, the following visitors were observed, all sucking:

Lepidoptera—*Rhopalocera:* (1) Danais archippus F.; (2) Colias philodice Gdt.; (3) Papilio thoas L.; (4) P. asterias F.; (5) P. philenor L.; (6) Pamphila peckius Kby.; *Heterocera:* (7) Scepsis fulvicollis Hbn.

PHLOX PILOSA L.—This species is common on prairies, growing in large patches. The flowers are pinkish. The border is about 20^{mm} wide, the tubes 10 to 15^{mm} long. The style is very short. Self-pollination may be effected by insect aid or may occur spontaneously by the pollen falling in the tube. The frequent visits of insects, however, render cross-pollination inevitable.

The principal visitors are butterflies; but, as commonly occurs with such flowers, long-tongued bees and flies also seek the nectar. The shorter tubes render the nectar more convenient to these insects than in the case of *P. glaberrima*. The plant blooms from May 3d to June 29th. May 8th, 16th, 17th, 31st, and June 5th, the subjoined list was observed, all the insects sucking:—

Lepidoptera—*Rhopalocera:* (1) Phyciodes tharos Dru.; (2) Pyrameis huntera F.; (3) Chrysophanus thoe B.-L.; (4) Colias philodice Gdt.; (5) Papilio asterias F.; (6) Pamphila peckius Kby.; *Heterocera:* (7) Plusia simplex Gn.

Hymenoptera—*Apidæ:* (8) Bombus separatus Cr. ♀; (9) B. pennsylvanicus DeG. ♀; (10) B. americanorum F. ♀; (11) Synhalonia speciosa Cr. ♂♀.

Diptera—*Bombylidæ* (12) Bombylius atriceps Lw.

PHLOX DIVARICATA L.—This is the earliest *Phlox* in my neighborhood, blooming from April 10th to June 2d. I have given a list (14) of eleven species of Lepidoptera and four species of long-tongued bees taken on the flowers. To that list must be added the following:—

Lepidoptera—*Rhopalocera:* (16) Papilio thoas L.; (17) Eudamus tityrus F.; *Heterocera:* (18) Plusia simplex Gn.—all sucking.

On the pollination of Phlox see:

(1) Sprengel, Das entdeckte Geheimniss, 105. 1793. *P. paniculata*, proterandry, butterfly-fl.—(2) Darwin, Forms of Flowers 119–21, 287. 1877. *P. subulata*, doubtful heterostyly.—(3) Bonnier, Les Nectaires 118, 168. 1879. *P. Drummondii.*—(4) Bonnier et Flahault, Observations sur les modifications des végétaux suivant les conditions physiques du milieu. Ann. Sci. Nat. Bot. VI. 8:—1879. *P. Drummondii*, brilliancy of color changing with geographical distribution.—(5) Flahault, Nouvelles observations sur les modifications des végétaux suivant les conditions physiques du milieu. ibid. 9: 159–207. 1880. *P. Drummondii*, colored more lively in Sweden than at Paris.—(6) Francke, Einige Beiträge zur Kenntniss der Bestäubungseinrichtungen der Pflanzen. Inaug. Dessertation. Freiburg-i-B. 1883. *P. setacea.*—(7) Müller, Fertilization of flowers 407. 1883. *P. paniculata*, ref. (1), visitors.—(8) Walker, Insects and Flowers. Nature **28**: 388–9. 1883. *P. sp.*—(9) Loew, Beobachtungen über den Blumenbesuch von Insekten an Freilandpflanzen des Botanischen Gartens zu Berlin. Jahrb. bot. Gartens Berlin **3**: 85 (17). 1884, *P. reptans, subulata*, visits of Apis.—(10) Loew, Weitere Beobachtungen, etc. ibid. **4**: 153, 1886. *P. paniculata*, visit of Echinomyia.—(11) MacLeod, Untersuch-

ungen über der Befruchtung der Blumen. Bot. Centralblatt **29**: 119. 1887. *P. sp.*, visit of Plusia.—(12) Kerner, Pflanzenleben. **2**: 111, 1891. Protection of pollen.—(13) Peter, Polemoniaceæ, Engler und Prantl, Die nat. Pflanzenfamilien 68: 40–48. 1891. Pollination.—(14) Robertson, Flowers and Insects. Asclepiadaceæ–Scrophulariaceæ, Trans. St. Louis Acad. Sci. **5**: 578. 1891.—(15) Knuth, Blütenbiologische Herbstbeobachtungen. Bot. Centralblatt **49**: 363. 1892. *P. acuminata*, vis. three butterflies.

LITHOSPERMUM CANESCENS (Mx.) Lehm.—According to Müller (4, 12, 13), *L. arvense* is homogamous and regularly self-pol-linated, though there is a chance of cross-pollination when the flower first opens. According to Kerner (18 Loew 21) it is slightly proterogynous, but Müller says the anthers begin to discharge their pollen before the flower opens. *L. purpureo-coeruleum* is slightly proterogynous, with anthers and stigma of equal height (17). *L. arvense* has small white flowers, rarely with blue (Loew 21) with tubes 4–5^{mm} long. Sprengel (1) saw it visited by butterflies, and Müller (4, 12, 13) observed as visitors two butterflies, two bees and two syrphids. *L. purpureo-coeruleum*, with red flowers changing to blue (17) and tubes 8–9^{mm} long (21), and *L. officinale* with small, dull white flowers, are classed by Loew (14) as bee-flowers. In the Berlin Garden the former is visited by *Anthophora pilipes* and *Osmia aenea*, and the latter by *Megachile willughbiella*.

Bebb (5) discovered that *L. longiflorum* is only the early state of *L. angustifolium*. This and *L. canescens* are early species which are able to attract insects until about the first of June (10), when probably on account of being over-shadowed by the trees or by the later more luxuriant vegetation, the latter goes out of bloom and the former continues to produce cleistogamic flowers. Bessey (10) concludes that *L. angustifolium* is not dimorphous, but highly variable, and Halsted (16) comes to about the same conclusion. In the case of *L. canescens*, Smith (9) seems to have regarded the flower as dimorphous, but found a rare third form with "flowers differing from the ordinary dimorphous condition." Bessey (10) regards it as a case of well marked dimorphism, though according to Darwin (11) the forms are variable and the case requires further investigation. Christy (15) mentions only two forms. Halsted (16) calls it decidedly dimorphic, saying he has seen no indication of trimorphism. At Madison, Wisconsin, Trelease (MS. notes) found only two forms and regarded the species as truly dimorphic. I have not taken great pains to examine flowers, but in all cases examined I have found indication of nothing but dimorphism.

In my neighborhood, *Lithospermum canescens* is the earliest butterfly-flower, blooming from March 18th to June 12th. The stems, often several from the same base, rise from 1 to 3^{dm} The racemes as they uncoil expose two or three erect orange-yellow flowers. The corolla is salver-form. The five-lobed border expands about 15^{mm}. The tube is about 8^{mm} long. At the throat it is narrowed to a diameter of about 1^{mm} by appendages whose purpose seems to be to restrict the visitors to slender tongues. The orange-yellow color and the narrow tube indicate an adaptation to butterflies, but the flowers are also visited by long-tongued bees. On April 30th, May 1st, 2nd, 17th, 20th, and June 5th the visitors observed were:

Lepidoptera—*Rhopalocera:* (1), Pyrameis huntera F.; (2) Chrysophanus thoe B.-L.; (3) Colias philodice Gdt., very ab.; (4) Papilio ajax L'; (5) P. asterias F.; (6) Nisoniades icelus Lint.

Hymenoptera—*Apidæ:* (7) Bombus americanorum F. ♀, ab.; (8) Synhalonia speciosa Cr. ♂ ♀, ab.; (9) Osmia cobaltina Cr. ♀, one.

Diptera—*Bombylidæ:* (10) Bombylius major L.—all sucking.

On the pollination of *Lithospermum* see:

(1) Sprengel, Das entdeckte Geheimniss 88. 1793.—(2) Kuhn, Einige Bemerkungen über Vandellia und den Blüthenpolymorphismus. Bot. Zeit. 25: 67. 1867. *L.*, heterostyled dimorphism in.—(3) Axell, Om anordningarna för de fanerogama växternas befruktning 22, 99. 1869. Ref. (2).—(4) Müller, Befruchtung der Blumen 270. 1873.—(5) Bebb, Lithospermum longiflorum only L. angustifolium. Am. Nat. 7: 691. 1873.—(6) Lubbock, British Wild Flowers in Relation to Insects 132. 1875. *L. arvense*, ref. (4)—(7) Henslow, On the self-fertilization of plants 375. 1877. *L. arvense*, ref. (6)—(8) Bonnier, Les Nectaires 125, 1879. *L. arvense.*—(9) Smith, Trimorphism in Lithospermum canescens. Bot. Gaz. 4: 168. 1879.—(10) Bessey, The supposed dimorphism of Lithospermum longiflorum (L. angustifolium). Am. Nat. 14: 417–21. 1880.—(11) Darwin, Forms of flowers. 2nd edit. 1880. *L. canescens* and *longiflorum*, ref. (9) and (10).—(12) Müller, Weitere Beobachtungen 3: 16. 1882.—(13) Müller, Fertilization of Flowers 417–18. 1883. *L. arvense*, pollination. *L. canescens, longiflorum*, ref. (11)—(14) Loew, Beobachtungen über den Blumenbesuch von Insekten an Freilandpflanzen des Botanischen Gartens zu Berlin. 1884. *L. arvense*, 8. *L. purpureo-coeruleum*, 38, 49, *L. officinale*, 45.—(15) Christy, Heterostyled plants. Journ of Bot. 23: 49–50, 1885. *L. canescens, hirsutum*, relative abundance of long and short-styled fls.—(16) Halsted, Notes upon Lithospermum. Bot. Gaz. 14: 202–3. 1889.—(17) Kirchner, Beiträge zur Biologie der Bluthen. Progr. z. 72 Jahresfeier d. K. Würtemb. landwirthschaftl. Akademie Hohenheim 51. 1890.—(18)

Kerner, Pflanzenleben. **2**: 1891. *L. purpureo-coeruleum*, color change, 190. *L. arvense*, autogamy, etc., 309, 330.—(19) Loew, Blüthenbiologische Beiträge II. Pringsheim's Jahrbücher, **23**: 52–3. 1892. *L. purpureo-coeruleum.*—(20) Mac Leod, Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. Bot. Jaarboek 5: 335. 1893. *L. arvense.*—(21) Loew, Blütenbiologische Floristik 282. 1894. *L. arvense, purpureo-coeruleum.*

PHYSALIS LANCEOLATA Michx.—According to Kirchner (2) *P. alkekengi* is proterogynous. The anthers finally approach the stigma until autogamy may occur. Kerner (3) states that autogamy results from the lengthening of the corolla.

Physalis lanceolata is common. The stem rises 3^{dm} or more and bears numerous pendulous flowers, which expand about 20^{mm}. The flowers are yellowish, the centers usually marked with five dark purple spots. The nectar is lodged in grooves alternating with the filaments, each groove being bounded on each side by a line of dense hairs. To reach the nectar, bees thrust their proboscides between the bases of the filaments. The broad bases of the filaments with the alternating tufts of hair nearly close the tube. The tufts aid in concealing the nectar and probably aid the bees in clinging to the pendulous flower.

The anthers dehisce in succession, so that to collect all of the pollen, the bees must visit each flower several times. Cross-pollination results from the stigma being in advance of the anthers and being touched before them. There may be slight proterogyny and in absence of insects autogamy may occur as in *P. alkekengi*. *P. lanceolata* blooms from May 12th to Sept. 21st. It is visited regularly and abundantly by (1) *Colletes latitarsis* Rob. ♂♀, s. and c. p., July 6th, Aug. 7th, Sept. 5th, 21st; (2) *C. willistonii* Rob. ♂♀, s. and c. p. May 29th, June 7th, 11th, Sept. 5th.

PHYSALIS VIRGINIANA Mill.—This species resembles the preceding. It blooms from June 7th to Oct. 4th and is visited for nectar and pollen by *Colletes latitarsis* Rob. ♂♀, ab., July 6th, 9th, 22nd, 25th, 26th, and *Halictus pectinatus* Rob. ♀, c. p., two, June 25th.

PHYSALIS PHILADELPHICA Lam.—This also agrees with *P. lanceolata* in most essential particulars. It was noted in bloom from July 12th to Sept. 27th. The flowers are visited for pollen by *Colletes latitarsis* Rob. ♀, July 27th.

The species of *Physalis* occurring in my neighborhood are remarkable for their close mutual relation with two bees of the genus *Colletes*. As far as known, *Heuchera hispida*[7] is the only other flower adapted to a bee of this genus. On twelve days, between May 29th and Sept. 21st, I found the flowers to be visited by these bees and by no other insects, except the *Halictus* taken on *P. Virginiana*.

I have taken single females of *Colletes latitarsis* on flowers of *Asclepias incarnata* (entrapped and dead) and *Polygonum hydropiperoides*. Both sexes are abundant on *Physalis*, and the female seems to depend exclusively upon the pollen of these flowers.

I have taken *Colletes willistonii* on flowers of *Rhus glabra* and *Melilotus alba*, but have never seen it collecting any pollen except of *Physalis*.

On the pollination of Physalis see:

(1) Sprengel, Das entdeckte Geheimniss 127–8. 1793. *P. alkekengi, pubescens*, nectar-glands, guides, etc.—(2) Kirchner, Neue Beobachtungen über die Bestäubungseinrichtungen einheimischer Pflanzen, Progr. d. 68 Jahresfeier d. K. Würtemb. landwirtsch. Akademie Hohenheim. 1886.—(3) Kerner, Pflanzenleben. **2**: 1891. Protection of pollen, 118, "revolverblüthen," 250, autogamy, 361.—(4) Wettstein, Solanaceæ. Engler u. Prantl, die nat. Pflanzenfamilien 65: 8. 1891. *P.*, pollination of.—(5) Loew, Blütenbiologische Floristik 285. 1894. *P. alkekengi*, ref. (2 and 3).

MIMULUS RINGENS L.—The flowers of *Mimulus* are homogamous. Bees entering the corolla first touch the stigma, which closes up and exposes the anthers behind it. Self-pollination occurs in *M. luteus*, but Darwin (13) found that pollen from another plant was prepotent over the flower's own pollen. He saw *M. roseus* visited by bees. According to Batalin (6) *M. guttatus* is visited by bees.

The irritability of the stigma of *Mimulus* was well known to Kurt Sprengel (1), Braconnot (2) and Vaucher (3). The latter mentions it as occurring in *M. luteus* and *glutinosus*, and supposes that it occurs in other members of the genus. This has been verified to such an extent that now it seems that a *Mimulus* without an irritable stigma would be a desideratum. Delpino (4, 7) was first to indicate the advantage of the movement in facilitating cross-pollination.

In the case of *Mimulus ringens*, Meehan (17) states that the stamens dehisce and the stigmas generally show pollen before the flowers are quite open. He observes the movement of

[7] Bot. Gaz. **17**: 178. 1892.

the stigma, and is the only one who does not regard it of any advantage. According to Beal (18) a student, Penoyer, has proved by detailed experiment that the flower is not self-pollinating. Foerste (25) observes that cross-pollination is not insured, and that the tubes are too long for the smaller bees.

The flowers are violet purple, the yellow palate forming a path-finder. The stigma slightly exceeds the anthers. I have found the lower lobe of the stigma with its tip touching the pollen. But most of the stigmatic surface remains exposed and may be thoroughly dusted with pollen from another flower. The corolla tube measures about 19^{mm}, but bees can insert their heads for about 5^{mm}, so that a tongue 14^{mm} long can exhaust the nectar. The plants are frequent in wet places, the stems growing from 11 to 14^{dm} high. The flowers were observed in bloom from July 11th to September 7th. They are visited for nectar by *Bombus americanorum* F. ♀☿.

MIMULUS ALATUS Soland.—See Foerste (25).—This flower is also adapted to bumblebees. It resembles the preceding, but the palate is larger, paler, and more strongly bearded. The tube measures 18^{mm} long. Bees can insert their heads for about 7^{mm} and drain the tube with a proboscis 11^{mm} long. As in *M. ringens*, the stigma finally touches the pollen and may be self-pollinated, but I am inclined to believe that the flowers are seldom neglected for a whole day, and are regularly cross-pollinated by bumblebees. The plants are not so tall as in *M. ringens*. They bloom from July 13th to Sept. 7th. The flower is visited for nectar by *Bombus americanorum* F. ☿.

On the pollination of Mimulus see:

(1) Sprengel, Anleitung zur Kenntniss der Gewächse **1**: 192, 274. 1817.—(2) Braconnot, Sur l'irritabilité du stigmate des Mimulus. Ann. de Chim. et de Phys. **29**: 333–4. 1825.—(3) Vaucher, Histoire physiologique des Plantes d' Europe **3**: 525. 1841.—(4) Delpino, Sugli apparecchi della fecondazione nelle piante antocarpee 32. 1867.—(5) Hildebrand, Federigo Delpino's Beobachtungen über die Bestäubungseinrichtungen bei den Pflanzen. Bot. Zeit. **25**: 284. 1867. *M. glutinosus* (*Diplacus puniceus* Nutt.), irritable stigma.—(6) Batalin, Beobachtungen über die Bestäubung einiger Pflanzen. Bot. Zeit. **28**: 53–4. 1870. Sensitive stigma, etc.—(7) Delpino, Ulteriori osservazioni. II. 2: 151. 1873.—(8) Müller, Befruchtung der Blumen 283. 1873.—(9) Kitchener, On cross-fertilization as aided by sensitive motion in musk and Achimenes. Jour. of Bot. **2**: 101–3. Am. Nat. **7**: 478–80. 1873. *M. moschatus*.—(10) Kitchener, A Year's Botany 118. 1874. Significance of sensitive stigma. Cit. by Darwin (13).—(11) Heckel, Du mouvement dans les stigmates bilobiés des Scrophularinées, des Bignoniacées et des Sésamées. Comptes Rendus **79**: 702–4. 1874. Cit. by

Miyoshi (28).—(12) Heckel, Sur la motilite dans quelques organes reproducteurs des Phanerogames. Thèse pour le doctorat ès sci. naturelles. 1875.—(13) Darwin, Cross and self-fertilization of plants. 1876. *M. roseus*, irritable stigma and visitors, 63. *M. luteus*, extended observations.—(14) Henslow, On the self-fertilization of plants. Trans. Linn. Soc. II. **1**:—1877. *M. luteus*, review of Darwin's observations.—(15) Behrens, Beiträge zur Geschichte der Bestäubungstheorie. Progr. d. Kgl. Gewerbschule zu Elberfeld 24–5. 1877–8. *M. luteus* (*Tilingii*), sensitive stigma, homogamy, etc.—(16) Heckel, Des relations que presentent les phénomènes propres aux organes reproducteurs de quelques Phanérogames avec la fécondation croisée et la fécondation directe. Comptes Rendus **87**: 697–700. 1878. Sensitive stigmas and pollination.—(17) Meehan, Irritable or sensitive stamens. Proc. Acad. Sci. Phila. **1878**: 333.—(18) Beal, The agency of insects in fertilization. Am. Nat. **14**: 202. 1880.—(19) Behrens, Blumen und Insekten. Methodisches Lehrbuch der Botanik für hohere Lehranstalten. 1880. *M. luteus* (*Tilingii*).—(20) Thompson, Fertilization of New Zealand flowering plants. Trans. New Zeal. Institute **13**: 241–88. 1880. *M. luteus*.—(21) Meehan, The stigma of Catalpa. Bot. Gaz. **8**: 191. 1883. Stigma of common garden *M.* closes in fifteen seconds.—(22) Müller, Fertilization of Flowers 436. 1883. *M. luteus* (*guttatus*, *Tilingii*), *puniceus*, ref. (5, 6, 15)—(23) Hoffmann, Culturversuche über Variation. Bot. Zeit. **42**: 216. 1884. *M. cardinalis* × *moschatus*, fruitful.—(24) Oliver, Ueber Fortleitung des Reizes bei reizbaren Narben. Ber. deut. bot. Gesellsch. **5**: 162–9. 1887. *M. luteus*, *cardinalis*.—(25) Foerste, Notes on structures adapted to cross-fertilization. Bot. Gaz. **13**: 153. 1888. *M. alatus*, *ringens*.—(26) Hansgirg, Ueber die Verbreitung der reizbaren Staubfäden und Narben, etc. Bot. Centralblatt **43**: 413. 1890. *M. ringens*, *purpureus*, *Lewissii*, *Californicus*, *parviflorus*, *moschatus*, *cardinalis*, *luteus*, (*Roezlii*, *cupreus*, *guttatus*, *Tilingii*).—(27) Kerner, Pflanzenleben **2**: 127, 253, 280. *M. luteus*.—(28) Miyoshi, Notes on the irritability of the stigma. Journ. of Sci. Imp. Univ. Tokio **1891**: 211. *M. Nepalensis*, *sessilifolius*, *moschatus*.—(29) Wettstein, Scrophulariaceæ. Engler und Prantl, Die nat. Pflanzenfamilien 65: 46–7. 1891. Pollination.

Carlinville, Illinois.

Notes from my herbarium. II.

WALTER DEANE.

NYMPHAEA ODORATA Ait. Sweet-scented water-lily.

The sweet-scented water-lily, whose chief attraction to the lover of nature is its beautiful flower, grows throughout eastern North America, and its praises have long been sung in prose and poetry. To the close observer, however, the flower is but one of many points of interest, and I have taken the greatest pleasure in collecting the plant for my herbarium. Even the best of professional collectors rarely send out in their sets full representations of the immersed parts of this plant. Indeed, it would not be a paying business if they did, for it took me the greater part of an afternoon to prepare satisfactory specimens for my own herbarium.

I spent a portion of July, 1886, in the Old Manse, in Concord, Mass., on the banks of the Concord river, close by the old battle-field. In early July, for some miles on either side of the stream, the water-lilies form a continuous bed of snowy white. I had already collected, elsewhere, the flowers and leaves, not realizing at the time what a small portion of the plant my herbarium would show. I resolved, now, to represent the whole plant, and, so, one pleasant afternoon, I took a boat and a rake, and rowed to a spot where the flowers were not too thick, and the water was about three feet deep. Then, getting the tines of the rake under a thick rootstock, I drew up a complete plant. I made a longitudinal section of the rootstock, keeping about a foot of it in length, and leaving the large terminal bud in place. The consistency of the stock is about that of a green apple. I trimmed the specimen carefully, leaving enough to show all the features, a single flower, a fully-developed leaf, of which I bent over a small portion to show the under surface, and three unopened leaves, which had not reached the surface. The vernation of the leaves is involute, and before expansion they resemble exactly those of *Sagittaria latifolia* Willd. form *c*, of J. G. Smith's recent revision. The smallest of these leaves is but an inch long, with a stem two inches long. This leaf had barely emerged from the mud at the river bottom. I left some of the copious roots on the stock, and by coiling the peduncle, petiole and roots, I made a good herbarium specimen. It took the rootstock some weeks to dry. It flattened gradually in the press, and is now three-sixteenths of an inch thick. It represents the original as well as a herbarium specimen can.

To illustrate the roots more fully, I made a specimen of rootstock and roots only, with the exception of an immersed leaf. The roots are about one-eighth of an inch wide at the base, and taper gradually. They are clothed with fine hairs, and average two feet in length. The immersed leaf was on a petiole five and one-half inches long, and, so, was nearly three feet under water. It was fully developed, dark brown on both sides, and generally round in outline, but with a very broad sinus, differing in this respect very much from the floating leaves.

Not the least interesting part of the plant is the fruit, while the manner of fruiting shows a wonderful adaptation of means to an end. The peculiar coiling of the stem, and the consequent drawing of the flower under water is an old story to tell, but the search and discovery of the fruit is ever a fresh one, for it is not always easy to find. On October 9, 1886, I was again in Concord, visiting the late Mr. Edw. S. Hoar, a good botanist, and an old friend of Henry D. Thoreau, with whom every spot in Concord is identified. We rowed on the river in search of the fruit of the water-lily. The air was still, the water perfectly clear for several feet in depth, and, as we moved slowly along over the places where in July the surface of the stream was white with the blossoms, I gazed down into the water searching for fruit. It is very strange what had become of the thousands of flowers. I found only two good fruits, and one almost eaten up by some water robber. Perhaps this last fact will partly explain their scarcity.

The fruits were from one to two feet under water, and one must know what to look for or he will certainly not be successful, even if the fruit is plentiful. The sepals and petals are still *in situ*, and the appearance is exactly that of a bud, for the pressure of the water keeps the sepals closed tight. The season of the year will determine whether it is a bud or fruit. The petals do not drop off, but slowly macerate. I found the fruit more easily in 1888, in Grassy Pond, Acton, Mass., but it was by no means abundant, although I know it is sometimes easily found.

If the surface of the water is ruffled, or the water itself is turbid, it can readily be seen how difficult the securing of the fruit must be. The stem coils in the middle or lower half and part of the coils are to the right, and part to the left. The coils are about one inch in width, and in my specimens they vary from five to nine in number. The fruit varies in size from about an inch to three-quarters of an inch in diameter. One must be sure to put into a pocket on the sheet cross-sections of the rootstock and of the fruit. The latter will show the seeds with their sac-like aril covering, and their peculiar habit of lining the inner face of the carpels, instead of growing on a distinct placenta.

These furnishings to a herbarium show the wonderful apparatus needed to produce the delicate flower of the water-lily.

APOCYNUM ANDROSAEMIFOLIUM L. Spreading dogbane.

I have a peculiar case of teratology in this plant. Two leaves have grown into one. They have a common base, and the appearance is the same as if the leaves had lapped over on to each other for about three quarters of an inch. There are two midribs, which are about half an inch apart in the middle of the leaf, and each leaf has its own separate apex, the two points being three-eighths of an inch apart. The venation between the midribs is normal, except that the primary veins are not nearly so spreading as those on the other side of the midribs. They curve quickly and are almost parallel to the midrib, as if crowded, as they really are. It is hard to believe that there are not two separate leaves before one, partly overlapping. I collected the specimen June 16, 1894, in Weston, Mass.

TYPHA LATIFOLIA L. Common cat-tail flag.

To represent completely our common cat-tail flag, the plant must be visited early in the season, before the enveloping spathes or bracts have opened. My herbarium sheets show these early forms, and aid me in the following sketch. I visited a swamp in Cambridge, Mass., on June 26th, and found the plant in prime condition. I first secured a specimen, in which the inflorescence was completely invisible. One spathe enwrapped the staminate spike above. It was firmly attached at the base, and terminated in a leafy projection five inches long. Another spathe enclosed the pistillate spike, and the greater part of the staminate spike, and had a leafy projection just a foot long, overtopping the staminate spike by five and one-half inches. These leafy terminations of the spathes resemble so closely the true leaves that I looked about for some time before I could discover the hidden inflorescence. I suppose that, had I visited the plant earlier still, the staminate spike, bract and all, would have been entirely enclosed by the female spathe.

Another plant showed the inflorescence a little farther advanced. The pistillate flowers were entirely free from the spathe which was but lightly attached to the base of the spike. I pressed it separately, for it became detached as I gathered the plant, and I have mounted it on the sheet near its original position, labelling it as belonging to the base of the female spike. The enveloping part of the spathe is three-quarters of an inch wide, and is light brown, as when I collected it, while the long leafy projection is a deep green, exactly resembling the color of the leaves. The male spike was just freeing itself from its spathe, and was shedding its pollen in copious showers. At intervals along the inflorescence, small bracts projected. On examining my various specimens, I find that the greatest number of bracts is six, varying in length from one-half to six inches. In one case a bract, half way up the spike, encloses the top of the spike, just as the bract or spathe at the base encloses the whole spike. The leaves of the plant have broad, sheathing bases, and there is a beautiful gradation from leaf to smallest bract. One can hardly afford to omit this feature from his herbarium. I pressed specimens showing every possible stage of inflorescence.

The fruit, though bulky, can easily be managed later in the season. A good way to supplement a specimen of the entire fruiting spike is to section one longitudinally, and mount it so as to show the inner face, with the stipitate fruit intact. The dark outer surface is then shown to be composed of the stigmatic surfaces on the ends of innumerable styles, while within are the copious hairs growing on the stipes. No dissection will be necessary to show this.

On August 14, 1886, at Rye Beach, N. H., I took up a whole plant to show the creeping rootstocks and the fibrous roots. My specimen has four stocks, the longest being one foot and two inches. The scaly nodes are about an inch and a half apart, and throw out but few roots. The stocks are about half an inch thick and, when fresh, were very white. The plant roots very freely from its base, the roots being long, with coarse fringing hairs half an inch in length. To show the roots and rootstocks fully, the upper part of the plant must be sacrificed or mounted on another sheet. I do not believe in folding a plant so that parts will overlap and crowd too much, thereby sacrificing clearness of detail, just to bring the whole plant within the limits of a mounting sheet. Herbarium specimens, too often, exhibit two extremes of careless work. They are either too fragmentary or too crowded. The utmost endeavors should be used to make the best specimens possible, that our herbaria may be visited for their aesthetic as well as useful qualities.

Cambridge, Mass.

Synopsis of North American Amaranthaceæ. II.[1]

EDWIN B. ULINE AND WILLIAM L. BRAY.

ACNIDA L. Sp. Pl. 1027. 1753.

Flowers completely diœcious, the pistillate ones without calyx, the staminate ones with 5 equal oblong sepals and 5 stamens: otherwise like *Amaranthus*.

At the time of the publication of Linnæus' *Species Plantarum*, but a single species of this genus was described, namely, *A. cannabina.* The specimen was collected in Virginia and was described in 1741 by Dr. John Mitchell under the generic name *Acnide.* Dr. Gray in his revision of the genus[2] states that "on the whole our botanists have failed to make out more than one species," although Moquin-Tandon had already described *A. rusocarpa.* Dr. Gray set up three sections: (1) EUACNIDA, in which he sets apart *A. rhyssocarpa* (*A. rusocarpa* Moq.) and adds *A. australis* (*A. cannabina* Chap.); (2) MONTELIA Moq., characterized by its indehiscent utricles, including *A. tuberculata;* (3) PYXIDI-MONTELIA, including *A. tamariscina* (*Amarantus tamariscinus* Nutt. and *Montelia tamariscina* Gray, in part).

With the increasing knowledge of the geographical distribution of the species, and with the considerable additions to herbarium material since Dr. Gray's revision, most of which we have seen, it seems best to indicate a somewhat modified disposition of the species. On the basis of geographical distribution, two very natural groups present themselves, those of the salt marsh and coast region of the Atlantic, and the inland and western forms. The former embraces Gray's EUACNIDA and *A. Floridana* Watson. Of the three species referred by him to this section, we believe that *A. cannabina* and *A. rusocarpa* are not distinct. We find here a complete series of intergradations, while the difference of age actually accounts for more than the difference called for in their original delimitation. The third species of EUACNIDA, *A. australis*, shows no specific departure from the others, but its range is

[1] The first number of this series, presenting the genus *Amaranthus*, was published in BOT. GAZ. **19**: 267, 313. 1894.

[2] Am. Nat. **9**: 487. 1876.

somewhat different, occurring mostly in Florida. This, in view of its comparatively slight variation from the species has prompted us to reduce it to a variety. *A. Floridana* stands as a distinct species. Of the inland and western forms there seems to be but one polymorphous species, consisting chiefly of tall erect plants with small indehiscent utricles (*A. tamariscina tuberculata* Moq.), although the original form of the group is characterized principally by a dehiscent utricle. According to priority these inland forms become *A. tamariscina.*

Finally, there is the definite shading toward *Amaranthus*, which is seen in certain specimens, which seem to defy all attempts at classification. This tendency is seen mostly in the appearance of minute sepals, varying in number. As this is the principal difference between *Acnida* and *Amaranthus*, it would seem that the generic rank of *Acnida* is not yet finally established.

SYNOPSIS OF THE SPECIES.

Fruit angled (Atlantic coast).
  Utricle fleshy, turning black.
    1^{mm} long or less . . . . *A. cannabina australis.*
    2 to 4^{mm} long, ... *A. cannabina.*
  Utricle thin and small . . . . *A. Floridana.*
Fruit not angled, 1^{mm} long (interior).
  Utricle indehiscent.
    Plant erect, inflorescence spicate, *A. tamariscina tuberculata.*
    Plant erect, spikes glomerulate, *A. tamariscina concatenata.*
    Plant prostrate . . . . . *A. tamariscina prostrata.*
  Utricle circumscissile . . . *A. tamariscina.*

1. A. CANNABINA L. Sp. Pl. 1027. 1753.

A. rusocarpa Mx. Fl. Bor.-Am. 2: 234. pl. 50. 1803.
A. salicifolia Raf. Am. Month. Mag. 2: 43. 1817.
A. obtusifolia Raf. (and vars.) New Fl. N. Am. 1: 53–55. 1836.
A. cannabina salicifolia Moq. DC. Prodr. 13^2: 278. 1849.

Tall, with leaves long, lanceolate, tapering at both ends: inflorescence naked and slender: bracts short: utricle mostly smooth, but sometimes rugose on the angles, orbicular, turning black in maturity: stigmas spreading: staminate flowers large, characterized by the oblong obtuse scarcely mucronate sepals.—River-banks and salt marshes in the Atlantic Coast Region from New England to South Carolina. Type unknown.

A. CANNABINA AUSTRALIS (Gray).

A. australis Gray (in part), Am. Nat. 10: 489. 1876.

Plant and leaves larger: bracts various, sometimes almost as long as the flower: utricle ovate, smaller than in the species: stigmas divaricate: spikes naked, long, slender and paniculate.—Alabama, Florida, West Indies and Mexico. Gray's types in herb. Gray, Columbia College and J. D. Smith. This variety is intended to embrace all southeastern forms having the above characters, which will give it a somewhat wider scope than the *A. australis* Gray.

2. A. FLORIDANA Wats. Proc. Am. Acad. **10:** 376. 1882.

Tall and slender, leaves linear to narrowly lanceolate, obtuse, attenuate to a slender petiole: flowers scattered on very slender, strict, elongated spikes: utricle faintly angled, tuberculate: staminate flowers more crowded.—Chiefly in Southern Florida. Types in herb. Gray, Columbia College, J. D. Smith and National herb.

3. A. TAMARISCINA (Nutt.) Wood, Bot. 289 (1874).

Amarantus tamariscinus Nutt. Trans. Phil. Soc. N. S. 5: 165. 1837.

This species possesses in some respects the habit of *Amaranthus græcizans*, having in common with that species slender and acuminate spikes, spinulose bracts and sepals, and a circumscissile utricle.—Indigenous on the dry prairies of the west and southwest, extending northward to Dakota, and occasionally found as far east as Illinois. The staminate forms are not easily distinguished from those of *Amaranthus Torreyi*, whose range overlaps that of this species on the west. The only specimen of Nuttall's type seen by us is a fragment in herb. Columbia College collected by Nuttall in Indian Territory, and labelled "Salt Creek." The specimen is very immature, but the locality, the slender acuminate spikes, and the spinulose bracts enable us to determine its place with reasonable certainty.

A. TAMARISCINA TUBERCULATA (Moq.).

A. tuberculata Moq. DC. Prodr. 13[2]: 278. 1849.
A. rusocarpa Moq. l. c.
A. tuberculata subnuda Watson (in part) Gray Man. 429. 1889. [ed. 6.]
A. tamariscina subnuda Coult. (in part) Mem. Torr. Bot. Club 5: 145. 1894.

Rank tall weed with flexuous branches similar in habit to *Amaranthus hybridus*, having an ovate, tuberculate, indehiscent utricle. The spreading bracts and withering stigmas render the utricles somewhat conspicuous when old. This probably accounts for one of the characters on which Dr. Watson based his var. *subnuda.* Those forms of Watson's var. *subnuda* with clustered inflorescence belong naturally with the following variety.—Most abundant in the north central states east and west of the Mississippi, but extending as far as Manitoba at the north, Vermont at the east, Tennessee at the south and western Nebraska at the west. With the exception of ballast specimens from New Jersey no Atlantic coast specimens were seen.

√A. TAMARISCINA CONCATENATA (Moq.).

A. cannabina concatenata Moq. DC. Prodr. **13**[2]: 278. 1849.
Montelia tamariscina concatenata Gray Man. 413. 1868. [ed. 5].
A. tuberculata subnuda Wats. (in part) l. c.
A. tamariscina subnuda Coulter (in part) l. c.

Somewhat weaker, often decumbent, with rather large flowers in isolated glomerules. Though there are occasional transition forms between this and the above, the mass of them seems to form a natural group, which may very conveniently be set apart.—Range as in the above variety. The locality and the aggregate inflorescence point to the probable identity of this with Moquin-Tandon's variety, though in one specimen of *Acnida cannabina*, collected in Massachusetts, the same aggregated tendency was seen.

√A. TAMARISCINA **prostrata,** var. nov.

Prostrate and diffusely spreading after the manner of *Amaranthus crispus*, though sometimes ascending as in *Amaranthus deflexus:* leaves small, spatulate: inflorescence crowded in axillary clusters and sometimes in minute glomerules, leafy.—Michigan to Dakota, extending as far south as Missouri. Type specimens in Nat. herb. and Mo. Bot. Gard.

GOMPHRENA L. Sp. Pl. 224. 1753.

Hirsute or villous herbs, erect, decumbent or prostrate, with usually swollen nodes, sessile or short petioled entire leaves, mostly solitary but sometimes clustered heads, which are usually sessile, though sometimes peduncled, perfect flowers, 5-parted calyx often villous at base, and stamen tube 5-cleft with emarginate or 2-cleft lobes, ovules with long strap-shaped funiculus.

**Stigmas short, stout, nearly sessile: bractlets keeled and slightly crested.*

1. G. Nealleyi Coult. & Fish. Bot. Gaz. **17**: 349. 1892.

Ascending from a fusiform root, having the habit of *G. decumbens* but easily distinguished by its subsessile stigmas, sepals indurated and more or less united at base.—In addition to the type, which was collected at Corpus Christi by Nealley in 1889, two specimens have been seen: Texas on the Lower Rio Grande (*Schott* 1853 of Mex. Bound. Surv.); Mexico (*Ervenberg* 140 in 1858). Type in herb. J. M. Coulter and Nat. herb.

***Stigmas filiform on a long style: bractlets keeled, more or less crested.*

+ *Heads and flowers small.*

2. G. Pringlei Coult. & Fish. Bot. Gaz. **17**: 349. 1892.

Plant prostrate, many-stemmed from a long filiform root: stems rose-colored, very slender, dichotomously or trichotomously branched: bractlets broadly and laciniately crested: flowers very small.—Mexico. Type in herb. J. M. Coulter, with corresponding collection numbers in herb. Columbia College and J. D. Smith.

3. G. decumbens Jacq. Hort. Schoenbr. *pl. 482.*

G. prostrata Desf. Hort. Par. app. 219. 1804, non Mart.

Stem procumbent (sometimes nearly erect), much branched, mostly dull gray or brownish in color: heads globose to globose-cylindrical according to age, dirty white or sometimes roseate: bractlets obtuse, keeled and crested, scarcely longer than the obtuse sepals.—Texas, West Indies and Mexico. Type unknown.

4. G. nitida Rothr. Wheeler's Rep. Bot. Geogr. Surv. **6**: 233. 1878.

G. globosa albiflora Moq. DC. Prodr. 13^2: 409. 1849.

Nearest in habit and appearance to *G. decumbens*, but mostly erect (sometimes procumbent), and rather stouter, with heads rather larger and mostly more globular, pearly white or rose-colored, flowers larger with long sharp bractlets and sepals, the former crested and sharply laciniate, one-third longer than the sepals.—Southern Arizona and nothern Mexico. Rothrock's specimen no. 520, collected in the Chirricahua Mts., Arizona, in 1874, is in the National herbarium. Moquin's type is unknown. The original name of Moquin's variety is not retained because of its previous adoption in this genus as a specific name.

A further acquaintance with growing specimens of *G. decumbens* and *G. nitida* may lead to their consolidation, for it is difficult to distinguish them on the basis of general habit. Rothrock, however, says of *G. nitida*, "Certainly it is not *G. decumbens* Jacq., as in the latter only the interior sepals are silky, and the outer ones are obtuse, whereas in my specimens all are silky and acute."

+ + *Heads and flowers large: bractlets broadly crested.*

5. G. GLOBOSA L. Sp. Pl. 224. 1753.

Distinguished from the next by its broad leaves, slender fibrous roots, and uniformly globular heads with broadly winged blunt bractlets.—Native of India, introduced into tropical America. Type unknown.

6. G. TUBERIFERA Torr. Bot. Mex. Bound. 181. 1859.

Stems erect from a fusiform fleshy and farinaceous root: leaves lanceolate to linear: peduncle elongated, simple: heads globose or oblong-ovate: flowers shining, pale rose-color: calyx about equalling the narrowly keeled broadly crested bractlets: sepals very acute.—On the rocky banks of the San Pedro and other western tributaries of the Rio Grande. Types in herb. Gray, Columbia College and Nat. herb.

*** *Stigmas filiform on a long style: bractlets thin, keeled, but without crest or lacineæ.*

+ *Stems very long, with conspicuously swollen joints: heads small, often aggregated.*

7. G. SONORÆ Torr. Bot. Mex. Bound. 181. 1859.

G. decipiens Wats. Proc. Am. Acad. 21: 437. 1886.

Stem tall, jointed, trichotomously branched, from a straight ligneous tap-root: leaves rather narrow, acute, 3 to 6^{cm} long, tapering into a winged petiole: both axillary and terminal heads mostly composed of two or three closely aggregated small heads, bractlets keeled, not crested, slightly longer than the sepals, easily deciduous, leaving the woolly flowers exposed.—Southern Arizona and Sonora. Types in herb. Gray, Columbia College and Nat. herb. (no. 1749 *Wright*, collected at Santa Cruz, Sonora).

SHULL on ENSLENIA.

Torrey's description of *G. Sonoræ* was founded on no. 1749 Wright and certain Thurber specimens of the same vicinity and date. But Wright 1749 was erroneously supposed to have serrate crested bractlets. Drawings on the label of the Columbia College specimen of Wright showing the cristate character must have been based on a Thurber specimen, resulting from confusion of material. The only Thurber specimens seen of that date and locality (1013 and 946) were properly referred by Dr. Watson to *G. nitida.* We have examined numerous other specimens correctly labelled *G. Sonoræ*, all of which agree with the Wright type in the absence of crested bractlets. In consequence of the absolute identity of the type of *G. decipiens* Wats. (*Palmer* 27 of 1885 in herb. J. D. Smith and Nat. herb.) with these specimens, we have been led to reduce *G decipiens* to a synonym of *G. Sonoræ.*

+ + *Low and cespitose.*

8. G. CAESPITOSA Torr. Bot. Mex. Bound. 181. 1859.

Very low, white villous, cespitose, spreading with thick woody caudex: leaves obovate, obtuse, the radical with attenuate base, the two cauline subsessile: peduncles short and simple: heads ovate, about 2^{cm} long, usually not subtended by leaves: flowers shining, yellowish white: bractlets hyaline, not keeled.—Mountains of New Mexico, Arizona, and Sonora. Types: *Wright*, *Bigelow*, 1752, 1753, in herb. Gray, Columbia College and Nat. herb.; *Thurber*, 256 of 1851, in herb. Gray and Columbia College; *Capt. E. K. Smith*, in herb. Columbia College; *Schott*, in herb. Columbia College.[3]

Herbarium Lake Forest University.

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[3]**Gomphrena Tuerckheimii.**

Telanthera Tuerckheimii Vatke, Ind. Sem. Hort. Berol. 187–, *fide* J. Donnell Smith.

Tall branching perennial with tetragonal stem: leaves short-petioled, ovate, acute, densely appressed-sericeous below, scabrous above: heads small (less than 1^{cm} in diam.), hemispherical: sepals prominently 3-nerved, lanceolate-acute, three times longer than the three equal bracts and the enveloping hairs: stigmas short, sessile, erect.

The above description is based on a specimen in herb. J. D. Smith (Guatemala, Coban, Depart. Alta Verapaz, *Tuerckheim*, 416 in 1885) which he has identified as *Telanthera Tuerckheimii* Vatke. Having seen neither the type nor any published description, we base our conclusion regarding it solely on the determination of Mr. Smith, who evidently thought this to be the same as Vatke's plant. If he is correct, Vatke's species undoubtedly belongs with *Gomphrena*. But if he was mistaken in their supposed identity then our plant becomes a new species of *Gomphrena*.

A reply to Dr. Robinson's Criticism of the "List of Pteridophyta and Spermatophyta of Northeastern America."

FREDERICK V. COVILLE.

It is with great regret that I have found myself called upon, under circumstances that make compliance a necessity, to reply to Dr. Robinson's criticism, published in the preceding number of this journal, on the List of Pteridophyta and Spermatophyta Growing without Cultivation in Northeastern North America, prepared by a Committee of the Botanical Club, American Association for the Advancement of Science. My hesitation is due to a feeling that nomenclatural discussions are often of little value, tending as they so frequently do to the expression of mere individual custom and prejudice. Since, however, I have never before put into print, except as a member of a committee, any statement of belief regarding principles of nomenclature, and have never published a controversial line on the subject, while at the same time I have been an active worker in the reform of our botanical nomenclature, I hope that I may not be accused unjustly, as others have been, of having thought little and written much.

First I must protest against Dr. Robinson's assumption, which pervades his whole article, that Dr. Britton, chairman of the check-list committee, is its real author, and that the other eight members were largely ornamental, if I may be permitted to use that word. In order that a false and injurious impression of this matter may not be further disseminated, it should be stated at once, that after another member of the committee had endeavored unsuccessfully to provide means for publishing the manuscript, as submitted by various members of the committee and by others, Dr. Britton consented to undertake the task and issue the publication from New York. The editorial work and the final verification of references fell therefore largely to Dr. Britton. Galley proofs were always sent, however, to each of the editors, and no small amount of time was spent by them in annotations and corrections and the verification of marked references.

If Dr. Robinson, furthermore, intended to express the opinion that Dr. Britton alone is responsible for the principles upon which the nomenclature of the check-list is based I must again protest. Not one of the principles therein incorporated is original either with Dr. Britton or with any other member of the committee, but all of them have been in practice in this or in other branches of biological science before the present code was formulated. More than this, some of the botanists who afterward became members of the committee had become definitely convinced of the validity of the main principles finally adopted, long before Dr. Britton had given expression to them. Dr. Britton has been most active and influential in *hastening* the reform of nomenclature in botany, and he has borne unflinchingly the brunt of criticism. It is therefore a matter of congratulation to him that the principles he has advocated have coincided in the main with those which have stood the test of experience in other branches of science and which have appealed also to the judgment of his fellow botanists.

Several years ago, when my own views on principles of nomenclature were in a formative stage, I had the good fortune to ask the eminent ichthyologist, Dr. David Starr Jordan, now president of Stanford University, what he considered the fundamental requirement of a stable system. His characteristic reply was, "There are only two ways of naming plants or animals, either to give them their oldest names or to give them any names you please." This epigrammatic statement represents well the difference between the new and the old systems. By the old, the standard is a moving one, changing from decade to decade in meeting the literary taste and custom of the time, or in conforming with the individual liking—too often arbitrary or capricious—of some stronger and more prolific writer. By the new system, on the contrary, the standard is a fixed one, and the possible errors of early practice are open to later correction, while the rare cases that do not appear to admit of decision by rule are necessarily in a position to be fully discussed and ultimately disposed of by agreement.

The detailed criticisms made by Dr. Robinson can not for want of space and time be discussed here, nor are they pertinent to the principles involved. Whether the name *Konig* or *Koniga* is the correct one, whether we shall write *Butneria* or *Büttneria*, whether the binding of a separately paged supplement at the beginning of a book makes it no longer a supplement, or whether albinos shall be treated as forms or as varieties, all these are proper matters for the expression of opinion and argument. I know that the committee would have been grateful and would still be grateful to Dr. Robinson or any other botanist for useful suggestions on these matters, and that all communications of this kind would receive fair hearing and sober judgment.

For the errors of citation which Dr. Robinson has pointed out it is hardly necessary to apologize. Those who have systematically verified by consultation of original sources of publication all the page and plate references in any group of plants of even moderate size, will appreciate the enormity of the task that devolved upon the committee in dealing with more than 10,000 references, ninety-eight per cent. of which were finally verified. But all errors in the book will be rectified hereafter, and while the few that now occur may be temporarily annoying to the botanist who uses the list, they have nothing to do with the principles themselves.

With reference to Dr. Robinson's criticism that the check-list differs from current standards in its conception of genera and species, I wish again to point out that, while the check-list is more nearly in accord with the highest recognised authority, Engler and Prantl's Natürlichen Pflanzenfamilien, than is any local or general descriptive American work, this fact has nothing to do with any system of nomenclature whatever and is not used justly as an argument in this case. Nor has the committee offered this treatment of genera and species as representing their combined judgment, for the contributor of each family is specifically and designedly named. The contributor is responsible for the matter, the committee for its presentation in proper form under the principles adopted by the club. Whether Astragalus and Phaca shall be treated as distinct genera as most European botanists treat them, or whether they shall be thrown into one, as most American botanists have held heretofore, is a question on which the contributor of the Leguminosæ, not the committee, has expressed an opinion. But all this aside, the disagreement between the contributors and Engler and Prantl are exceedingly few.

I must correct one lamentable error into which Dr. Robinson has fallen through a misinterpretation of one of the fundamental principles of the new system. He says (p. 101):

"It will always be possible for an erratic botanist to throw together large genera like *Aster* and *Erigeron*, *Bidens* and *Coreopsis*, *Panicum* and *Paspalum*, thereby displacing many specific names which according to the rule of "once a synonym always a synonym" can never be revived. This outcome seems so preposterous that it must be stated that it is not merely the writer's own unauthorized interpretation but the distinctly expressed although unpublished view of one of the compilers of the list, who has been among the foremost in the cause of nomenclature reform."

I fully agree with Dr. Robinson that the outcome he depicts would be preposterous, and I take this opportunity to point out his error, feeling also some responsibility for not having made the case clear to him formerly. The phrase "once a synonym always a synonym" is unfortunate and misleading, and I have preferred to substitute for it in conversation the equivalent phrase, "the rejection of homonyms." The principle is simply this, that after a name has once been published, the same name shall not again be a valid designation for any other plant, even though the original name should meanwhile have become a synonym of some other still older name. For example, the name Bigelovia has been applied to five or six widely scattered genera, all the earlier of which have been referred to other still older genera. The rule of the rejection of homonyms renders the name Bigelovia, therefore, unavailable for the genus to which it has been applied in recent years, and the check-list consequently takes up the next older name, Chondrophora. The force of the rule may be illustrated by the fact that by the old system, if any one of the earlier genera named Bigelovia should at any time be revived, it would necessitate a change also in the name of the later and current Bigelovia. There are many cases in which under the old system the revision of a family and the consequent necessary revival of some old generic name would entail changes in the names of two or three other genera as well. Under the new system a change in one generic name can not affect any other genus. Moreover, quite the opposite of Dr. Robinson's supposition, a restoration of the name Bigelovia would be perfectly valid, under this system, should the genus to which it was first applied be found really autonomous and therefore require a separate designation.

It is to be regretted that Dr. Robinson did not, while at the Madison meeting, bring forward for discussion his questions as to principles, for they undoubtedly were well understood, and would have been ably explained, by many of the botanists present. Now that they have been adopted by overwhelming majorities in democratic botanical assemblages, we may well ask whether Dr. Robinson's protest is not out of place, and whether he has any available substitute to offer or improvement to suggest. He surely cannot expect American botanists to revert to a now discredited system of nomenclature under which they had been chafing more and more for the past fifteen years.

Dr. Robinson's remarkable statement of opinion that stability is not the most important quality of nomenclature, fills me with amazement. After a reconsideration of this view, having in mind the relation which must exist between stability and ready intelligibility, he surely will not attempt to maintain such a position.

Dr. Robinson's statement (p. 103) that uniformity, consistency, and stability of nomenclature are in his opinion unattainable, confirms my impression that he has only the faintest conception of the strength of the new principles or the community of opinion of which this simple list is the expression. One by one our botanists have become convinced that the new system *is* adequate to the requirements, and I cannot believe that Dr. Robinson, when he fully grasps the intent and the working of this code, can fail to be convinced of its utility. It would require too much space to recount the history of the new system, receiving successive impulses as it did from Henry and Arthur Adams in 1858, in conchology; from our own illustrious Baird in the same year, in ornithology; from the now venerable Dr. Gill in 1861, in ichthyology; and in the past twenty years perfected by other eminent biologists with whose names and work we are familiar. The Rochester meeting of botanists was held in 1892, the Madison meeting in 1893, and now in the spring of 1895 we are able to cite the following as some of the organizations which have already issued publications incorporating essentially the same principles of nomenclature as those under which the committee carried on its work.

United States National Museum.

United States Department of Agriculture, Division of Botany and Division of Forestry.

Arnold Arboretum.

Missouri Botanical Garden.

Columbia College Department of Botany.
Torrey Botanical Club.
Nebraska State University and State Botanical Survey.
Indiana State Botanical Survey.
University of Minnesota and State Natural History Survey.
University of California.
University of Wisconsin.
University of Ohio and State Botanical Survey.
Kansas Agricultural College.
Systematic Botany of North America.
Eli Lilly & Co., drug dealers.
United States Official Pharmacopœia of 1890 (the last issued).
Sargent's Silva of North America.

The directors of many other botanical establishments, many scientific serials, and a very large number of individual botanists have also published in conformity with the same principles. Thus the new system seems to have those marks of early virility which are usually possessed by long needed and stable reforms.

To hold that the ornithologists—to draw an illustration from a popular science—have not a more useful or stable nomenclature than formerly, or that they regret their reform, or that the movement has brought its early supporters into popular disrepute, or that the revised names are now considered objectionable, is to question matters of fact.

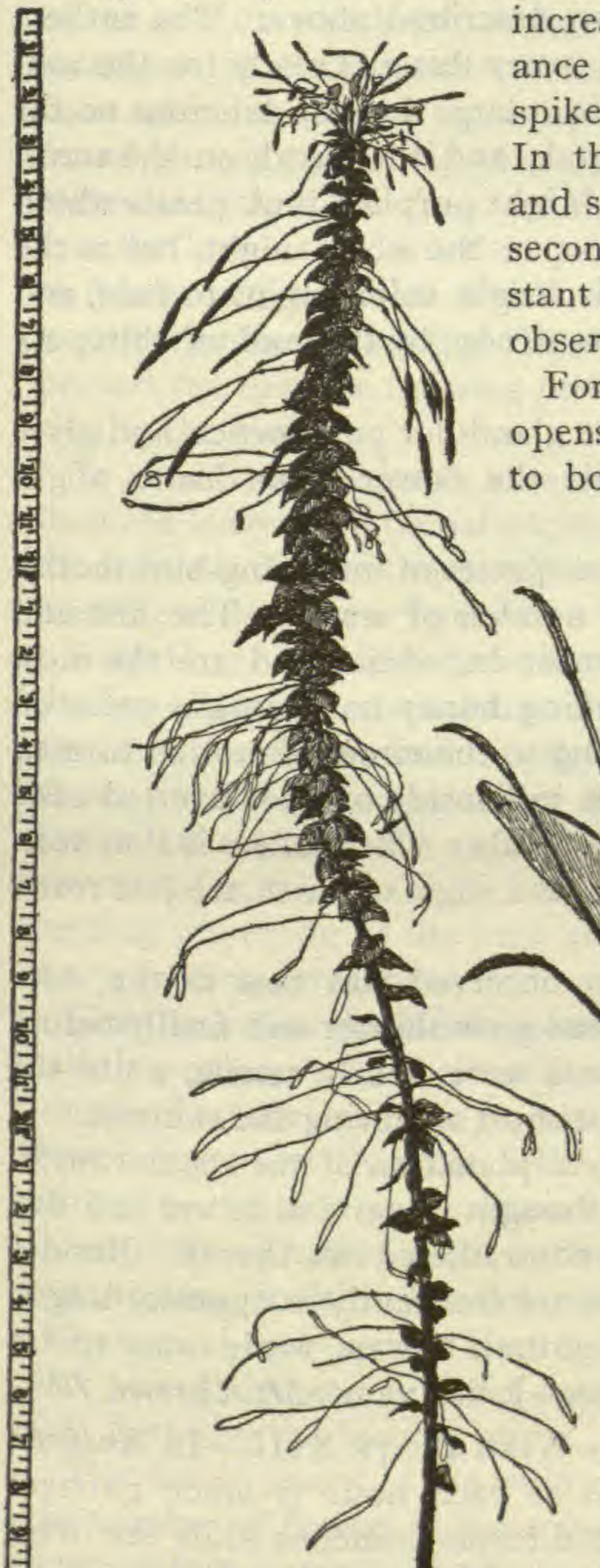
In closing, therefore, I feel justified in expressing the hope that Dr. Robinson and the few who think with him on this subject will lay aside personal prejudices and join the remaining nine-tenths of our botanists and almost all our conchologists, ichthyologists, herpetologists, ornithologists and mammalogists, in a nomenclature based on scientific needs and a scientific method.

United States National Herbarium, Washington, D. C.

BRIEFER ARTICLES.

Observations on the spider flower.—*Cleome spinosa* L. is a tropical American annual, which has long been cultivated in flower-gardens for its curious spider-shaped flowers. In this vicinity it has escaped to rich neglected places about dwellings. Its especial choice is a neglected wood-yard or some uncultivated rich spot just outside the barnyard. I have in mind several such places where it has appeared annually for the past twenty years, so that it may be said that it is thoroughly "introduced." The plant begins to bloom in July, and continues until frost. It attains a height of from four to six feet; the branches are long and spreading or drooping. The inflorescence is centripetal and terminal, and consists of long lax spikes of purplish-pink spreading flowers. The bracts are large and foliaceous in the fruiting spike. The peduncles are usually 33^{mm} long; the stipes are slender and about 55^{mm} long; the pod, when ripe, is near 50^{mm} long There is a row of seeds along the ventral and another along the dorsal side of the pod or legume. When mature the valves fall off, the seeds are dropped and scattered, but the ribs along which the seeds grew remain; these with the stipes and peduncles are spreading and slightly pendent on the rachis. See Fig. 1. There are four sepals which are 8^{mm} long, and are reflected when the flowers are opened; they are early deciduous. The petals are four in number, 33^{mm} long, ovate-oblong and clawed; their attachment to the torus takes up about four-fifths of a circle, the lower fifth is not occupied. When fully opened they spread outwards and upwards at an angle of about 45°, so that their outer points form about two-fifths of a circle; the lower three-fifths of the circle being occupied by the stamens, the two forming an inverted cone whose apex is at the torus. The stamens are usually 55^{mm} long, six in number, and are arranged in two sets of three each; one set on each side of the pistil. They spread outwards at the same angle that the petals do, and fill up the lower three-fifths of the cone formed by them and the petals. The pistil stands in the center of the cone formed by the four petals and six stamens; it varies in length, when the flowers first open, from 12 to 80^{mm}. The pistils develop in two series; for several successive days there will be only short or sterile ones, then for a number of days only long or fertile ones on a given spike. All the pods contain immature and unimpregnated ovules when the flowers first open, but the pistils that are short do not develop further, and soon the whole flower drops off, leaving nothing but the empty bract; while the pods of the long ones increase in size and mature an abundance of seed. The result is that the spikes are interrupted as shown in Fig. 1. In the fertile flowers the sepals, petals and stamens are dropped usually on the second day. This phenomenon was constant in all the numerous spikes I have observed this summer.

For twenty-four hours before the flower opens the long stamens and pistils begin to bow downwards and backward and



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CLEOME SPINOSA.

Fig. 1. A regularly interrupted spike.
Fig. 2. A flower bearing a fertile pistil; taken at 10 A. M. when it had begun to wilt. × ¾.

commence to protrude in a doubled up condition above the point where the petals are wanting on the lower margin of the torus, their upper ends being held down by the convolutely folded petals until shortly after sunset. At this time the petals gradually unfold and liberate the stamens and pistil. The pistil assumes an erect position while the stamens with the petals spread outward and form the inverted cone described above. The anthers do not open until about dusk, when every thing is ready for the welcome visitors. These are attracted by a large drop of delicious nectar lodged between the bases of the petals and the pistil, on the torus. The repast is advertised by the four bright purplish-pink petals which stand just above it. These remain open the whole night, but as the sun rises the following morning their bright color begins to fade, and they with the stamens commence to droop, by the end of thirty-six hours they are ready to drop.

The whole plant is covered with a glandular pubescence and gives off a rank disagreeable odor; while the flower alone has a slight pleasant balsamic odor.

Its principal visitors are the various species of humming-bird moths, humming-birds, honey bees and a number of wasps. The first and second of these appear to be the most beneficial, and are the most frequent visitors. In the act of taking honey both usually poise on their wings before the flower; in doing so the circle of motion formed by the outer points of the wings is just inside of the inverted cone formed by the six stamens and four petals. The pollen is thus scattered in all directions and thrown on the stigmas which are just ready to be fertilized.

Another interesting phenomenon observed was that as the cool nights of autumn came on the stamens grew shorter and finally before they were killed by frost the anthers were nearly sessile, while the pistils continued to be either long or short as during the summer.

I am unable to give a satisfactory explanation of the regular interruptions of the spikes. At first I thought it was due to wet and dry periods, but further observation has contradicted this theory. Besides the various spikes on the same plant are frequently in opposite stages, some bearing short abortive pistils in their flowers, while other spikes are producing long and fertile forms.—J. SCHNECK, *Mt. Carmel, Ill.*

Observations on Enslenia albida.—WITH PLATE XIII.—In *Enslenia albida* Nutt. one of the axillary buds at each node is much stronger and more forward than the other, and forms branches while the other remains almost or quite latent. At first the weaker bud can scarcely be seen, but it becomes more prominent later and may finally develop several internodes, but never makes such great growth as the stronger, unless injury to the terminal and other axillary bud necessitates its further development. The more potent axillary buds form a continuous spiral, either right or left, and frequently right and left on different branches of a single plant.

An alternate pubescent line found on the stem is always on the side of the axis on which the stronger axillary bud occurs, and on the first internode of each branch on that side of the branch next the axis from which it arises. In rare instances the two axillary buds were found almost equally developed, in which case the main axis has two pubescent lines. As these strong axillary buds are apparent even before the leaves to which they are axillary unfold, they are an obstacle to free growth and also points of greatest pressure in the bud. It would seem from this that the utility of pubescence is in this case to protect the delicate forming parts from the effects of pressure and friction in the bud.

In accordance with this view the axis, which has a more rapid growth than the leaves, has its pubescence directed downward, while that of the leaves is directed upward toward the apex, thus offering the least possible resistance to growth.

Both Gray[1] and Wood,[2] in their descriptions of this plant, say that the flower-clusters are axillary, but it appears that the peduncle arises not from an axillary bud but at the side of the axillary bud which is in its normal position. The absence of the axillary bud of the opposite leaf explains this apparent anomaly. Instead of the flower-cluster arising from an axillary bud it terminates the axis and each succeeding internode of the stem arises from the stronger axillary bud of the preceding internode.

Gray describes the inflorescence as a raceme-like cluster and Wood calls it a racemous umbel. The raceme and umbel both properly belong to the indeterminate or botryose type of inflorescence, while the flower-clusters of Enslenia follow out the same determinate plan exhibited by the terminal position of the peduncles. This results in that form of the scorpioid cyme known as a bostryx, development following the same spiral in the inflorescence as that noted in the stem; thus the plane of each pedicel is at right angles to that preceding, and the fifth internode bears a flower opposite the first, and the sixth opposite that borne by the second, etc.

The development of the weaker axillary bud into a flower doubles the number of flowers in the spiral and thus it occurs that the ninth flower stands opposite the first.

Anthesis takes place in the order of the successive divisions of the axis and is in this order: first, third, fifth and second, seventh and fourth, ninth and sixth, etc., each pair of numbers corresponding to the buds arising from one node.

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[1] Manual of Botany 343. 1889. [6th ed.].

[2] Class Book of Botany 595. 1880.

The pollinia are quite small and occupy only the upper portion of the anther. They are almost cylindrical and are attached to the anther by placentæ which break away with the pollinia forming a hyaline line along their outer sides as arranged in pairs.

The pollinia of Asclepias with which they are usually compared are larger, occupying the anther from base to apex. They are quite flat and do not exhibit the hyaline line seen in Enslenia.—GEO. H. SHULL, *Sulphur Grove, Ohio.*

EXPLANATION OF PLATE XIII.—Fig. 1. *Enslenia albida* Nutt., a node and cluster of flowers. × 1.—Fig. 2. Diagrammatic view of the inflorescence reduced to a single plane.—Fig. 3. Anther with its appendage. × 10.—Fig. 4. Section near the summit of the central column showing the arrangement and attachment of the pollinia. × 27.—Fig. 5. Section near the base of the central column showing anthers quite empty. × 27.—Fig. 6. Pollinia. × 32.—Fig. 7. Pollinia of *Asclepias incarnata* L. × 32.

On the development of the bulb of the adder's-tongue.—WITH PLATE XIV.—In the BOTANICAL GAZETTE for February, 1894, I presented results of observations made in 1893, upon the adder's-tongue, or spring Lily (*Erythronium Americanum* Ker.), and will here add, results of observations made in 1894 in hopes that as soon as the weather admits others will begin to make observations that may aid in determining questions of growth.

Here at New Brunswick, N. J., the flowers are about a week later than in the vicinity of Washington, D. C., and nearly a week earlier than in the vicinity of Springfield, Mass., the blossoms of the Erythronium being about their prime here on April 27th last year; the runners being at their best about May 5th, and the seeds ripe June 13th. The seeds are not easily found except when the exact spot where the plants grow has been previously noted carefully, for very soon after blooming the plants begin to decay and often the seeds ripen with the ovary on the ground, the remnants of the plant being prostrate and partly hidden by later growths of vegetation. By the first of May the profusion of bloom had passed and buds were found only in sheltered spots.

In the vicinity of Washington the anthers of *E. Americanum* Ker. observed were almost invariably dark brown; here the anthers observed were most frequently yellow, although the brown anthers were not rare. No direct relation was observed between the color of the anthers and the blotching on the leaves, as dark anthers were found on some plants whose leaves were free from brown, but freely blotched with white. The yellow anthers are often found associated with leaves thickly sprinkled with brown spots. All stages between these two extremes were found. As regards fertility, no comparative laboratory experiments have been made here as yet, but the plants in the fields have about the same size of ovary in the case of the yellow as in the case of the brown anthers; but the best development reached by any of the plants seen was in those having yellow anthers. These grew in a cool, shady ravine, and within a few feet were other plants having brown anthers, which were but slightly inferior in development.

Nearly seventy-five plants were examined in the field on May 3d, all of which had yellow anthers. These were in various stages, from the recently opened flower to the blossom that had fallen to the ground, but age did not seem to have any effect on the color of the stamens.

The anther opens not by the throwing of the adjacent lateral pollen chambers together, but by the dividing of the dorsal and ventral partitions inward until the elasticity of the walls ruptures the thin remaining portion.[1] The upper half of fig. 1 illustrates by dotted lines the approximate path of such a rupture. This process begins at the base of the dorsal suture and extends upward, as shown in fig. 3, the dotted line indicating the probable position of the walls when fully opened. A transection of a fully opened anther is shown in fig 2. The pollen covered surface is thus exposed to the wind and insects.

The active mature bulb of one year seems in some cases to be developed from a bud of the previous year, the parent bulb being absorbed in the growth of the bud. Remains of this parent bulb are sometimes adherent to the new bulb, and such a case is shown at *a*, fig. 4. Here the husk has been carefully removed, and the sheathing stalk bent back to show more plainly some details. At *b* is a bud already started although the bulb on which it occurs has not fairly begun its independent life. Figure 5 gives a longisection of a similar bulb showing the young bulb found within the active portion, which is marked with the vascular bundles.

If two buds should develop from the same parent at the same time, there might be produced a growth similar to that in fig. 11, but such contact developments are more likely to occur by the growth of two runner-bulbs in contact.

On account of botanical work at Cottage City, Mass., I could not continue my collecting during the summer, but my father, Mr. James H. Blodgett, kindly collected, at various dates ending with November 28th, over six hundred bulbs of all sizes, from marked spots near Washington, D. C. This collection contains two cases of the "contact developments." One of these is represented at fig. 11, and under careful examination they show no break in the husk; a small bud is

[1] This process is described by Van Tieghem, Traité de Botanique, 882.

developing near the base of the upper one and is pointed downward. It is the first case noticed in which this occurred. That the secondary bulbs are really buds from the primary but immature bulbs, is shown by the structure of the runner-tip. This tip forms the terminal bud of the runner and is shown in fig. 6. The runner is hollow for nearly its full length when in its best condition, the tube tapering toward the upper part. Through the runner some vascular-bundles extend. These are more highly developed near the parent bulb than at the tip, and are surrounded by cells which contain a supply of starch. In a section of a runner-tip at a point corresponding to *A B*, fig. 6, a structure like fig. 9 is seen, the irregular patches being the bundles, and the line cutting off a portion being the boundary of the bud within the runner. Some of these runner-buds in shape closely resemble the seeds, (compare fig. 7 a bud and fig. 8, a seed). Figure 7 shows a longisection of a runner-bud, natural size, as it reaches its full development as a bud. It is now ready to absorb the runner and becomes a bulb.

The bundle, *f*, is seen running down to the base of the bud, and is also shown in a similar position in the seed. The soft spongy portion of the seed is directed away from the placenta, as the point of the bud, just above, is away from the runner. In figs. 9 and 10, in a section of a bud similar to the trans-section *A B* of figs. 6 and 7, the structure is seen to be more highly developed, bearing a resemblance to the bulbs themselves. The bundles are more differentiated and more numerous, and the bud has begun to develop its internal sprout.

The growth of fleshy fibers from the upper part of the runner-bud, (See BOT. GAZ. 19: *pl. 7. fig. 11.* 1894.) noted in 1893 has not been seen since, but such fibers were well developed in that specimen.

As the fibrous roots at the base of the mature bulbs are persistent through the year they are ready to start with the warm weather so that the plants have means for very rapid development, when spring opens.

The immature bulbs develop their roots in order of their size, the smallest not producing theirs until the latter part of October, between October 26th and November 15th, in 1894.

Among the plants collected by the students of Rutgers College last spring one Erythronium was brought in having two flowers, on separate pedicels, but springing from the same point of the plant, which was otherwise normal. In the general herbarium of the institution is a plant bearing a third leaf, which springs from the stem just below the separation of the normal leaves. This third leaf is considerably smaller than either of the others. Another plant has a blossom, with the bulb less than an inch and a half below the surface. It was apparently trying to get deeper, as a strong runner had started from the bottom of the bulb.—FREDERICK H. BLODGETT, *Rutgers College, New Brunswick, N. J.*

John H. Redfield.—The death of Mr. John H. Redfield, conservator of the herbarium of the Academy of Natural Sciences of Philadelphia, which occurred in that city on the twenty-seventh of February, is regarded as a serious loss to the science he loved. He was for many years a member of the car-wheel manufacturing firm of that city, Asa Whitney & Sons, the founder of the firm being his father-in-law. His spare time from his business was devoted to self-culture, especially to learning languages, and studying natural history. He became a thorough Greek and Latin scholar, and continued the acquisition of modern languages through life, having mastered Spanish but a few years before his death. In natural history he was proficient in chemistry, mineralogy, conchology, and botany—the later years of his life being wholly devoted to the latter pursuit. In the knowledge of ferns he had few superiors anywhere, and workers in this group of plants were always happy in examining his rare collection, and profiting by his wide knowledge. The greatest monument to his labors will be the herbarium of the Academy of Natural Sciences of Philadelphia.

He retired from active business in 1885, and from that time devoted his whole time to building up this herbarium. Though with good material collected by many eminent men, it was in a sad state in the early sixties. On the death of Elias Durand, only one worker was left to give a few hours a day to its care. Its condition may be imagined by the reply of Dr. Gray to an application for a share in some specimens, "what is the use of throwing valuable material into a dust bin?" The letter, shown to Mr. Redfield, stirred a strong desire to give encouragement. During his noon recess from business he would call to enquire how the work was coming on. From this beginning he left the herbarium at his death with over 35,000 species of flowering plants and ferns, accurately determined, with many suites of specimens to show geographical range and variations, with a very large number undescribed. He had undertaken the immense labor of verifying and fastening to sheets the huge collection, and had more than half completed the task, leaving an unfinished genus on the table to take to his death bed. By his will he leaves all his books and collections of natural history to be sold, the proceeds to be devoted to continuing the work on the herbarium. This will start a "Redfield Memorial Hebarium Fund," by which the memory of his unselfish labors will be perpetuated.

He was born July 10, 1815, at Middletown, in modern times Cromwell, Connecticut. When a young man became acquainted with Prof. Torrey in New York and Dr. Gray, through membership in the New York Lyceum of Natural History. In 1846 he was elected to membership in the Philadelphia Academy. Always declining election to any high honors in the institution, he was glad to fill positions of usefulness. He served long as one of the Council of Management, and at his death had filled for many years the responsible position of chairman of its publication committee. Eminent botanists from many parts of the world made their calls on him when passing through Philadelphia.

"The Flora of Mount Desert Island, Maine," was his latest work, prepared in conjunction with his friend Edward L. Rand, and issued last year. The modesty of his nature may be inferred from the subtitle, "A Preliminary Catalogue," as no more complete local flora has probably been issued. He derived much satisfaction in his last days from the numerous letters commending the stand taken in that work against violent changes in plant nomenclature, his main point being the impossibility of practically carrying out without endless confusion that which might be correct as an abstract proposition. The Academy will soon publish a memoir giving an abstract of his life and services to science. In the language of one of his colleagues, "an association of the past eight years made me familiar with his beautiful character. He was always high principled, single-hearted, charitable, kind and helpful,—an affectionate friend, a wise counsellor, an upright judge." —THOMAS MEEHAN, *Germantown, Philadelphia.*

George Hunt.—In the death of Mr. George Hunt botanical science in Rhode Island has met with an irreparable loss. For over sixty years he has been familiar with every bog and wood in the state. When over eighty he could outwalk all his younger companions. He never seemed to know fatigue. Even for the nooning he never sat down, but ate, and that sparingly, while searching the rocks or glens.

He was a true wood-lover. The plants seemed to guess his feeling and to do their very best for his delight. For many years he was the chosen guide of some of us younger men, who all loved him with tender regard. His character was as sweet and pure as the aroma of the mayflower. It was a precious privilege to accompany him on a walk. Each year we went with him to welcome the hepatica. Sweet, unobtrusive, gentle, he could be roused to earnest remonstrance, or to contest a wrong. He was eminently a right minded man and a true gentleman.

He was one of the earliest members of the A. A. A. S., and always glad to attend its meetings. He was a life-long member, too, of the Rhode Island Horticultural Society, and the Providence Franklin Society, and a member of that group of Rhode Island botanists that included at one time George Thurber, J. W. Bailey, S. T. Olney and A. L. Colder. He was personally known to doctors Torrey and Gray, and had sent specimens to Harvey. As was often the case in those early days, he had embraced several sciences and divided his life between entomology and botany. In his garden he grew the most precious wild flowers and made every one welcome to their enjoyment. He passed away on Feb. 21st at the ripe age of eighty-four.—W. WHITMAN BAILEY, *Providence, R. I.*

The Systematic Botany of North America.—The Board of Editors of the "Systematic Botany of North America" announce the following arrangements for the presentation of groups thus far decided on. Other assignments will be reported as made, and also such changes as may arise in the present arrangement. It is requested that collectors communicate material for study to the monographers, even of the commoner and well-known species, so that the geographical distribution may be presented as accurately as possible.—N. L. BRITTON, *Chairman, Columbia College, New York.*

Myxomycetes: Mr. O. F. Cook, Huntington, N. Y. (at present abroad).
Schizomycetes: Prof. H. L. Russell, University of Wisconsin.
Chlorophyceæ: In charge of Prof. Geo. L. Atkinson, Cornell University.
Phycomycetes: Prof. Byron D. Halsted, Rutgers College, New Brunswick, N. J.
Saccharomycetes: Dr. J. Christian Bay, State Board of Health, Des Moines, Iowa.
Taphrineæ: Prof. Atkinson.
Helvellineæ: Prof. Lucien M. Underwood, Greencastle, Ind.
Pezizineæ, Phacidineæ: Mr. Elias J. Durand, Cornell University.
Fungi Imperfecti: Prof. Halsted, and Mr. J. B. Ellis, Newfield, N. J.
Ustilagineæ: Prof. Halsted.
Uredineæ: Prof. J. C. Arthur, Purdue University, La Fayette, Ind.
Polyporineæ: Prof. Underwood.
Boletineæ, Agaricineæ: Prof. Chas. H. Peck, State Museum, Albany, N. Y.
Gasteromycetes: Mr. A. P. Morgan, Preston, Ohio.
Hepaticae: Prof. Underwood.

Musci: *Acrocarpi*, Mrs. N. L. Britton, Columbia College; *Pleurocarpi*, Prof. C. R. Barnes, University of Wisconsin; *Sphagnaceæ:* Mr. John K. Small, Columbia College.

Pteridophyta: Prof. Underwood.

Typhaceæ, Sparganiaceæ, Naidaceæ, Juncaginaceæ: Manuscript of the late Dr. Thos. Morong.

Alismaceæ: Mr. Jared G. Smith, Missouri Botanical Garden.

Hydrocharitaceæ: Manuscript of Dr. Morong.

Gramineæ: In charge of Prof. F. Lamson-Scribner, U. S. Department of Agriculture.

Cyperaceæ: Prof. L. H. Bailey, Cornell University, and Prof. N. L. Britton, Columbia College.

Araceæ: Manuscript of Dr. Morong.

Lemnaceæ: Mr. E. P. Sheldon, University of Minnesota.

Eriocaulaceæ: Manuscript of Dr. Morong.

Commelinaceæ: Mr. J. N. Rose, U. S. Department of Agriculture.

Juncaceæ: Mr. F. V. Coville, U. S. Department of Agriculture.

Liliaceæ: Mr. J. N. Rose.

Smilaceæ: Manuscript of Dr. Morong.

Dioscoreaceæ: Prof. A. S. Hitchcock, Kansas Agricultural College, Manhattan, Kansas.

Saururaceæ, Piperaceæ, Casuarinaceæ: Mr. T. H. Kearney, Jr., U. S. Department of Agriculture.

Juglandaceae: Prof. Britton.

Myricaceae: Prof. Britton.

Leitneriaceae: Prof. Wm. Trelease, Missouri Botanical Garden.

Salicaceae: Mr. M. S. Bebb, Rockford, Ill. (*Salix*).

Betulaceae, Fagaceae, Ulmaceae, Moraceae: Mr. Geo. B. Sudworth, U. S. Department of Agriculture.

Urticaceae, Loranthaceae, Santalaceae, Olacaceae, Aristolochiaceae: Mr. T. H. Kearney, Jr.

Polygonaceae: Mr. John K. Small.

Chenopodiaceae: Mr. Willis L. Jepson, University of California.

Amaranthaceae: Messrs. E. B. Uline and W. L. Bray, Lake Forest University.

Phytolaccaceae: Prof. Hitchcock.

Portulacaceae: Mr. Jepson.

Nymphaeaceae: Prof. Chas. A. Davis, Alma College, Alma, Mich.

Ranunculaceae: Prof. Britton.

Menispermaceae: Prof. Hitchcock.

Calycanthaceae: Mr. T. H. Kearney, Jr.

Geraniaceae, Oxalidaceae, Linaceae: Prof. Trelease.

BLODGETT on ERYTHRONIUM.

Malpighiaceae, Zygophyllaceae, Rutaceae: Miss Anna M. Vail, Columbia College.
Simarubaceae, Burseraceae, Meliaceae: Mr. Sudworth.
Polygalaceae: Dr. Wm. E. Wheelock, Columbia College.
Callitrichaceae: Studies of Dr. Morong.
Malvaceae: Mr. J. Burtt Davy, University of California.
Guttiferae, Hypericaceae: President John M. Coulter, Lake Forest University.
Cistaceae: Prof. Britton.
Empetraceae: Prof. Hitchcock.
Limnanthaceae, Aquifoliaceae, Celastraceae, Hippocrataceae, Staphyleaceae, Aceraceae, Hippocastanaceae, Sapindaceae, Balsaminaceae: Prof. Trealease.
Rhamnaceae: Mr. Jepson.
Vitaceae: Prof. L. H. Bailey.
Loasaceae: Dr. Wheelock.
Cactaceae: President Coulter.
Thymeleaceae, Eleagnaceae: Prof. Hitchcock.
Halorageae: Studies of Dr. Morong.
Araliaceae: Prof. Hitchcock.
Umbelliferae: Pres. Coulter and Mr. Rose.
Cornaceae: Pres. Coulter.
Clethraceae, Pyrolaceae, Monotropaceae, Lennoaceae, Ericaceae, Diapensiaceae: Mr. F. V. Coville.
Myrsinaceae, Primulaceae, Plumbaginaceae, Sapotaceae, Ebenaceae, Symplocaceae, Styracaceae, Oleaceae, Loganiaceae: Mr. Small.
Gentianaceae: Mr. Chas. L. Pollard, U. S. Department of Agriculture.
Borraginaceae: Prof. Edw. L. Greene, University of California.
Verbenaceae: Prof. Hitchcock.
Solanaceae, Scropulariaceae: President Coulter.
Chichoriaceae, Compositae: Prof. Greene (*Aster* and *Solidago* by Prof. Thos. C. Porter, Lafayette College, Easton, Penn.

EDITORIAL.

IT IS hard to eliminate personal prejudice from any discussion of the nomenclature question, and as the contention proceeds extreme views seem to become more pronounced. Such a condition of things is always unpleasant, but it is necessary, and all progress is the result of contest between conservative and radical. It would be unfortunate if either spirit had its way unchallenged. What we should desire is a resultant of opinions, for no one should have the temerity to believe that his own personal views are the only ones worthy of acceptance. For this reason, it is probable that permanent good will come from the discussion now attracting so much more attention than its importance deserves.

THE GAZETTE has been more conservative than radical, but it has always been open to conviction, and has allied itself with every movement that has promised to advance the interests of American botany. At the same time, it has repeatedly urged that ripe preparation and experience are necessary in the direction of any profitable change. One of the greatest obstacles in the way of the proposed American code of nomenclature has been the eager and hasty fashion in which it has been applied in all sorts of lists by all sorts of botanists. We are firmly convinced that the fundamental principles of the proposed code are sound and tend to permanency, but its hasty application has brought about some unwise and unwarranted changes. Nothing short of monographic study can properly apply any code of nomenclature. We question whether many of the younger botanists who are publishing in this country really appreciate the amount of critical skill and wide investigation involved in questions of synonymy. Much of the synonymy that has been handed down to us is but reputed synonymy, and when these transmitted opinions are simply juggled according to any code of nomenclature the confusion is likely to be increased.

EVEN IF a code acceptable to all could be formulated it would take many years of study by all of our systematists to properly apply it throughout the American flora, and until it can be done with certainty it should not be attempted. An old name should stand until a thorough and competent investigation has proven it faulty. In this we are not condemning the action of the Botanical Club in directing the application of the Rochester Code by a committee to the "Manual flora." We believe that action was wise and in the result we have illustrations of the working of the rules which will serve to clarify discussion and form a basis for future action. The "List" prepared by that Committee must not be looked upon as a list of the authorized names of our eastern plants. While the general principles of the American code are believed to be sound, certain details seem to work unhappily in that List, and certain things are left unsettled. Only careful consideration can suggest the necessary modifications. Our taxonomists ought to give serious thought to all these questions this year. We particularly commend to their consideration the propositions by Messrs. Ascherson and Engler elsewhere recounted. There should be wise action taken at Springfield this summer.

THERE IS A conservatism which means self-opinionated obstinacy, and a radicalism which means a greediness for change. With neither of these should we have any sympathy. But the conservative and the radical who are open to conviction are in the proper judicial attitude to settle this question. Our contention, therefore, is by no means against the American code, for we are partly responsible for its promulgation, but against the idea that all its details are finally settled, and more than all against its hasty and unstudied application.

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THE PROPOSED "Systematic Botany of North America" has been placed upon a sure financial basis, and work has already been begun upon many parts. The present assignment is published elsewhere in this number, covering nearly half the entire work. Whatever may be said of its general merits it marks an important stage in the co-operative spirit of American botanists. A uniform style of presentation has been adopted, that is, as uniform as widely different groups will permit; and a system of nomenclature has been outlined for general guidance. Further than this each monographer is as independent as though the work were all his own, and the work of editing will only concern itself with seeing that uniformity of style is preserved. Diversity of opinion may and does exist as to some of the rules for general guidance, but when once adopted it needs no argument to show that they must be followed. The really significant part of the work, the subject matter, is in the control of the individual monographer. As a consequence, this great work offers the largest opportunity for independent individual effort in systematic botany that has ever been given in this country. As a result, our whole flora will be passed in review as it never has been before, and the facts brought to light will form the basis of future work even though many of the opinions expressed may be discarded.

CURRENT LITERATURE.

Pharmacal botany.

For the student of pharmacy two sciences, chemistry and botany, are indispensable. Of the two, chemistry finds the most continuous application, and as a consequence students of pharmacy are given thorough courses in chemistry, pure and applied. But the botany has always suffered, and attempts are numerous to produce in the form of a text-book or a laboratory guide some short cut to what is considered a sufficient knowledge of botany to enable the student to recognize the vegetable drugs. The book before us is a manual of organic materia medica[1] with a prefatory part I entitled *pharmacal botany*. It is with this chiefly that we are concerned.

And we remark at the outset that Prof. Sayre's introductory section is out of date. Why should M. C. Cooke's quotation from Lankester (!) on the distinctions between plants and animals be quoted to the extent of half a page when the student is told in a footnote that these are of historic interest but is given no real information on the differences, or rather the resemblances?

The first chapter, miscalled morphology, is an illustrated glossary of the descriptive terms for phanerogams, among which the gymnosperms figure as a "polycotyledonous" division coördinate with di- and monocots.

The second chapter, miscalled structural botany, treats of the histology of vascular plants, with special reference, it is said, to the needs of the student of pharmacognosy. While the first chapter was an inadequate account of the organs of the higher plants, the second is eally ridiculous as an introduction to their histology, illustrated as it is with the antiquated—for the year 1895 the grotesque—figures from Bentley's Manual of Botany. The chapter covers 35 pages in all, of which 5½ are devoted to starches, while the remaining cell contents are treated in 3 pages; forms of cells in 1 page; systems of tissues in half a page; and the anatomy of the stem in 2 pages!

"The cavity left in the cell by its disappearance ['this protoplasm becomes assimilated'] is called a vacuole." As one method we are

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[1] SAYRE LUCIUS E.:—A manual of organic materia medica and pharmacognosy; an introduction to the study of the vegetable kingdom and the vegetable and animal drugs, comprising the botanical and physical characteristics, source, constituents, and pharmacopœial preparations, with chapters on synthetic organic remedies, insects injurious to drugs, and pharmacal botany. 8vo. pp. 555. figs. 543. Philadelphia: P. Blakiston, Son & Co., 1895. $4.50.

told that "the cell divides by an ingrowth of the cell-wall:" while the only other mode of division is by free cell formation. Glands and secretion reservoirs, structures which one would suppose of great interest to the pharmacist are dismissed in 12 lines. But it is useless to go into further details. Prof. Sayre is undoubtedly competent to write about materia medica, but he is not competent to write about botany, and it is a pity that he undertook to prepare this part of his book, for it is unworthy of the larger special part and of the handsome dress in which the well known publishers have clothed it.

A manual of histology.

A new laboratory manual for classes beginning the study of vegetable histology is being perfected and will be issued after a time. It is by Professors M. B. Thomas of Wabash College and W. R. Dudley[1] of Stanford University. It is the outcome of a number of years experience and trial, first in the laboratory of Cornell University and afterward in the institutions with which the authors are now connected, In the division of labor Part I on technique and also the editorial supervision of the whole work has fallen to Prof. Thomas, and Part II on laboratory directions and also the general plan of the whole book to Prof. Dudley.

The aim of the authors is to furnish concise and detailed direction for the elementary study of cells and tissues according to the most approved methods of manipulation. The idea is to lead the student who enters the laboratory, where the microscope and microtome are the chief instruments, through a careful and well-thought-out course of instruction from the handling of a compound microscope to the preparation and examination of serial sections, and to familiarize him with the most common forms of tissues of the vegetative organs of the higher plants. Numerous references are made to standard text-books, that are likely to be found in a well equipped laboratory.

As an aid in teaching the pupil exact methods at the outset of his course, the work is admirably conceived and will doubtless meet with favor. The plates are somewhat lacking in the finish of the drawings and in their arrangement on the page, but are serviceable.

A monograph of the Mycetozoa.

If any one imagines that in our abounding zeal for histological and physiological research among the higher plants the investigation of the so-called cryptogamic world is likely to be forgotten, a glance at recent

[1] Thomas, Mason B. and Dudley, William R.—A laboratory manual of plant histology. Preliminary edition. The authors, Crawfordsville, 1894. 8vo. 115 pp. 15 pl. $1.50.

literature will certainly reassure him. To say nothing of bacteriology, which is in itself a science, work in all lines among the lower forms of life was surely never so great as now. Take even that small group of organisms, the mycetozoa, which forms the topic of the volume before us[1] and here we have treating the same subject two monographs in the English language within as many years. These two comprehensive works represent, of course, different collections; but that such works, handsome, costly works, should appear at all is evidence of the universal, cumulative interest lately roused in the organisms of which the volumes treat. The former volume dealt with the collections of Myxogastres, or, as they are familiarly called, slime-molds at Kew; the present volume treats of the collections, equally rich, which have place in the magnificent herbarium of the British Museum. Mr. Lister, the present author, has been long a student of his subject, has had access to all the largest collections, especially American collections, in the world, has the advantage of writing last, and has consequently given us the best account of the slime-molds that has so far appeared: nevertheless it is plain for many reasons that the last word on the subject has not been said. Mr. Lister, adopting De Bary's view of the relationship of the group and following the wavering authority of Rostafinski calls the organisms he discusses *Mycetozoa*. This name was substituted by De Bary for *Myxomycetes* Link, simply to express his view that the organisms in question were animals rather than fungi. Both names are bad on etymological grounds and have the further disadvantage of supplanting the old appellation *Myxogastres* Fries, which has no etymological falsity. Myxogastres ought to stand as it was correctly applied and limited.

In his arrangement Mr. Lister follows Rostafinski; but in almost nothing else; the Polander's species are thoroughly revised and a great many go down as synonyms of each other. In this revision Mr. Lister is not always consistent. For instance: the form familiar to American students as *Clathroptychium rugulosum* (Wallr.) R. is, in the face of Rostafinski's protest, *Sluzowce* p. 225, written down under the generic name *Dictydiæthalium*, adopted under mistaken conception by Rostafinski in his university studies, and committed to Fuckel for publication in *Symbolæ Mycologicæ*, 1873. Rostafinski was the first to discover his mistake, and as cited made the necessary corrections, 1874–5, and the name in general use resulted. Under the circumstances it might, one thinks, have been allowed to stand. But, now

[1]Lister, Arthur:—A monograph of the Mycetozoa, being a descriptive catalogue of the species in the herbarium of the British Museum. 8vo. pp. —. pl. 78. figs. 51. London: 1894.

for specific name we must say *D. plumbeum* Rost., though Rostafinski never called the species *plumbeum!* *Plumbea* is the oldest specific name applied to the object, it is true; but it was under an entirely different genus, viz., *Fuligo plumbea* Schum. 1803. According to Mr. Lister's own ruling the species should now be called *D. applanatum* Rost., for that adopts "the first authentic specific name published under the genus in which the species now stands." Whatever we may think of the rule, Mr. Lister does not always observe it. The generic changes are on the whole few. *Ophiotheca* disappears, merged with *Perichæna*, and *Tilmadoche* and *Physarum* are consolidated as they should be. On the other hand we gain a new family, *Margaritaceæ*, to include the genera, *Margarita*, *Dianema*, and *Prototrichia*. The changes in the present volume, as indicated already, come in the way of consolidating species. To make too many species is not good and revision is always in order; but the crowding of too many forms under one specific name is a sin in the opposite direction, induces confusion and will by and by provoke a change. Compare, for instance, *Physarum compressum*, *Physarum berkeleyi*, etc. On the whole the book will be exceedingly useful to students. The little wood-cut sketches will generally aid in the determination of genera and many of the most common species are figured in the plates. These are in the main excellent, reproduced by photographic process from water-color drawings. As a consequence those representing species whose natural colors are black and white are reproduced best. The publication is by the Trustees of the British Museum, and they may well share with the author congratulations on the completion of a beautiful and very successful piece of thoroughly scientific work.—MACB.

Minor Notices.

THE FIRST PUBLICATION from the Field Columbian Museum,[1] of Chicago, gives an account of the founding of the museum and a brief description of its present collection, with illustrations. The botanical department is in charge of Dr. C. F. Millspaugh. It occupies the galleries, and is particularly rich in forestry exhibits. No mention is made of the rather large herbarium which forms a part of the collection, but which for obvious reasons can not be displayed. It is encouraging to botanical students that so notable a museum should put botany on an equal footing with zoology and other departments.

DR. ROLAND THAXTER has continued his publications on Laboulbeniaceae by a recent paper in *Proc. Amer. Acad.* 30: 467. The gen-

[1] Publication I. An historical and descriptive account of the Field Columbian Museum, Chicago, 1894. Vol. I, no. I. 91 pp. Illust.

eric name *Acanthomyces* Thaxter is changed to *Rhachomyces* Thaxter on account of preoccupation, and a seventh species added. Two new genera are established, *Diplomyces* and *Eucantharomyces,* and twelve new species are added to *Laboulbenia.* We are informed that twenty-four quarto plates, including 600 figures, illustrating these and all the other Laboulbeniaceae described by Dr. Thaxter, have been completed, and will be published as soon as suitable arrangements can be made. We sincerely hope that a publisher will be secured at an early day.

CAMPBELL'S Biology[1] is another one-sided book from the botanist's point of view. There is a chapter on plant tissues, one on plant structure, one on yeast, one on protococcus and glœocapsa, and one on bacteria (together 42 pp.). The rest is almost purely zoological, and seems to be accurate and well-put, though much condensed. The botanical part is good, what there is of it. But the book would be better without such an inadequate treatment of the life-work of plants.

A HANDY VOLUME of about one hundred and twenty pages, in pocket form, dealing with the organic drugs of the United States Pharmacopœia has been compiled by John S. Wright,[2] botanist to the large pharmaceutical establishment of Eli Lilly & Co., of Indianapolis, Ind. Over two hundred and fifty vegetable drugs are treated in a very compact but comprehensive manner. Under each is briefly stated the name, source of the drug, character of the plant, range and habitat, constituents of the drug, properties, dose and preparation. The non-pharmaceutical student would have been glad of an index. The work bears evidence of careful preparation. It is well printed and bound, and must serve a useful purpose. It is distributed by the firm, to whom application may be made, or to the author.

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[1] CAMPBELL, H. J.:—Text book of elementary biology. 8 vo. pp. xii+284. figs. 136. London: Swan Sonnenschein & Co. [New York: Macmillan & Co.] 1893.

[2] WRIGHT, JOHN S.:—A guide to the organic drugs of the United States Pharmacopœia, 1890, containing, in addition to the brief account of organic drugs, a conspectus of the natural orders of plants mentioned, and glossaries of the botanical and medical terms used. Narrow 16 mo. pp. 118. Eli Lilly & Co., Indianapolis, 1895.

NOTES AND NEWS.

THE SYLLOGE FUNGORUM by Prof. P. A. Saccardo is to be continued. Volume IX is now in preparation.

THE PLANT INDIVIDUAL in the light of evolution is the title of a paper by Prof. L. H. Bailey, read before the Biological Society of Washington on Jan. 12th.

THE MICROSCOPICAL BULLETIN will be issued by Queen & Co. for the present year as heretofore. It appears bimonthly, at the subscription price of 25 cents a year, and contains many good things for workers with the microscope.

THE MARCH NUMBER of the *American Microscopical Journal* is of special interest to botanists, inasmuch as it contains a good portrait of Dr. Samuel Lockwood, so well known among the botanical fraternity, and also an artificial key to the genera of lichens, prepared by Mr. L. A. Willson.

IF THOSE who use live marine algæ in their courses of instruction will indicate to the Cambridge Botanical Supply Co. the time of year when they need such specimens the Company propose to prepare and issue a schedule of shipments. These have been successfully made as far west as Nebraska.

THE SUMMER SCHOOL at the University of Wisconsin offers botanical instruction by Professor Barnes, Dr. R. H. True, and Mr. F. D. Heald. Courses in general morphology and experimental physiology, and special work for advanced students are offered. The school begins July 8th and closes August 16th.

IN THE summer school of Cornell University, July 8th–August 16th, botany will be in charge of Prof. Rowlee. Courses are offered in systematic botany and histology; also a "general course" consisting of lectures upon the natural groups of plants accompanied by appropriate studies in the field and laboratory.

A SUMMER SCHOOL of cryptogamic botany will be held in the laboratory of the Cambridge Botanical Supply Co., Cambridge, Mass., beginning July 5, 1895, and continuing five weeks. Laboratory work and lectures will embrace courses in general cryptogamic botany for teachers, covering recommendations of "Committee of Ten," and economic mycology for investigators, with special attention to culture methods and literature.

DR. HARVEY W. WILEY has just published an account, with plates, of the culture, properties and uses of the "sweet cassava" (*Janipha Manihot*) of southern Florida and tropical America. It seems to be an exceedingly valuable human and cattle food, yielding a large amount of easily separated starch, and well suited to cultivation in the southern portions of the Gulf states. The publication is Bulletin 44 of the Division of Chemistry, U. S. Department of Agriculture.

The methods and aims of the horticultural department of Cornell University are set forth with some detail in an interesting article in the *American Florist* (10: 557. 12 Ja 1895) by Mr. Michael Barker. While the methods pursued are strictly scientific and the results often of great interest to botanists, the primary design of the work is to develop the knowledge and practice of horticulture.

The proceedings of the Davenport Academy of Sciences (6: part I) contains an excellent portrait of Dr. C. C. Parry, and also a biographical sketch by Dr. C. H. Preston. Mrs. Parry also furnishes a complete list of titles, the number of which is much larger than botanists will expect, as Dr. Parry's writings were scattered through numerous publications.

Professor E. L. Greene publishes a new Californian *Ceanothus* in the *Kew Bulletin* for January. The sheet of type specimens is at Kew and seems to be unique. The plants were collected long since by Lobb, probably in the Coast Range. It has probably been confused with *C. divaricatus*, but its white-glaucous branches and branchlets distinguish it, along with other characters, and suggest the specific name *leucodermis*.

An emergency poster, in relation to Russian thistle, printed on a sheet 20 by 24 inches, has been sent out by the Ohio Experiment Station as a supplement to Bulletin 55, to warn farmers and acquaint them with the appearance of the much dreaded weed. Good illustrations and brief description of the weed make it easy to be recognized by every one. This method of displaying posters throughout the state, if it can be properly done, must be a rapid way to acquaint a large section of country with new facts of moment.

Botanical work at the Department of Agriculture is developing rapidly in the number of separate organizations and is increasing in scope. The Division of Vegetable Pathology has had Physiology added to its title, an enlargement of name to cover physiological work which has been going on for some time. The Division of Grasses and Forage Plants has been newly organized, cut off from the old Division of Botany. These two Divisions, with those of Botany and Forestry, constitute a broad range of botanical investigation, and should yield large results.

A welcome departure for biologists will be the division of the subject matter of the journal, *Centralblatt für Bakteriologie und Parasitenkunde*, into two separately issued parts, beginning with the present year. The first part will contain medical bacteriology and animal parasites, and the second part general, technical and agricultural bacteriology and plant diseases. It will be a saving of much labor and a great convenience to have the non-pathological portion of bacteriology free from the overshadowing and bulky pathological part, for which biologists especially will doubtless be grateful.

M. F. Boergesen has begun the publication in *Jour. de Botanique* (Jan. 1) of a paper on the leaves of Arctic plants. The present number contains an account of the epidermis, including the stomata and the transpiration tissues. A large list of Arctic plants has been examined and the results are stated as follows: (1) Most arctic plants possess stomata on both leaf surfaces, the greater number being on the upper surface; (2) the stomata are situated even with the surface of the leaf; (3) the mesophyll (transpiration tissue) is a very porous structure.

In 1892 Dr. Ignatio Urban began the publication of "Additamenta ad cognitionem florae Indiae occidentalis," in Engler's *Botan. Jahrb.* The second contribution ("Particula II") of the series has just now appeared (l. c. **19**: 80–199), dealing exclusively with the great and perplexing tropical family *Myrtaceæ*. The amount of synonymy in many of the species is appaling, their great variability having led the earlier students of the family to a large multiplication of species.

Anhalonium Lewinii (*Lophophora Williamsii Lewinii* Coulter) is to be reckoned among the poisonous Cactaceæ. Its alkaloid, anhalonin, has been studied by L. Lewin, after whom the species is named. Warm-blooded animals are severely poisoned by a dose of 0.02–0.04^{gm} and killed by 0.16–0.2^{gm} per kilo. The Mexican Indians use a substance they call *peyotl*, or *pellote*, as an intoxicant, and Herr Lewin thinks this cactus furnishes the material. On chemical and structural grounds he would keep *A. Lewinii* distinct from *A. Williamsii*. Besides four other species of Anhalonium, *Mamillaria uberiformis* and *Rhipsalis conferta* have been found to contain poisonous alkaloids.

In the *Bull. l'Herb. Boiss.* (Jan.) Ad. Tonduz begins a series of papers upon the botanical features of Costa Rica, the present number containing a photographic reproduction of a forest of "Indian trees." In the same number Edmond Bonnet publishes some letters from Linnaeus and his son to David van Royen, Professor of Botany at Leyden. Linnaeus seems to have had a prodigious correspondence, no less than 163 botanical correspondents having been listed. If he wrote to them all as fully as in the case of the letters before us it is difficult to understand how he found time for investigation. About 400 of his letters are known, but the vast majority seem to have disappeared.

The herbarium of Mr. Walter Deane, of Cambridge, is one of the most interesting collections in the country. Mr. Deane has confined himself to what may be known as the "Manual" plants. He has not merely tried to make a collection of excellent specimens of the ordinary sort, but he has undertaken, so far as material has been accessible, to represent on his sheets all the various stages of development. As a consequence, his collection has become full of valuable information with reference to the growth of many species. It is a matter for congratulation that Mr. Deane has consented to publish some of the facts which have thus been gotten together in his herbarium.

A sketch of Thomas Nuttall, with portrait, appears in *Pop. Sci. Monthly* for March. The large impress he left upon American systematic botany is becoming better recognized than formerly. Not only was he the indefatigable explorer of a new flora, but a man of rare discrimination in the matter of genera and species, of which he is said to have described more than any other writer on American plants, excepting Dr. Gray. He was born in Yorkshire, England, in

1786, became a printer by trade, came to America in 1808, where he resided for thirty-four years, chiefly in Philadelphia and Cambridge (Professor in Harvard College, 1822–1833), taking several extended trips, returned to England in 1841, and died there September 10, 1859.

PARTS 111 and 112 of Engler and Prantl's *Die natürlichen Pflanzenfamilien* contain the Araliaceæ by H. Harms, the Jungermaniaceæ akrogynæ (concluded) and Anthocerotaceae by V. Schiffner, and the Musci (Laubmoose) begun by Carl Müller. Schiffner gives the following summary of the Hepaticae (up to July 1893): Ricciaceae, 4 genera, 110 species, of which 3 genera and 28 species are found in Europe; Marchantiaceae, 22 genera, 165 species, of which 17 genera and 28 species are European; Jungerm.-anakrogynae, 19 genera, 266 species, of which 12 genera and 34 species are European; Jungerm.-akrogynae, 116 genera, 3,321 species, of which 53 genera and 232 species are European; Anthocerotaceae, 3 genera, 103 species, of which 2 genera and 10 species are European.

THE INDIANA Academy of Sciences held its tenth annual meeting at Indianapolis on December 27th and 28th. Of the eighty-nine numbers on the program, thirty-one were botanical subjects, or 35 per cent. The officers elected for 1895 are Mr. A. W. Butler, president, and Mr. John S. Wright, secretary. The Iowa Academy of Sciences held its ninth annual session at Des Moines on the same dates. Of the fifty-five numbers on the program, eleven were botanical, or 20 per cent. It should be noted, however, that three were only to be presented "by title," i. e., were not to be read. The Ohio Academy of Science held its fourth annual meeting at Columbus on December 27th and 28th. Of the fifty-three numbers on the program, nineteen were botanical subjects, or 36 per cent.

THE REPORT of the Gray Herbarium for the year 1893–94 (September to September) contains the following items of general interest. Plants received, 8,787; number of sheets added, 9,675; number of volumes added to library, 231, of pamphlets, 241. The botanical collector for the Herbarium, Mr. Pringle, with two assistants, is exploring Oaxaca, reputed to be the richest region of Mexico botanically. Dr. Robinson and Mr. Schrenk collected for six weeks in Newfoundland, and brought back some very interesting material; collections and library have been card-catalogued; work on the "Synoptical Flora" has about closed the largest gap (*Cruciferæ*) left in Dr. Gray's manuscript of the first volume, which is to include *Ranunculaceæ—Leguminosæ;* L. H. Bailey's revision of "Field, Forest and Garden Botany," is announced for January, 1895.

THE INSECT THEORY to account for the disease of potato tubers known as "scab," had been completely overthrown, as every one thought, by the bacterial theory, now fully established as fact. Yet at this late time we are shown by Mr. A. D. Hopkins (Proc. Ent. Soc. Wash. 3: 149) of the West Virginia Experiment Station, that one form of the scab may certainly be produced by a small gnat, about a millimeter long, the larvæ which are the depredators being four times that length. The larvæ eat into the potato wherever the periderm is injured. The investigator scratched his initials upon a potato tuber and the insects (Epidapus scabei) turned the injured surface into a scab mark, in a similar way to Dr. Thaxter's well-known initial-mark test with bacteria (Oospora scabies). The distribution of the gnats outside of West Virginia has not yet been ascertained.

Mr. O. F. Cook is expected to return to this country in May from his rather extended African sojourn. Mr. Cook is in the employ of the American Colonization Society, and his nominal duties are the foundation of an agricultural and mechanical school to which the Liberian government has donated a tract of 1,000 acres for an experimental farm in the interior of the country. He has, however, sufficient time and freedom in which to make large collections, and will return with much valuable material, especially cryptogams. His first visit to Liberia was in 1891-2. After spending a few months in America, during which he married Miss Alice Carter, known to our readers by her contributions to our pages on the subject of pollination, he returned to his African duties in October, 1893, accompanied by Mrs. Cook. The last rainy season, ending in December, was spent in the Canary islands where he has also made some collections.

Professor John Macoun has published in *Trans. Roy. Soc., Canada* (Section IV, 1894) a paper on the forests of Canada and their distribution, with notes on the more interesting species. He speaks very strongly of their ruthless devastation, and gives many unhappy results of this vandalism. The following regions are discussed separately: subarctic belt, Prince Edward Island, Nova Scotia and New Brunswick, Quebec, Ontario, Manitoba and the Northwest Territories, Rocky Mountains and British Columbia, Vancouver Island. Some very interesting remarks are made on the distribution of certain species, and the changes observed in those which have an east and west continental distribution. He states that, including Vancouver Island coniferous forest extends from the Pacific to the Atlantic, bounded on the north by the tundra of Alaska and the Barren Grounds of the Dominion, and southerly with a varying border until it meets and intermingles with the poplar forests of the Northwest Territories, and eastward with the deciduous forests of Ontario, etc. He estimates this huge forest belt as containing about a million square miles.

An explanation of the appointment of an International Committee on Nomenclature by the Genoa Congress (1892) was given by Ascherson and Engler at the Vienna meeting last September. This paper now comes as a separate from *Oesterr. bot. Zeit.* 45: 27. 1895. A review is given of the recent nomenclature discussion, the unhappy results of various extreme views are pointed out, and the following suggestions are offered for consideration: (1) That the rule for homonyms be recommended for future guidance, and be not made retroactive; (2) that in the generic transfer of a species the original specific name be retained according to the rule; (3) that the year 1753 be the datum-line for priority of both genera and species; (4) that while the principle of priority shall be used in the naming of the species a safe name shall not be replaced by a doubtful one; (5) that in the naming of genera, a name which has been ignored for at least fifty years shall not replace one which has been in use during that time; (6) that an exception be made to this rule in the case of generic names that have been in use at least fifty years since their restoration.

PROFESSOR L. H. BAILEY, in a recent address before the Biological Society of Washington, discussed the subject of the plant individual in the light of evolution. He suggests the idea that both Lamarckism and Darwinism are true, but that the former finds its expression best in animals and the latter in plants. His chief points, however, are: (1) that the plant is not a simple autonomy, in the sense in which the animal is; (2) that the plant parts are independent in respect to propagation, struggle for existence, and transmission of characters; (3) that there is no essential difference between bud-varieties and seed-varieties; (4) that all these parts are at first sexless, and finally may or may not develop sex; (5) that much of the evolution of the vegetable kingdom is accomplished by wholly sexless means.

Professor Bailey's conception of a plant, therefore, seems to be that it is a colony of potential individuals, each one of which is capable of working out its own independent development under the various influences of environment. If this be true there can be no localization or continuity of a germ plasm in the sense in which these conceptions are applied to animals.

FROM ADVANCE sheets of the Report of the Missouri Botanical Garden we take the following: The financial results for the past year have been very satisfactory considering the depressed condition of trade. The surplus Dec. 31, 1893, amounted to $40,649.75; $19,824.18 have been added in 1894, making the total surplus $60,473.93. No extensive improvements have been made, but the addition of a plant-house 21×97[ft], costing about $2,700.00 and several granitoid ponds for the growing of the Victoria regia and other lilies have added greatly to the beauty and attractiveness of the Garden. The fruticetum has been further improved this year by the removal of all of the old and worthless apple trees and grape vines and is to be largely replanted in the spring to carefully selected varieties of fruit. While much remains to be desired, the labeling of the plants of the Garden is being greatly improved each year. The enamel (granite ware) tree labels which were at first tried have not proved satisfactory, and trees of sufficient size are now receiving zinc alloy labels cast with raised letters, affixed by two pins in a vertical line so as to admit of the expansion of the tree during growth. For the smaller plants, celluloid labels, lettered with a special ink, have been employed very largely. The herbarium has been increased by the incorporation of 9,307 sheets of specimens, of which 3,567 sheets were purchased, 126 belonged to the Bernhardi herbarium, and 5,614 were received by donation or exchange. About 1,220 duplicates have been distributed to correspondents by way of exchange. As now constituted, the herbarium contains about 231,527 specimens. The additions to the library consist of 373 books and 166 pamphlets purchased, and 379 books and 999 pamphlets, donated or received by way of exchange. Exclusive of the Sturtevant pre-Linnean collection of about 460 volumes, the library now contains 7,631 books, 9,822 pamphlets, a total of 17,453 works, and 110,000 index cards, exclusive of the author catalogue.

BOTANICAL GAZETTE

MAY, 1895.

The development of botany in Germany during the nineteenth century.

EDUARD STRASBURGER.

AUTHORIZED TRANSLATION BY GEORGE J. PEIRCE.

[The following paper was published in 1893 in the second volume of the great and expensive work, *Die Deutschen Universitäten*, which the German Imperial Government prepared for the World's Columbian Exposition at Chicago. Its translation and publication in the BOTANICAL GAZETTE have been authorized by Professor Strasburger and by the Editor of the government publication in which it appeared. Since it forms the only supplement, so far as I know, to Sachs's "History of Botany," and brings the account to date, I have thought it would be extremely useful to American and English readers. The original publication is costly and not generally accessible, another reason for presenting it in English.—G. J. P.]

During the last half century Germany has been accorded a very high rank in botanical science. One evidence of this is that the botanical establishments of the German universities are able to congratulate themselves on being the resort of foreign botanists. It may safely be asserted that the impulses which, during this century, have carried botanical investigation into new lines, have been given in many cases by the teachers at the German institutions of learning. In purely systematic work England has held first place until recently, and now Germany is becoming her more and more successful competitor. The objects of botanical inquiry, like those in other departments of biology, were greatly affected by the theory of selection emanating from England, which Germany quickly accepted. For the theory of descent, which found fresh support in Darwin's theory of selection, the ground was well prepared, so far as botany was concerned, by Hofmeister's researches in comparative morphology.

The first decades of this century were devoted mainly to anatomical investigations, but at that time attention was given almost entirely to the fully developed tissues and the solid cellular framework of plants. In the course of these researches the methods of investigation were improved, and observations were no longer made on crushed or torn objects, but on delicate sections. The improvements in microscopes, which were made at the same time, greatly aided such studies; and when one compares the figures made in successive decades, one sees how great have been the advances in the graphic reproduction of the objects seen. One may say that this sort of investigation of the plant body reached its fullest development during the thirties, and that the works of HUGO VON MOHL (of Tübingen, died in 1872) are its crowning achievements. By M. J. SCHLEIDEN (1839–1863 in Jena, died in 1881) the life history of plants was brought into prominence and declared to be the necessary foundation of every morphological conception. Schleiden's works were also the first in which the attention of investigators was directed to the cell-contents. From this time on, morphological study with the microscope began to develop in different directions; one which, at the same time that notice was taken of the development, was but the continuation of the former phytotomic researches, anatomy strictly so-called; another, which concerned itself with the cell-contents, cell-structure, and the origin of the tissues, histology; the third, whose main problem was the development of the members of the plant body, the solution of which was sought by the study of growing points and of forming embryos. These three directions were indicated by Schleiden and NÆGELI (of Freiburg and Munich, died in 1891), in part by the latter only. A contemporary of Schleiden, Nägeli excelled him in keenness of understanding, in critical power, and in observing faculty.

Nägeli's researches into the growth of the stems and roots of vascular plants, published in the year 1858, laid the foundations of plant-anatomy. In this work Nägeli developed from the purely morphological standpoint a classification of tissues, distinguished various types of growth, and finally traced the course and arrangement of the fibro-vascular bundles in the plant. Phytotomic investigation with morphology as the foundation was carried on by H. von Mohl, Schacht, Dippel, Frank, Count Solms-Laubach, Sanio, and von Hanstein. Of these, SANIO (a teacher in Lyck, in East Prussia, died in 1891) undoubtedly won most credit. His work, without the least loss in value, was put somewhat into the background in 1877, when the "Vergleichende Anatomie" of A. DE BARY (at Freiburg, Halle, Strassburg, died in 1888), appeared. This book codified and extended our knowledge of plant anatomy, and established a nomenclature of the tissues which still holds good. The anatomical work of L. KNY (of Berlin), E. STRASBURGER (of Jena, now in Bonn), and H. SCHENCK (docent in Bonn) followed essentially the same direction.

Many celebrated investigators in other lands took part in the development of morphological phytotomy, but it is not for me to describe their labors here, since this can be a historical survey of the work of the German universities only, especially those of the German Empire. This limitation will naturally cause the sketch here presented to be very incomplete, and may even make it appear as though credit were given to the investigators at German institutions of learning for work in which they were merely participants with others. This possible reproach must be met by the frank acknowledgment of the limitations here necessary.

In contradistinction to that form of anatomy in which comparative morphological and, of late, in conseqence especially of Strasburger's work, phylogenetic characters were considered the essentials in estimating the importance of the tissues, there developed in the seventies the so-called physiological-anatomy. This new direction was given to the subject by SCHWENDENER (of Tübingen, now of Berlin) in his book "Das mechanische Princip im anatomischen Bau der Monocotylen," which was published in 1874. Schwendener's pupils work along this line, and the most talented of these, G. HABERLANDT (of Graz), attempted in 1884 to give a complete outline of physiological plant-anatomy.[1] Physiological plant-anatomy is a part of physiology, and as such it has led to conspicuous achievements. It has brought confusion into anatomy only in so far as it has attempted to establish its conceptions in the place of strictly morphological ones.

THEODOR HARTIG (Berlin, Brunswick, died in 1880), whose peculiar terminology rendered an understanding of his conceptions so difficult that they were often less regarded than they deserved, went his own way in the study of anatomy, though following essentially the morphological direction. Indeed, Th. Hartig was a keen observer, and many a discovery since made can be pointed out in his writings as a fact already known to him.

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[1] Physiologische Pflanzenanatomie. Leipzig, 1884.—G. I. P.

The cell-theory which Schleiden set forth in 1838, soon showed itself to be defective, but it is nevertheless of great historical importance. It stimulated Th. Schwann to the microscopical investigations of the similarity in the structure and growth of plants and animals, which he published one year later; and it directed the attention of all to the contents of the cells. Soon Nägeli published his, for that time, remarkable researches into the formation and division of cells. H. Mohl also turned his attention to this new direction, exhaustively studied the appearance which the nitrogenous portions of the cell-contents display during their constant changes of form, found that they present for the most part the phenomena of streaming, and gave to them the name of *protoplasm.* In the year 1850, FERDINAND COHN (of Breslau) emphasized the identity of the contractile substance of animal cells with the protoplasm of plants, and this induced the zootomist Max Schulze, of Bonn, in 1863, to extend the name of protoplasm to the living substance in the whole organic kingdom. The minute structure of vegetable protoplasm was described by N. PRINGSHEIM (Jena, Berlin [2]) in a way which is valuable to this day, and our insight into its nature was thereby greatly advanced. On the other hand no investigations into cell-formation and cell-division, as they were conducted by Nägeli, Mohl, Pringsheim, Hofmeister, and others, could go beyond a certain point, and necessarily led in part to fallacious conclusions, so long as they were conducted on living, or at least not "fixed" objects. E. Strasburger was the first to conduct such investigations on suitably hardened material. In the first edition of his "Zellbildung und Zelltheilung" in 1875, this method was systematically employed. Combined with the most extended investigations, which included the whole vegetable kingdom, and parts of the animal kingdom as well, this method led to general results which applied to the whole organic realm. This publication stimulated manifold researches, especially by the animal histologists, which extended, and in various ways corrected, the statements of its author, without, however, impairing the value of the most important results therein set forth. Strasburger himself, in the third edition of the book in 1880, was able to trace back free cell-formation to the general phenomena of the origin of cells; and in subsequent

[2] Died in Berlin, October 6, 1894.—G. J. P.

publications, he pursued the further development of the question. While the material studied for the first publication of the book was nearly all unstained, in further observations stained objects were used, and in the course of these investigations microscopic technique made not the least important of its advances.

From the moment when the attention of investigators was turned to the contents of cells, further researches into the nature of the bodies enclosed within the body of the cell itself had to be undertaken. Special studies of starch-granules, chlorophyll bodies, aleuron-grains, and the like, were made by Nägeli, J. Sachs, Th. Hartig, W. Pfeffer, W. Schimper, Fr. Schmitz, Arthur Meyer, Zimmermann, and others. In this series the discovery of the amylogenic bodies by W. SCHIMPER (of Bonn), was of fundamental importance.

Nägeli's mathematical talent, and his desire to fathom the causes of these phenomena, led him to deduce from the phenomena of swelling, double-refraction, growth, and from the visible structure of stratifications and striations, a theory as to invisible structure of organized bodies. The stratification of cell-membranes has since been shown by DIPPEL (Professor at the Polytechnic School in Darmstadt), FR. SCHMITZ [3] (in Greifswald), Strasburger, NOLL (docent in Bonn), and KRABBE (docent in Berlin), to be due to growth by apposition. Although the theory of growth by intussusception is no longer held in the sense in which Nägeli conceived it (for the double refraction of organized bodies has presumably other causes than those assigned by Nägeli), yet his micellar theory remains as a brilliant conception which must hold a high place in the history of our science. Recently Wiesner (of Vienna) has put forth other views as to the elementary structure and the growth of living-substance, which are quite opposed to those of Nägeli. On the other hand, G. BERTHOLD (Göttingen) has sought by his studies in the mechanics of protoplasm [4] to explain by physical causes the structure, the formation, and the movements of the body of the living cell. Similar investigations of the zoological aspects of the question have been published by Bütschli and by the physicist Quincke. The chemical constituents of the living cell have occupied the attention of REINKE (Göttingen, now in Kiel), ZACHARIAS (of

[3] Died January 28, 1895.—G. J. P.

[4] Studien über Protoplasmamechanik; Leipzig, 1886.—G. J. P.

Strassburg), and especially of FRANK SCHWARZ (at the Forestry Academy at Eberswalde).

The tendency to give a mathematical aspect to observed phenomena controlled Nägeli's investigations of apical growth, which he published in 1845. In a similar way, but with independent broadening and deepening of the problem, W. HOFMEISTER (Heidelberg, Tübingen, died in 1877), followed the course of development of the organs of the plant from the processes of division which take place in growing points and embryo and in 1851 published his now famous comparative researches on the germination, development, and fruiting of the higher cryptogams, and the formation of seeds in the Coniferæ. Those researches laid the foundations for a phylogeny of the vegetable kingdom ten years before the appearance of Charles Darwin's "Origin of Species." The value of a knowledge of development, of morphological comparisons based on exhaustive investigation, was thus set in a new light, and a broad field was opened for further study. That many single statements in this book were erroneous does not in any way diminish its value, for this rests on the broad foundation of the whole work.

Hofmeister's remarkable ability to comprehend the homologies of the most remote divisions of the vegetable kingdom, gave permanent value to his morphological comparisons. At the same time, the gulf which seemed to separate the cryptogams from the phanerogams was bridged by Hofmeister's discoveries, and the processes which take place in the formation of the embryo among phanerogams, were set in their proper relations with the alternation of generations among the higher cryptogams. In the field thus opened by Hofmeister, Pringsheim labored with similar objects in view, but with limitations of the problem, and his achievements are now classical in every detail. Gaps in our knowledge have been closed by the valuable contributions of METTENIUS (Leipzig, died in 1866), CRAMER (of Zürick), von Hanstein, Kny, and Strasburger. LEITGEB (of Graz, died in 1888) devoted to the Hepaticæ seven full years of the most careful study along similar lines. The value of these researches, which laid bare the origin, development and homologies of the organs of the plant, will be permanent, despite the fact that the early investigations, inaugurated by Nägeli, of the processes of division which take place at the vegetative point have lost the importance which was once attributed to them; for Sachs has shown that the arrangement of the elements at vegetative points is not of morphological significance, but is controlled by mechanical conditions.

Schleiden's investigations into the formation of the embryo of phanerogams, which date from the year 1837 on, led him curiously astray. He considered that the embryo originated from the tip of the pollen-tube, and that the ovule was merely the place in which it was further to develop. If this were so, then there would be no sexuality in plants, and a comparison with the phenomena of fertilization in the animal kingdom would be quite out of the question. Schleiden's views found warm defenders, but in 1849 Hofmeister came out clearly in opposition to him, in a very comprehensive work. (Amici, in Italy, had already in 1842, taken such a stand). Hofmeister proved beyond controversy that the egg (germinal-vesicle) was already formed in the ovule, and that it was fertilized by the contents of the pollen-tube. He did not arrive at the current notion of the structure and phenomena of the sexual apparatus. These were first made clear by Strasburger in 1877. In the same paper Strasburger showed also that the hitherto supposed cases of parthenogenesis among phanerogams were due to the adventitious formation of embryos by non-sexual branching of the nucellar tissue into the cavity of the embryo-sac. Since the number of such branchings is indefinite, it is at once evident why, in the supposed cases of parthenogenesis, polyembryony is so common. Two years before (1869) it had already been demonstrated by Strasburger that the so-called corpuscula of the Coniferæ are true archegonia, and that their contents represent a single egg.

In 1880 KARL FRIEDRICH SCHIMPER (a scientific man who occupied no public office, and who died in 1867, at Schwetzingen) established the new theory of phyllotaxy, which attracted due notice, and became further developed and carried to formal completion in the writings of ALEXANDER BRAUN (Freiburg, Berlin, died in 1877). This theory assumed, in consequence of Braun's idealistic conception of nature, the form of abstract principles which controlled the processes of development in the body of the plant. Hofmeister was the first, in 1868, to attempt to explain the observed regularity in the arrangement of members on a common axis, and their spiral sequence, by reference to definite mechanical causes. The mechanical basis for the theory of phyllotaxy was completed in Schwendener's writings (1878), which showed that mechanical and geometrical conditions, especially the pressure exerted upon one another by the young members forming on the common axis, control the regularity of their positions in relation to each other. In the same way K. SCHUMANN (Custodian in the Botanical Museum at Berlin) is now attempting to explain the arrangement of floral organs.

Closely akin to Braun's work, in that he established certain types, which, however, he considered to be phylogenetically the true starting points of later variations, W. EICHLER (Graz, Kiel, Berlin, died 1887) published in 1875 and 1878 the two volumes of his "Blüthendiagramme." These are founded on general comparative investigations of the mature form, supplemented by a study of the development. From a similar stand-point PAX (Custodian in the Botanical Garden at Berlin), wrote his "Handbuch der allgemeinen Morphologie der Pflanzen" which appeared in 1890. K. GOEBEL (Rostock, Marburg, Munich), on the other hand, tried in his "Entwickelungsgeschichte der Pflanzenorgane," published in 1883, to be independent of the morphological ground-plans, to consider the distinct members of the body of the plant for themselves, and to be directed in their comparison only by the homologies. Development and comparative morphology are to him the most important aids in organography.

Although the philosophical element in Braun's most important work, concerning rejuvenation in nature, published in 1851, is contrary to the principle of cause, which is now the basis of scientific thought, yet this work still holds attention because of the freshness of its descriptions and the affectionate absorption of the author in his problem. For this reason the work contributed no slight stimulus to the further study of the lower cryptogams, especially of the Algæ. Thuret performed certain experiments in 1853 which demonstrated the sexuality of the *Fucaceæ*, but he attributed fertilization to the effects of the contact between spermatozoid and egg. Pringsheim was the first to show, in his researches published in 1855, that in generation "a mingling of the whole spermatozoïd mass with the fructifying sphere takes place." Important works by Pringsheim, which made clear the whole development of various groups of algæ, and of the alga-like *Saprolegniœ* followed in subsequent years. Other valuable researches by Ferdinand Cohn, de Bary, PFITZER (Heidelberg), Goebel, Berthold, Fr. Schmitz, Reinke, and other German investigators supplemented them, but in 1869 Pringsheim made another remarkable contribution to this field of knowledge by his discovery of the copulation of gametes (zoospores).

Early in the sixties the impulse to a reform in the study of the Fungi was given by de Bary in Germany, while Tulasne had already done the same in France. It was de Bary who, more than any one else, perfected the methods of investigating the Fungi, directed researches into decisive lines, and laid the foundations for the results which this department of knowledge was soon able to show. After him O. BREFELD (Münster) took the lead by his achievements in this field, and since 1872 has devoted himself to studying the development of fungi, beginning with a single spore and tracing its development to the end. Brefeld's methods, extended and adapted to the field of bacteriology, have produced great results. De Bary first effected the artificial infection of a host by a fungous parasite, but Brefeld was the first to succeed in cultivating typical parasites in nutrient solutions, thus making them saprophytic. By de Bary's investigations, our notions of the alternation of generations among the Fungi were brought within the true limits, while Brefeld leveled the ground for the construction of a natural classification of the Fungi, and considerably limited the statements as to sexual differentiation in this group.

The demonstration of the fact that lichens are symbiotic double organisms, depending upon the union of ascomycetous (rarely hymenomycetous) fungi with algæ, attracted general attention. In 1860 and 1868, in the first two parts of his researches into the lichen thallus, Schwendener declared the gonidia to be the terminal cells of short lateral branches of the hyphæ. In 1866 de Bary led up to the true idea of the lichen thallus in the gelatinous lichens, and spoke the words which solved the whole problem and brought about the right conception of all lichens. This final step was taken by Schwendener in the supplement to the last part of his "Flechtenstudien," and was repeated still more decisively in his "Algentypen der Flechtengonidien," published in 1869. In basing this conception on studies in development, STAHL (of Jena) has won most credit in Germany. Further questions as to the presence of sexes in lichens, and as to the structure and development of their organs of fructification, have been pursued especially by Stahl, FÜNFSTÜCK (docent in Stuttgart), and G. Krabbe. Alfred Möller succeeded in Brefeld's laboratory in cultivating lichens saprophytically, and without the algæ, in nutrient solutions.

The appearance in 1865 of "Die Experimentalphysiologie der Pflanzen," by JULIUS SACHS (Freiburg in Baden, Würzburg), marked an epoch in the development of vegetable physiology. The work at once restored vegetable physiology to its place at the center of scientific research, whence it had been pushed aside by the increased interest in anatomical investigation. The work did this the more successfully since it contained not merely a clear and well arranged review of the achievements of former times, but also the fundamental investigations of its author which extended to nearly all of the divisions of physiology. The number of physiological researches which were then carried on by Sachs himself, and by his pupils, grew from year to year, and were for the most part published in the Arbeiten des botanischen Instituts zu Würzburg. These researches concerned all divisions of physiology, but especially the relations of plants to those external forces which operated upon them. PFEFFER (Basel, Tübingen, Leipzig) developed especially the physical side, and during the last twenty years has produced a series of most remarkable works. His investigations of the chemotactic movements awakened special interest, for they explained, at a single stroke, as the attraction of definite organisms by chemical substances, the until then enigmatical influence which the sexual products exert, even at a distance, upon each other. His "Handbuch der Pflanzenphysiologie," which appeared in two volumes in 1881, at once became indispensable to every botanist. GEORG KLEBS (of Basel) has since then especially developed the physiology of the vegetable cell; phototactic phenomena were exhaustively studied by Strasburger and Stahl; W. DETMER (of Jena), and W. Schimper have distinguished themselves in the field of physiology of nutrition, and many valuable contributions to our knowledge of this subject have been made by B. FRANK (professor at the Agricultural College in Berlin). We are indebted to A. HANSEN (of Giessen) for good chemico-physiological contributions, Besides Sachs, ROBERT HARTIG (of Munich), Schwendener and Strasburger have especially interested themselves in the problems of the movement of water in the plant; while ALFRED FISCHER (Leipzig), and others have been concerned with the transfer of food-materials. Concerning the physiological phenomena of irritability, in addition to the fundamental labors of Sachs, the researches of WORTMANN (professor at the Academy in Geisenheim), of VOCHTING (Basel, Tübingen), and especially of FR. NOLL (docent in Bonn), have found well merited respect.[5] An attractive presentation of our entire physiological knowledge was given in Sachs's "Vorlesungen über Pflanzenphysiologie,"[6] the first edition of which was published in 1882. The phenomena of the irritability of the living substance were there thoughtfully set forth, and their importance in the true estimation of the phenomena of life clearly elucidated.

Our knowledge of the reproductive processes has gained merely a firm morphological basis. Strasburger especially has contributed to this during recent decades. The physiology of reproduction is still, for the most part, on speculative ground; but it was notably advanced in 1884 by Naegeli's mechanico-physiological theory of descent, in which the idioplasm theory was first formulated. Naegeli's observations on the production of bastards, on the conditions for the appearance of species and varieties, and his studies, extended through years, of the intermediate forms among the Hieraciums, are to this day important contributions to the phenomena of genera and development.

Thanks to Darwin's classical work on the arrangements for pollination among the orchids, the attention of students was directed to a very remarkable book by Christian Konrad Sprengel which, published in 1793, remained quite unnoticed and had practically disappeared. In all parts of Germany, workers turned their active attention to this subject, and in consequence, Sprengel's assertions were generally confirmed, often extended, and in many essential points given their correct significance. FR. HILDEBRAND (Freiburg in Baden) was the first to distinguish himself in this direction; but HERMANN MÜLLER (teacher in Lippstadt, died in 1883)

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[5]No one will doubt that Pfeffer's name was only unintentionally omitted, and that it deserves a prominent place in this list.—G. J. P.

[6]Translated and published in English in 1887.—G. J. P.

especially did so in the numerous writings in which he described the arrangements for pollination in flowers. This is still a promising field for investigation, and busies many students, merely to name whom space here forbids.

The investigation of the phenomena of pollination of flowers, and of the striking adaptations between flowers and insects, which here present themselves to students, greatly promoted the study of adaptations in general. These are now comprehended under the general name of biology but, under the name of ecology or the study of adaptations, would better form a part of physiology. We are indebted to Hildebrand, Stahl, VOLKENS (docent in Berlin), but especially to Goebel and Schimper, for valuable contributions to this subject. The last named has contributed material of remarkable value bearing upon the problems of plant-geography. A distinct field of physiology was opened by Vöchting's striking work on the apex and base of plant members, on the inner polarity of the plant body, and on the related phenomena of regeneration.

[*To be concluded.*]

Bonn, Germany.

CHAMBERLAIN on ASTER NOVÆ-ANGLIÆ.

CHAMBERLAIN on ASTER NOVÆ-ANGLIÆ.

The embryo-sac of Aster Novæ-Angliæ.

CHAS. J. CHAMBERLAIN.

WITH PLATES XV AND XVI.

In its early history the ovule of *Aster Novæ-Angliæ* presents little to distinguish it from the well known types of Compositæ. Its anatropous character is already obvious, and its only integument is almost as conspicuous as the nucellus itself, when the archesporium appears. This cell undergoes the expected divisions and, of the four resulting cells, the one farthest from the micropyle is usually, but not always, destined to become the embryo-sac.

Development of the macrospore.

In tracing the early stages in the development of the embryo-sac, I employed methods suggested by Auerbach's researches.[1] He emphasized the significance of the fact that if a preparation containing both spermatozoa and ova be stained with some combination like Biondi-Ehrlich, the nuclei of the spermatozoa take the green while those of the ova prefer the red. He proposed the terms, cyanophilous and erythrophilous to indicate these preferences. Since 1891 a few attempts have been made to obtain analogous results in plants. It is not very difficult to differentiate the nuclei of the pollen grain. The generative nucleus takes the green while the vegetative prefers the red, but I was not able to find a single green nucleus in the embryo-sac. The mother cell of the embryo-sac and also the four cells resulting from its division, stain red. At the first division of the nuclei of the embryo-sac the resulting nuclei stain red. It might be noted, however, that the nucleus which produces the egg apparatus sometimes differs in appearance from the one which gives rise to the antipodal cells. In all the stages which precede fertilization the nuclei stain alike, even the two polar nuclei which unite to form the endosperm-nucleus. Since some have imagined this fusion to be a sexual process, I took particular care in staining, but

[1] AUERBACH, LEOPOLD:—Zur Kenntniss der thierischen Zellen Sitzungsb. der Kgl. preuss. Akademie der Wissenschaften, 26 Juni, 1890, and "Ueber binen sexuellen Gegensatz in der Chromatophilie der Keimsubstantzen," in the same journal of 25 Juni, 1891.

even when the pollen grains and active glands were taking a brilliant green, the fusing nuclei persisted in taking only the red, thus indicating that the fusion has no relation to a sexual process.

With the formation of the endosperm-nucleus the embryo-sac completes its preparations for fertilization. All my figures, except fig. 3, are drawn from embryo-sacs in which the endosperm-nucleus is already formed.

The mature embryo-sac.

The mature sac is surrounded by a beautifully distinct wall of tapetal cells, *t*, figs. 1, 2 and 3, filled withdense protoplasm remarkably free from vacuoles. The egg apparatus usually occupies the micropylar sixth of the sac and displays that reluctance to vary which characterizes structures directly concerned in reproduction. Indeed, there is such uniformity that one knows beforehand just where to focus his mind and microscope to catch the elusive outlines of the synergidæ and micropylar portions of the ovum.

The egg occupies from one-half to four-fifths of the entire diameter of the sac. It well deserves the name, oösphere, for it is often a perfect globe. Usually, however, the egg is pear-shaped, with the smaller end nearest the micropyle; but whatever its shape, there is almost invariably a large vacuole, occupying the greater part of the interior. Below the vacuole in a dense mass of protoplasm, is the egg-nucleus.

The two synergidæ generally fill the entire diameter of the sac. They are somewhat ovate in form and extend from the micropyle to about the middle of the ovum. Their nuclei do not seem to have any favorite position, for they are found, sometimes at one end of the cell, sometimes at the other, but perhaps, more frequently, near the middle. In a few specimens I found the nuclei doubled but never found more than two synergidæ. In two or three cases the principal vacuole was found in the micropylar end, but its usual position is at the opposite extremity. Like the egg, the synergidæ are not protected by any membrane.

As one glances at the mature embryo-sac, its most conspicuous feature is the endosperm-nucleus. Its nucleolus is large, dense and apparently homogeneous, if we except one or more globules which are invariably present. When xylol is used to precede the paraffine, these globules become extremely refractive and seem to be composed of oil. Connecting the nucleolus with the nuclear membrane are delicate radiating filaments. Fig. 2 represents a typical egg-apparatus with its two synergidæ and ovum. The large endosperm nucleus lies just below the egg.

In tabulating measurements of various features of the embryo-sac, I was so impressed by the uniformity in the size of the nucleoli of the egg-apparatus and secondary nucleus that I will give some of the measurements here. The length of the mature sac varies from 250 to 300μ, its diameter at the egg from 35 to 45μ, the diameter of the egg from 22 to 28μ, that of the egg-nucleus from 10 to 13μ, and that of the endosperm-nucleus from 16 to 20μ. The nucleoli, however, presented an unbroken uniformity, the endosperm-nucleolus measuring almost invariably just 10μ, the egg-nucleolus 6μ, which occasionally inceased to 7 or 8μ. The nucleoli of the synergidæ usually measured 4μ, although in a few cases, they reached a diameter of 5 or 6μ.

Development of the antipodal region.

The uniformity which characterizes the egg-apparatus and secondary-nucleus is left behind when we descend to the antipodal region. For this very reason the antipodal cells of *Aster Novæ-Angliæ* furnish an exceptionally interesting field for investigation. The text-books would lead us to expect just seven cells in the mature embryo-sac, and indeed, in the case before us, the sac is often found in this stage, with its egg, two synergidae, secondary-nucleus and three antipodal cells. But previous to the formation of the secondary-nucleus, the antipodal cells frequently enter upon a career of development which can hardly fail to attract attention. My results here do not agree very well with those of Martin, [2] published in this journal. He finds no walls on these cells, finds no cross partitions, never finds more than four antipodal cells and those never arranged in a single longitudinal row. I find that even when there are *only* three antrpodal cells, they form membranes and are usually arranged in a single longitudinal row; also that when there are more than three antipodal cells, one or more cross partitions are found. From my preparations of Aster and Solidago I should conclude that cell walls, cross partitions and longitudinal arrangement

[2] Development of the flower and embryo-sac of Aster and Solidago. Botanical Gazette **17**: 406. D. 1892.

were the rule in these two genera. My sections of embryo-sacs, which were just approaching maturity, resemble Martin's figures and lead me to suspect that his conclusions have been drawn from material in an early stage of development.

Strasburger has noted that there are sometimes more than three antipodal cells, and Mottier[3] figures a case in which each of the three cells has divided.

In rare cases I found just three antipodal cells, each with a single nucleus, three cells with doubled nuclei were not quite so rare, while the condition represented in the figures was not at all uncommon. In fig. 2 we have six antipodal cells, arranged in a single longitudinal row, with the divisions approximately in the same plane. Fig. 11 shows seven antipodal cells which present more complexity in their arrangement. Fig. 13 has nine antipodal cells with still another variation in the plane of division. Fig. 3 goes a step farther and displays thirteen cells. The first three of these cells, of course, arise from free cell formation, but when the number exceeds three, the extra cells are produced by cell division with the formation of partitions. If the partition is not formed at the first division of the nucleus, as in fig. 11, *k*, I am inclined to think that it will not be formed later, at least I have not seen anything which would lead me to believe that partitions are formed after the nuclei have begun to multiply, as in fig. 10.

I am well aware that the doubling of nuclei is not unusual in these cells, but neither my reading nor my preparations of other embryo-sacs foreshadowed the condition represented in fig. 13 where we have thirty nuclei in a single section. Fig. 10 shows twenty nuclei in one section of a single cell. The occurrence of mitotic figures proves that these nuclei multiply by indirect division, but whether they multiply by fragmentation also, I am not prepared to say, although some of the cases figured would suggest such a possibility.

The homology of the antipodal cells has long been a subject for controversy. Without reviewing theories, it seems to me that Strasburger was correct in making them homologous with the prothallium of the gymnosperms. This homology seems sound when we compare their origin with that of the gymnosperm prothallium, but the gymnosperm prothal-

[3]On the embryo-sac and embryo of Senecio aureus L. Botanical Gazette **18**: 245. Jl. 1893.

lium proves its title to the name by bearing archegonia. The bearing of archegonia would vindicate the claim of the antipodal cells in the same manner, but my reading has failed to furnish a single instance of such a phenomenon. A glance at my figures will show that the antipodal cells are not all alike, the lower one sometimes differing decidedly from the others. It is often much larger than the rest, it differs in the density of its protoplasm, appearing as if it had increased much more rapidly in size than in substance, and its nuclei resemble the endosperm-nucleus rather than the nuclei of the other antipodal cells. Figs. 1, 2, and 3 illustrate various forms of this cell with its large nuclei. The behavior of this cell recalls the free cell formation which occurs in the early history of the macrospore. This antipodal growth breaks through the layer of tapetal cells which surrounds the embryo-sac, and, continuing its development sometimes to an extent equalling half the original length of the sac, exerts a destructive effect upon the cells of the adjacent tissues. The mere tendency toward further development manifested by the antipodal cells is worthy of careful consideration.

I desire to call particular attention to the lower cell in fig. 3. I feel positive that I have discovered in this cell a veritable oösphere. It has precisely the appearance of the ordinary oöspheres of *Aster Novæ-Angliæ*, even to the position of its nucleus and vacuole and the distribution of its protoplasm. Furthermore, it has no cell membrane, thus differing in another important particular from the usual antipodal cell. It would seem that after the nucleus had divided, one of the daughter-nuclei had surrounded itself with protoplasm and become free, just as the ordinary oösphere originates and separates itself from the surrounding protoplasm of the macrospore. The fact that nuclei of other antipodal cells sometimes surround themselves with protoplasm in a way which recalls the formation of the ordinary oösphere, makes this theory seem possible. Figs. 2 and 6, *x*, furnish examples of such nuclei. It might be suggested that we have here a macrospore, in an unusual position, but a macrospore nevertheless. Whatever its real nature may be, its origin is not so uncertain. In some slides, the septum proves that this cell arises from division; in others, it may be one of the three original antipodal cells. In any case, its origin is not that of the macrospore, but that of the antipodal cell. The appearance of the accompanying bodies which present such a resemblance to synergidæ and cause a more complete likeness to the egg-apparatus of the other end of the sac, is probably accidental. This figure, like the other figures of the plates, was drawn with an Abbé camera and Zeiss 2^{mm} immersion lens, but the figure fails to show the extent of the resemblance. Lest it might be imagined that I have inverted the embryo-sac and mistaken the endosperm nucleus for the nucleus of this cell, I have drawn in fig. 4, the egg-apparatus of this same sac. It is to be noted here that all this development of the antipodal region has preceded the fusion of the two polar nuclei (fig. 4 *pn*) to form the endosperm-nucleus. It might also be added that the length of this sac is double that of ordinary sacs.

Additional evidence will doubtless be demanded by many, but the frequent occurrence of this peculiar antipodal cell in *Aster Novæ-Angliæ* leads me to believe that other instances of this phenomenon will be discovered. Indeed, like the unnoticed centrosomes, they may even now be awaiting observation on the slides of earlier investigators. The more conservative may ask that the history of this alleged oösphere be traced at least a few steps further before they allow its right to the name. Let fertilization and the formation of an embryo be observed. It is to be regretted that my material was collected for the purpose of studying the earlier development of the embryo sac rather than the formation of the embryo itself, and consequently the search for another antipodal oösphere, to say nothing of these later stages, is necessarily deferred.

Since reading Strasburger's recent discussion of the periodic reduction of chromosomes,[4] I have been curious to know the number which prevails in the nuclei of these antipodal cells, but as my material was collected late in October, after several severe frosts, mitotic figures were very infrequent and I have not yet been able to obtain any reliable results. Guignard's statement, that in lilies the nucleus which gives rise to the egg-apparatus is constant in its number of chromosomes, while that which produces the antipodal cells varies, is of interest in considering this irregular region.

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[4] On the periodic reduction of chromosomes in living organisms. Annals of Botany **8:** 281. Ag. 1894.

Other Compositæ.

In pursuing these studies, I have made preparations of several other Compositæ, and in Solidago especially I have found considerable irregularity in the number and arrangement of the antipodal cells, but in no other have I found such extensive variation as in *Aster Novæ-Angliæ.*

Methods.

Absolute alcohol, saturated aqueous solution of picric acid, and 1 per cent. chromic acid were used in fixing material for this work. The smaller heads were merely halved; the larger heads were cut into sections about one-eighth of an inch thick before placing in the fixing fluid. Picric acid gave as good results as the chromic. With either acid the fixing is complete in twenty-four hours. Picric material should be washed in 70 per cent. alcohol until all yellow color disappears. Chromic material should be washed at least twenty-four hours in cold water or twelve hours in warm. In either case the water should be changed frequently.

Xylol, followed by a mixture of xylol and paraffine was used to precede the paraffine bath. Rosen's method was also quite satisfactory. After dehydration it is briefly this: (*a*) equal parts of absolute alcohol and bergamot oil; (*b*) pure bergamot oil; (*c*) equal parts of bergamot oil and paraffine at 40° C; (*d*) soft paraffine; (*e*) hard paraffine.

All sections were serial. I did not find it necessary to cut thinner than 5μ.

With the exception of a little material which was stained in bulk with alum carmine, all sections were stained on the slide. Delafield's haematoxylin, acid fuchsin, Bismarck brown and Biondi-Ehrlich are excellent stains for this work. After many slides have been rinsed in the distilled water jar, the water becomes deeply colored. Some slides left over night in this jar to await staining in the morning showed a striking differentiation. My most satisfactory staining was subsequently obtained in this way.

Summary.

1. (*a*) The early development of the macrospore of *Aster Novæ-Angliæ* differs little from described types.
   (*b*) The formation of the secondary nucleus has no relation to a sexual process.

2. (*a*) The egg is sometimes spherical and sometimes pear-shaped.
   (*b*) The vacuoles and nuclei of the synergidæ vary in position.
   (*c*) There is a striking uniformity in the size of the nucleoli of the egg-apparatus and the endosperm-nucleus.
3. (*a*) The number of antipodal cells varies from two to thirteen. Six or seven are as frequent numbers as three.
   (*b*) The number of nuclei in an antipodal cell varies from one to over twenty.
   (*c*) The lower antipodal cell differs from the rest in size, density of its protoplasm, appearance of its nuclei, and in its effect upon the surrounding tissues.
4. The discovery of an antipodal oösphere in the antipodal region is an additional proof that the antipodal cells are homologous with the endosperm of the gymnosperms.

Acknowledgements are due Dr. John M. Coulter for his kindly encouragement and valuable suggestions during these researches.

University of Chicago.

Explanation of Plates XV and XVI.

All figures are drawn from sections of the embryo-sac of *Aster Novæ-Angliæ* and are magnified 407 diameters.

Abbreviations.—*ao*, antipodal oösphere. *en*, endosperm nucleus. *la*, lower antipodal cell. *m*, micropyle. *o*, oösphere. *on*, nucleus of oösphere. *pn*, polar nucleus. *syn*, synergidae. *t*, tapetal cells. *ua*, upper antipodal cell.

Description of figures.—*Figs. 1 and 2.* Sections through the entire embryo-sac. *Fig. 3.* Antipodal cells with an antipodal oösphere. *Fig. 4.* Egg-apparatus of Fig. 3. *Figs. 5–13.* Antipodal region showing variation in number of cells and mode of arrangement. Fig. 8 represents one of the middle antipodal cells.

Present problems in the anatomy, morphology, and biology of the Cactaceæ.

W. F. GANONG.

[*Concluded from p. 138.*]

The development of the flower is unknown, excepting for references by Goebel and others. It is likely to prove of great interest, and may throw light upon the relationships of the family, as it certainly will of the genera. Biologically it is equally unknown, Schumann, Goebel and Loew giving it but the barest reference. How is it fertilized? How generally are the stamens sensitive or the flowers dichogamous? Why sometimes so evanescent? Why are the flowers often so showy? Do they illustrate the principle of showiness in proportion to scarcity of insects ? Do the colors contrast with the background simply, or do they attract particular groups of insects ? How do the less showy Mamillarias thrive ? Is self-fertilization common ? By what animals is the dissemination of the fruit effected ? How are the dry fruits of Echinocactus and some Opuntias scattered? In berries, what is the meaning of the white and red colors; do they simply contrast with the background, or do they attract specific animals ? How are bristle-covered Opuntia berries eaten? Are they picked at by the bills of birds and neglected by mammals ? The pulp has been found in several species to be formed chiefly by the funiculus of the seed, though the wall of the hollowed receptacle co-operates. The extremely "inferior" character of the ovary of Cactaceæ leads us to question whether there be a biological reason for it. If so, is it to be found in protection to the ripening ovary, or in utilization of the receptacle to help form an edible berry ? In some species, as Goebel has shown, the seeds germinate in the fruit. What does this mean? How are such fruits scattered? Upon the surface of some fruits, new branches appear; do they occur when those fruits have seeds?

Species of Cereus often show a sudden crest, forming where the few ribs are replaced by very many. What conditions determine this ? How does the vegetative point act in the transition? The stems of several genera often show a close crowding together of the spine-clusters, suggesting that the stems shorten as roots sometimes do in the ground. Do they shorten, or is the crowding simply the result of the pressing together of the spine clusters as the curved ribs straighten out in growth? It is easy to see an advantage for the shortening, as it would allow of a considerable development of new green tissue each year without an equivalent lengthening of the entire stem, and condensation is always an advantage to them. Moreover, in some stems, when cut across, the central cylinder soon shrinks down, showing that it is exerting a shortening pull upon the other tissues. I have seen this very marked in *Mamillaria macrothele*.

In several genera, as Opuntia, Rhipsalis, Phyllocactus and Epiphyllum, flat shoots occur, differing somewhat morphologically. These are usually jointed, and the joints commonly represent a year's growth. An important question arises as to how the flattening has been produced, and this has lately been investigated by Vöchting[16] and Goebel.[17] The latter shows clearly that light exercises a direct (not intermediate through natural selection, etc.,) effect in causing the flat form and the growth of the tubercles in Opuntia, and the same probably holds good in other genera. Is it true in others and how widely? The cause of the jointing needs investigation. It is a common xerophilous character as seen in Euphorbias, Kleinia, etc. Is it primarily a growth condition or a characteristic acquired for biological advantage? In some cases at least it is utilized, for joints break off and are rolled away to start in a new place.

It is important to search for other modes of protection in addition to spines. Do any Cactaceæ have a rank odor making them unpalatable to animals? Lewin has recently proven[18] his earlier statement that *Echinocactus* (*Anhalonium*) *Lewinii*, a variety of *A. Williamsii*, contains a poisonous alkaloid,[19] and he shows also that four or five others including a Cereus and Mamillaria are likewise provided. But it is not proven that these forms are thereby protected from animals. Are they? And if so, how do animals know that they are poisonous? Is it by smell or sight? They show no warn-

[16] Pringsheim's Jahrbücher **26**: 483–494. 1894.
[17] Flora **80**: 96–116. 1895.
[18] Ber. der d. b. Gesellschaft **12**: 283. 1894.
[19] See Havard, Bull. Torr. Bot. Club **22**: 117. 1895, where *A. fissuratum* and *E. Lewinii* are said to produce intoxication when chewed.

ing colors, and if animals are not in some way allowed to distinguish the poisonous from the harmless they would destroy the plants before discovering that they are poisonous, and the object of this mode of protection be defeated. Either the animals are warned, or else the presence of the alkaloid is incidental and not an "adaptation" to protection. Not only *E. Williamsii* and closely related forms, but also the species of Anhalonium are without obvious means of protection, unless the hard cuticle of the latter serves to this end. The flattened and roughened and gray colored upper surface of *A. fissuratum* and the fact that they live partly sunken in the earth suggest that they may be protected by their resemblance to the ground on which they grow. Are they? The exudation of nectar already mentioned is perhaps protective, and the arrangement of crystals in a sort of armor just under the epidermis of *Opuntia arborescens* (to be described below) is probably protective against snails. Are any others to be found in the family? A red color occurs on the under surface of Peireskia leaves, on young shoots of Cereus, etc., and on nearly all seedlings. Is this, as Stahl would suggest, associated with the presence of tannin or other distasteful substance, and hence of the nature of a warning color? Or is it in the seedlings a light-screen? The probability of some protection against too great light and heat has already been mentioned, and possibly the hairs, or even the hypoderma may assist in this,[20] but nothing positive is known about it. The investigation of the minimum, optimum, and maximum temperature points for some desert Cactaceæ would give results of great interest. There is reason to think that electrical currents are to be detected on the deserts.[21] Do plants show any relations to them?

The entire relation of form-conditions to climate requires more careful study.[22] Is condensation proportional to dry-

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[20] See McFarlane's suggestion, Bot. Centr. **51**: 184. 1895.

[21] National Geographical Mag. **4**: 171. 1893.

[22] As a basis for such study, the forms seem to fall into divisions about as follows. Goebel has traced the subject for the genus Opuntia.

a. *The branching, shrubby type*, little removed from the typical condition: the woody Peireskias.

b. *The unjointed column*
- upright
  - ribbed: Cereus, Pilocereus, etc.
  - tubercled: fleshy Peireskias, Cylindropuntiæ.
- creeping or deflexed: creeping Cereus and Echinocereus.

ness of climate?[23] If so, to means or extremes of dryness? It is to be noted that condensation can be more easily effected in the deserts than in cloudier climates, for the great cause in antagonism to condensation, *i. e.*, the need for a large spread of green surface, is here much less operative; for the slow growth of the plants requires less assimilation, and the intense and continuous light render possible a given annual amount of assimilation with a far smaller surface than is possible in cloudier climates. Hence condensation is absolutely easier to desert than other vegetation, and it may mean that the conditions are as not extreme as they appear judged by other standards.

Passing now to internal anatomy, the first great problem is to study it in relation to external conditions. As one views Cactaceæ in collections, he is continually surprised at the apparent lack of relation between the development of the tissues and the supposed habits of the plants. Some forms, such as Rhipsalis, Phyllocactus and some Opuntias, though not very xerophilous in habit (except in some cases where they possess xerophilous characters in common with other epiphytes), possess very strong cuticle, hypoderma and mucilage, while other marked desert forms, such as some Mamillarias, have very slight cuticle and no hypoderma. Even granting that the former cases are examples of survival of old xerophilous characters, how are the latter to be explained? Does tissue anatomy respond sensitively to changing conditions or does it not? Here, perhaps, better than anywhere else, is the opportunity to delimit internal growth conditions from those of "adaptation." A comparative anatomy of the family, studied in relation to life-conditions, and introducing comparisons with the characteristics of other desert families, would be of great value.

The very common collenchymatous hypoderma is proba-

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c. *The jointed column* .. { upright; Cereus testudo. / deflexed: some Rhipsalis species.

d. *Phyllocladia*, two-ribbed flat shoots: Phyllocactus, Rhipsalis, Epiphyllum.

e. *Flattened ribless shoot* { lateral, on cylindric axis: Opuntia Brasiliensis. / all flattened: Platopuntiæ.

f. *Sphere form* (including short columns) { ribbed: Echinopsis, upright Echinocereus, Echinocactus, Astrophytum, Melocactus, etc. / tubercled: Mamillaria, Leuchtenbergia, Pelecyphora, Anhalonium.

[23]Noll has given (Flora **77**: 353–356. 1893) exact data on relation of form to transpiration.

bly water-holding, as is the mucilage, but this is proven in neither case. To the mucilage, Stahl[24] assigns a function of protection against animals, which its abundance in some non-xerophilous forms seem to sustain. The "Nebenzellen" of the stomata are certainly a xerophilous character, but in what way are they? Probably nowhere else in nature, though it is a xerophilous character, are the rings and spirals better developed in tracheids than here—they are particularly superb in Leuchtenbergia, where as elsewhere they often form gland-like masses along or at the ends of fibro-vascular bundles. What is the use of the spirals in this water-holding family? Can it be that the spiral in a tracheid is associated with the *holding* of water, and that it acts by presenting a larger surface and hence stronger capillary attraction for the water? And are the gland-like tracheid masses really water storers, and if so why are they better than the ordinary pith or cortex cells? The entire internal anatomy of Leuchtenbergia is most beautiful and interesting and the study of its development will prove of great interest. Pits between water cells are particularly fine and show thickened plates at the contact-walls. The hairs show many fine markings and are recommended to those interested in the structure of cell-walls. A micro-chemical study of the tissues is needed, for I have frequently found that the reactions to reagents are not such as our suppositions as to the nature of the walls lead us to expect. The crystals are excessively abundant, doubtless in part because of the very slow growth of desert Cactaceæ and the lack of falling parts, leaves and bark. In certain cases, as in *O. arborescens*, use seems to be made of them for they are deposited in a close single layer, apparently as a sort of armor, just under the epidermis, and perhaps hinder the ravages of snails, or other small animals. But do snails occur on the desert and try to eat the Cactaceæ? This is but one of many examples of what seem to be the converting of a disadvantage to use; probably many of the special secretions, substances once purely excretions but converted to protective purposes, are of this origin.

The Cactaceæ show great "vitality," not only in withstanding bad treatment, but in rooting freely from almost any part, as from the leaves in Peireskia, the tubercles in Mamillaria, etc. Perhaps the possibility of free grafting is another phase

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[24] Pflanzen und Schnecken, Jena. 1889.

of it. In what does "vitality" of this sort consist? Is it a more hardy composition of the protoplasm of that plant, or is it in the fact that nearly all cells are alive, i. e., non-skeletal, or a result of the abundant water and food supply in every cell?

The bundle systems are built upon a very uniform system; in the several genera examined they form modifications of that which occurs in Opuntia, which in turn is easily derivable from that of Peireskia. This should be examined for the remaining genera. The bundle systems seem to follow closely external form and morphological changes, a fact which comes out with particular beauty in Mamillaria, where the grooved and ungrooved forms have bundle systems answering exactly to the morphological difference between them. Further study of this relation between internal anatomy and external changes is needed before generalization is possible, but the point is as a principle one of great interest and importance. A careful study of the sieve elements is needed. Many thick forms of Cereus, Melocactus and Mamillaria show a pith-system of interlacing bundles, the development of which is still unknown. In Anhalonium, and confined to it, is found a remarkable bundle-cylinder system. It resembles somewhat, though in more extreme degree, that figured for the separate cylinders of Bauhinia.[25] In cross-section the bundles radiate fan-like in clusters, and then curve about plume-like, so that they often come to face inward towards the center of the stem. Its development is unknown. The entire minute anatomy of this genus, like that of Leuchtenbergia, is of great interest. The composition of the excessively hard cuticle in the rough-tubercled forms, such as *A. fissuratum*, is not known. A latex-system is found in many Mamillariæ (in which the mucilage is generally absent), but its meaning is as little understood here as elsewhere.

The constancy of the behavior of the axillary vegetative points in the same "genus," and the differences in its behavior in different "genera" have suggested that it may be used to indicate true relationships, and I have given in Flora (l. c.) a scheme showing such relationship. This point needs much more full investigation. For systematic purposes, this family needs above all others exact study in the field, for variation is rife in it. The affinities of the family as a whole are not

[25] See Engler & Prantl, Pflanzenfamilien. Leguminosæ, p. 81.

known, different students having placed them in very different positions. If a form is found which will give the transition to some known family, it will probably be a Peireskia-like species growing in the forests of north-western Brazil. All evidence goes to prove the newness of the family, such as their great variability, their lack of sharp divisions between the species and the genera, the large size of some of the latter, the constancy in the structure of the flowers, great similarity in the seedlings, similar characteristics of the axillary vegetative points (differences being derivable by slight modifications in degree), practical confinement in range to a single continent though a very large family, perhaps also their very "vitality," already referred to, including possibility of free grafting and hybridizing.

The study of the development of the flower may give a clue to affinities. Their geographical distribution is imperfectly known. It is worth observing how closely this follows the line of newer mountain chains on the American continent—extending along the Andes and in Brazil to Venezuela through the West Indies to Mexico and northward into the United States.[26]

So much for some of the special questions which, by those who can study the plants in the field or who can command the proper material, should be solvable. In addition to these, certain unusually marked characteristics of the Cactaceæ, in particular their variability, the perfection of their adaptations, and their segregation into many species under a simple environment, make it seem that they are particularly fitted to contribute to the solution of more general problems. As to all of these points, variation, historical development of adaptations, and causes of segregation into species, the old questions remain yet to be answered. Is there or is there not an innate tendency in living matter to variation, or is variation in some unexplained way induced by the surroundings? In the former case, is variation a function of living matter, co-originating with it, or has it been acquired by selection or otherwise, since it gives such good results? In either case, does variation tend of itself to follow certain lines, or is it "fortuitous?" In the former case, are the lines of themselves adaptive or are they adaptive in different directions, natural selection cutting off the unfit and leaving

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[26] See the map in Neumayer, Erdgeschichte, **2**: 655.

the fit? I doubt whether we have as yet any certain knowledge upon any of these points. Inseparably bound up with these questions is that as to the direct effect of the external world. Light makes some shoots grow flat: how much of form and size conditions are thus directly imposed, and hence not due to natural selection? How much to internal constitution or mechanical growth conditions? How much to selective action of the environment? The greatest problem of the present time in the dynamics of evolution, is the delimitation of the effects of these three sets of influences: (1) internal constitution, which includes (*a*) properties or functions of protoplasm, (*b*) hereditary characteristics of the particular organism, (*c*) mechanical, physical or chemical conditions of growth; (2) the direct effect of external, mechanical, physical or chemical influences upon the plastic organism either (*a*) directly, or (*b*) through the intermediation of irritability; (3) the preservation of adaptive variations, and the elimination of the unadaptive by the operation of natural selection. A few years ago an overwhelming preponderance was ascribed to the third, but evidence is accumulating to show that the first and second play a part equally, perhaps more, important. I doubt if any family of plants can equal the Cactaceæ, when properly studied, in their bearing upon these matters.

Aside, however, from this, the family is one which the extreme natural selectionist will find it difficult to deal with. On the deserts the conditions of life are comparatively speaking, very uniform. Heat and light, the gases of the air, the minerals of the soil are more than ample for all, and all share practically alike as to rain. Enemies are not numerous, not highly differentiated, and not of the kind with which they come into competition for survival. The plants grow well apart, and the struggle for existence lacks the complexity of forest and jungle and is reduced simply to a struggle with hard but uniform inorganic nature, the scarcity of water being the greatly preponderating element. Such conditions as these should, upon the natural selection hypothesis, produce a monotonous, little differentiated vegetation, for without keen competition between similar or closely related forms, slight favorable differences have no chance of survival over slight unfavorable ones, and hence differentiation along advantageous lines alone could not occur. Now what are the facts? Despite uniform, non-competitive conditions, this family has produced a thousand species, with some genera including over two hundred species; and in addition has developed hundreds of forms of spines, hundreds of modifications of tubercles and ribs, and hundreds of variations upon other points of its structure. Clearly we must allow for differentiations which are without reference to use. He who believes that differentiation depends solely upon the preservation of favorable over unfavorable variations can find in this family less support for his view than can he who sees in nature the known tendency to variation led along certain lines by little known though omnipresent principles of inertia and segregation, these lines cut off by natural selection when they are opposed to adaptation (*i. e.*, unfit), but allowed when competition is absent to persist whenever not opposed to adaptation (*i. e.*, not unfit, or indifferent) as well as when positively adaptive; until finally when competition comes into play the positively adaptive lines triumph over the indifferently adaptive and natural selection has won the day. I believe the Cactaceæ are in the condition in which there is little competition, and that there are present many indifferently adaptive as well as positively adaptive features of structure, and that the former sometimes are not much behind the latter in degree of differentiation.

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Noteworthy anatomical and physiological researches.

Some recent cell literature.

The literature of the various problems touched by studies on the cell increases so rapidly and leads so often to modifications in our knowledge and our theories of cell-phenomena, that the best hand-book very quickly becomes antiquated, perhaps more quickly at present in this field of research than in any other. It is now little more than two years since the appearance of Hertwig's admirable summary of our cytological knowledge, "Die Zelle und die Gewebe," but already certain disputed points there discussed have been further elucidated, and certain views there defended have gained or lost in probability. The request of the editors of the GAZETTE for a brief account of recent literature in its effects on our knowledge of the nucleus and centrospheres seems therefore justifiable. In this discussion we may best take Hertwig's book as a starting point; for, although it treats the cell from the stand-point of the animal histologist, it shows the thorough acquaintance of its author with the botanical literature and his willingness to use it wherever it can throw light on the problems discussed. The present account will, naturally, deal chiefly with the literature of the plant-cell, while referring also to certain important zoological papers.

The question of the nature of the nucleoli and of their fate during karyokinesis is still an open one. While Strasburger and others believe that the substance of these bodies becomes dissolved in the so-called nuclear sap, it is pretty generally held by zoologists to be taken up by the chromosomes. The position taken by Moll (12) may be regarded as an extreme form of this view. He finds in the resting nucleus of *Spirogyra* a very large nucleolus which gradually disappears as the chromatin thread becomes more prominent during the spirem stages. And he believes that he has observed the termination of one end of this thread in the nucleolus, which thus directly furnishes the material for the formation of the chromosomes. Only further studies can definitely decide this important question which bears so directly on the nature of the nucleoli. Zimmerman (20) has observed, like others before him, that masses of nucleolar substance may sometimes be seen in the cytoplasm during karyokinesis. But this author attempts to show that the nucleoli are characteristically thrown out of the mother-nucleus into the cytoplasm during division, to be reabsorbed into the daughter-nuclei. The present reviewer (9) has attempted to show that this extrusion of nucleolar substance is not constant, nor even common, in any plant studied by him; and Guignard has found (7) in *Psilotum triquetrum* that the frequence of the phenomenon depends, in the sporogenous tissue, upon the stage of its development. The writer can see nothing in the behavior of nucleoli to justify Zimmerman's view of them as organs of the cell. Their indefiniteness in form, size, number, and position in the nucleus, and their total disappearance in most cases during karyokinesis, all point to the conclusion that they are masses of substance subject to the activity of the nucleus and perhaps furnishing plastic material for certain cell-processes, to whatever parts of the cell it may be distributed while unrecognizable as nucleolar masses. And the fact that such recognizable masses sometimes occur in the cytoplasm affords no evidence that the whole of this substance passes normally into the cytoplasm when it disappears during karyokinesis. It is perhaps quite as probable that these masses represent a surplus which is not or cannot be disposed of in the usual way.

The observation of nucleolar masses in the cytoplasm in *Psilotum triquetrum* led Karsten (10) to believe that they are the centrospheres, and that therefore, at least in this plant, the latter bodies are of nucleolar origin. The writer (9) has shown that this was due to his having quite overlooked the true centrospheres, a conclusion since entirely confirmed by Guignard (7).

Since their first discovery in plant-cells by Guignard, the centrospheres have been recognized with more or less certainty by various investigators, so that their occurrence in most of the great groups of plants seems now assured. As has been intimated, the evidence is not equally satisfactory in all cases that the structures regarded as centrospheres by the various writers have really been such. But, as it is practically impossible to determine justly the merits of each case, it may suffice to give a systematic list of those plants in which they are claimed to have been seen, with the name of the observer in each case.

ALGÆ: *Surirella calcarata*, Bütschli, (2); Lauterborn, (11).
Pinnularia nobilis Bütschli, (3).
Spirogyra sp., de Wildeman, (18).
Chara fœtida, Schottländer, (14).
Sphacelaria scoparia, Strasburger, (15); Humphrey, (9).

FUNGI: *Agaricus galericulatus*, Wager, (17).

BRYOPHYTA: *Marchantia polymorpha*, Schottländer, (14).
Pellia epiphylla, Farmer and Reeves, (5).

PTERIDOPHYTA: *Gymnogramme* sp., Schottländer, (14.)
Asplenium sp., Guignard, 1891.
Polypodium sp., Guignard, 1891.
Osmunda regalis, Humphrey, (9).
Equisetum limosum, de Wildeman, (18).
Psilotum triquetrum, Humphrey, (9); Guignard, (7).
Isoetes sp., Guignard, 1891.

GYMNOSPERMAE: *Ceratozamia longifolia*, Humphrey, (9).

ANGIOSPERMAE: *Liliaceæ* (*Lilium*, *Fritillaria*, *Allium*), Guignard, 1891; Schaffner, (13).
Amaryllidaceæ, *Orchidaceæ*, etc. Guignard, 1891.
Tradescantia sp., Guignard, 1891.
Vicia Faba, Schaffner (13).

The fact that they have been seen chiefly in the reproductive cells is due plainly to the greater size and better development of most important structures in such cells. But there is no reason to doubt their occurrence in purely vegetative cells also. Their minute size and the difficulty with which they take up stains makes their recognition in most plants dependent on very favorable conditions for observation. But in some algæ, including some diatoms, according to Bütschli, they are much more easily recognizable, even in the living cell.

In his cell-book Hertwig inclines to the view that these bodies will be found to be of nuclear, rather than of cytoplasmic origin. But the results of the past two years do not, on the whole, favor this opinion. Certain zoologists, notably Brauer (1), believe they have observed them within the nucleus before division, but botanical workers on this point, with the exception of Karsten, agree in finding them in the cytoplasm during the resting stage, in agreement with the original observations of Guignard. Reference may be had to papers by Strasburger (15), Humphrey (9), Guignard (7), and Schaffner (13). Karsten's theory (10) of the derivation of the centrospheres from the nucleoli has been shared by Julin and other zoologists; but the source of his error has already been pointed out, and the observations of most students of animal cells are equally opposed to this view.

As early as 1888, Boveri gave the name *archoplasm* to the centrosomes with the surrounding cytoplasm, and this term has been more or less loosely used by subsequent writers. Strasburger has more recently (15) proposed to distinguish that part of the cytoplasm which appears to play an active part in karyokinesis, surrounding and including the centrosomes, as *kinoplasm*, from the merely nutrient portion, or *trophoplasm*. And this distinction is a very useful one. In their morphological application, the terms archoplasm and kinoplasm appear to be synonymous. The number of centrosomes present in the kinoplasm of a cell just before division appears to be typically two. In animals and in some algæ the number during the resting stage is but one, and this divides as a preliminary to nuclear division. In the higher plants this division occurs before the resting period, and indeed in the earliest stages of the formation of the daughter nucleus which the kinoplasm accompanies. Heidenhain (8) finds in some animal cells as many as a hundred granules in a group, which he regards as equivalent to a single center. But it seems fair to ask if these may not represent pathological conditions or artificial products. At all events, no such condition has been recognized in plants.

Normal karyokinesis appears to be introduced by the passage to each pole of the nucleus of a part of the kinoplasm with a centrosome, and by the formation, apparently from these starting points, of a spindle-shaped frame-work of delicate fibres. The question as to the source from which the material of these fibres is derived has long been a matter of dispute. Most zoological writers have believed it to be formed chiefly within the nucleus, while most botanists maintain for it an extra-nuclear origin. Flemming now concedes that the ends of the spindle originate outside of the nucleus, while Hermann and the latest writer on karyokinesis in animals, Drüner (4), fully agree with Strasburger in deriving it from the kinoplasm.

The disagreement among zoologists as to whether the spindle fibres are continuous from pole to pole was due to insufficient knowledge of the facts. The difficulty has been cleared up by the pretty general acceptance of the view that there are formed in some cells, such as the spermatocytes of the salamander, continuous spindle-fibres reaching from pole to pole, and, outside of these, groups of peripheral fibres which reach, at farthest, only to the equator of the spindle; while in other cells, including the egg of *Ascaris megalocephala*, only these peripheral fibres, and none of the central spindle, appear to be formed. Hermann and Drüner derive the central spindle, where it has been observed, from the substance connecting the centrosomes. It appears at first very small and grows as the centrosomes separate. A somewhat similar phenomenon is described by Lauterborn (11) as giving rise to a spindle-like structure in one of the diatoms. This observation needs confirmation, but points to processes of much interest. Strasburger (16) denies the existence of peripheral fibres in the higher plants and finds the threads of the spindle always continuous. Therefore, until our knowledge of facts is much more complete, it is useless to discuss the homologies and significance of the structures above mentioned.

It is, perhaps, in their ideas of the mechanics of the karyokinetic process that vegetable and animal cytologists remain still most widely apart. Most zoologists regard the arrangement of the chromosomes into an equatorial plate and the migration of the daughter-chromosomes to the poles of the spindle as the direct result of the active growth and subsequent retraction of the peripheral fibres. These are believed to grow outward from the centrosomes, attaching themselves to the chromosomes and pushing these before them until they reach the equator, where fibres from opposite poles become attached to the respective halves of each chromosome. Now begins the contraction of the fibres, which results in the separation of the daughter-chromosomes and in their being drawn finally to the poles, on the complete retraction of the peripheral fibres. Drüner (4) also attributes the migration of the centrosomes to the poles of the nucleus to the push of the fibres seen radiating from them at this time, against cell-wall and nucleus, their paths being determined by the resultants of all the pushes to which they are exposed. Many zoologists, with this writer, regard the centrosomes as mere points of attachment for the kinoplasmic threads.

On the other hand, as has been said, Strasburger (16) denies the existence of peripheral fibres in the best-studied plants. Maintaining justly that the splitting of the chromosomes is an active, vital phenomenon, he holds that the movement of the daughter chromosomes to the poles is equally so. He considers the spindle fibres to be the guiding paths along which the chromosomes move, since he and Guignard have found a close correspondence in number between these fibres and the chromosomes. And he believes their motion to take place in response to some sort of attraction exerted by the centrosomes. Yet, since all radiations from the centrosomes are so faintly visible in plant-cells treated by the best known methods, Flemming's suggestion (6) is worthy of consideration, when he hints that an improved technique may bring out the peripheral fibres in these cells, also.

Of the details of karyokinesis in most of the *Thallophyta* we know very little, and most of the accounts we possess contain details so at variance with what we know of other groups, that they must be regarded as requiring confirmation. This seems especially true of the accounts of the centrosomes in these plants which have been published.

Concerning the process of cell-fusion, which constitutes the essential feature of fertilization, there have been no very recent advances on the vegetable side; but it should be noted that recent studies of some American zoologists (19) tend strongly to discredit the supposed fusion in pairs or "quadrille" of male with female centrosomes. The centrosomes of the fertilized egg are said to be furnished sometimes by one, and sometimes by the other sexual element. If this be true for animals, a similar condition may be expected among plants also; but, until Guignard's observations of the quadrille in *Lilium Martagon* are proved erroneous, there is no ground for doubting their accuracy.

Since the present status of our knowledge of the facts concerning the reduction of the number of the chromosomes in the nuclei of the gametophyte, and of their significance so far as plants are concerned, has lately been sketched in this journal (**20:** 23), in an abstract of Strasburger's last paper, it will not be profitable to discuss that most interesting cytological phenomenon here.—J. E. HUMPHREY.

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BRIEFER ARTICLES.

Vitality of Marsilia quadrifolia.—A most remarkable instance of the retention of vitality in the spores of this plant has recently come to my notice. In the summer of 1892 I gathered fertile specimens at Fresh Pond, near Cambridge, Mass. The rhizomes and their attached sporocarps were at once put into commercial alcohol (95%) and have been kept therein continuously to the present time. Spores from specimens used by a student in morphology (Miss Anna Tarnutzer) were left in water in the dissecting dishes for several days. When about to clean up the dishes Miss Tarnutzer was surprised to find young plants in the water. She called my attention to them and examination showed that they were young sporophytes of Marsilia, with shoots an inch or more long and roots well developed.

It was thought that this might be exceptional, and Miss Tarnutzer was directed to select spores from a freshly opened sporocarp and sow them in water. These also germinated as did many others which were tried, and the class was able to study the prothallium and sexual organs as well as the developing sporophyte.

The sporocarp of this plant is of course very resistent, but one would hardly expect it to be able to exclude alcohol so completely during three years immersion as to leave both microspores and megaspores capable of germination.—CHARLES R. BARNES, *University of Wisconsin.*

Aspidium simulatum DAVENPORT.—Since the publication of this species I have received specimens for examination from a number of sources and found that my suspicion in regard to its having been many times collected for either *Aspidium Thelypteris* or *A. Noveboracense* was well founded.

I give the following additional stations not only as an indication of its range, but as positive evidence that botanists may expect to find it masquerading under one or the other of its congeners' names in their herbaria:

"Sawmill Pond, Anne Arundel co., Maryland, October 1, 1894, in wet thickets and quite plentiful."

Collected by C. E. Waters, Johns Hopkins University, Baltimore, who writes that "the sporangia were still unopened, but so nearly ripe that on taking the fronds from the damp driers the dry air caused the sporangia to open so rapidly that a decided crackling noise could be heard." He also writes that "with us *A. Thelypteris* ripened this year (1894) in the early part of September, and *A. Noveboracense* in July or August," confirming my own observations on the relative differences in the development and ripening of the three ferns.

From Prof. Trelease of the Missouri Botanical Garden I have received specimens collected on Poplar Bluff, S. E. Missouri, August 15, 1875, by George W. Letterman, and at Sapulpa, Indian Territory Sept. 24, 1894, by B. F. Bush, no. 847, ticket marked "common."

There are a few forked veins in the lowermost pair of pinnæ on Mr. Bush's specimen, and it will be noticed that the date for Mr. Letterman's is the earliest yet recorded.

The species has also been collected by Mr. Merritt L. Fernald, of the Cambridge herbarium, in Georgetown, Maine, in a different locality from that recorded by myself.

Erratum.—By a careless inadvertence, for which I alone am responsible, in my account of the habitat of this species (BOT. GAZ. **19**: 496. 1894) Seabrook is made to appear in Essex co., Mass., instead of New Hampshire, where it belongs; Essex co., Mass., should follow Salisbury.—GEORGE E. DAVENPORT, *Medford, Mass.*

Dr. Joseph Schrœter. — This eminent mycologist died at his home in Breslau, Dec. 12, 1894. His name and works are well known to American botanists, who regarded him as a leader in the departments of knowledge which he cultivated. The following account of his life is taken in the main from an article in the *Botanisches Centralblatt*, by Dr. H. Kionka of Breslau.

Schrœter was born in Potschkau in Upper Silesia, March 14, 1837, and was therefore only in his fifty-eighth year at time of his death. As a boy he was fond of plants, but being the son of a physician he naturally devoted himself to medicine, upon the completion of his gymnasium studies. He took his doctor's degree in Berlin at the age of twenty-two, and then entered military service. He was soon made an army surgeon, and in 1865 was promoted to the position of staff surgeon in the royal grenadiers stationed at Breslau.

During these years he still found time to pursue his botanical studies. When the Plant-Physiological Institute was established at Breslau in 1866, under the management of Prof. Cohn, Schrœter became the first investigator to enter, and maintained his connection with the institution up to the time of his death. He at first assisted Professors Cohn and Koch with their famous studies upon bacteria, and published a number of his own researches in this line, but was soon diverted to the study of the fungi, especially parasitic forms, which he made his life work. He opened Cohn's classical series of *Beiträge zur Biologie der*

Pflanzen in 1870 with a monograph upon Synchytria. He now contributed also to the botanical section of the *Schlesischen Gesellschaft für vaterlandische Cultur.*

When the Franco-German war broke out in 1870 he followed his regiment to the field, and was in a number of engagements, including the battle of Sedan. His services were recognized both by promotion and decoration. In 1874 he was again stationed at Breslau, and returned to his studies of the fungi with greater zest than ever. In the following year upon the occasion of the half century jubilee of Göppert's doctorate, he undertook the elaboration of the fungi for the cryptogamic flora of Silesia, a work inaugurated by the *Gesellschaft* already mentioned.

This great work could not have been carried out by one better fitted for it, as he had himself first collected most of the species, and had first described many of them. Unfortunately it was not quite finished at his death. The first volume was published in 1889, and of the second and last volume three lieferungen still remained unpublished. The necessary manuscript was ready, however, with the exception of about one signature. The portion to be supplied embraced part of the fungi imperfecti, which must now be prepared by other hands.

Through this work and a number of monographs of separate groups of fungi he has become known at home and abroad as one of the foremost mycologists of the time. He had begun the elaboration of the fungi for the monumental work of Engler and Prantl, *Die natürlichen Pflanzenfamilien,* but had only prepared a few orders. Besides this he had recently begun to issue the *Pilze Schlesiens* in exsiccati, to serve as a basis to his cryptogamic flora of Silesia. Of this only 400 numbers in an edition of about twenty-five copies had been issued at time of his death.

In 1886 Schrœter qualified as a member of the Breslau medical faculty in the department of mycology and bacteriology, and in 1890 became a professor. In 1892 he was entirely relieved from military service.

He was an exceedingly industrious collector, and in the last few years, especially, extended his travels over a wide range of country, covering all of Europe from Italy to the North Cape. Last summer he undertook a scientific expedition to Asia Minor, stopping at Cyprus, and especially remaining in Cilicia and the Taurus mountains. In the unhealthy climate he contracted malaria, which developed into a fever upon his return home. During the autumn there was a recurrence of the fever from time to time, and in one of these attacks, which kept him upon a sick bed for only a few hours, he expired.

Schrœter was much beloved, and greatly appreciated for his high attainments by those who knew him best. To the scientific world his loss is well nigh irreparable.—J. C. A.

Collinsia bicolor.—While studying the genus Collinsia with reference to future revision, certain peculiarities of structure in the flower of *C. bicolor* have come to light which seem to be of sufficient significance to merit some mention in the GAZETTE.

At the point where the upper pair of stamens become free from the corolla, the wings of the filaments turn into the sac of the corolla. After continuing attached to the corolla by one edge for a little way they end in free tips which are somewhat bearded. These tips point out into the sac so that they almost meet over the rudimentary fifth stamen or gland at the base of the sac.

The conclusion arrived at after careful study of the question was that their function is to guard the nectar gland. The utility of such a device can readily be seen. The four stamens are declined toward the lower lip of the corolla and clasped by its middle lobe; so that the insect must enter by this path in order to reach the pollen. But the throat is so large and with such a wide opening that the insect could easily enter and reach the gland without coming in contact with the pollen, were it not for these guards, which effectually bar this road to the nectar.

The same phenomenon has been observed in milder form in *C. franciscana.* Both species are easily distinguished from all others by this peculiarity.—ALICE E. KEENER, *Herbarium Lake Forest University.*

EDITORIAL.

THE TRANSFER of the National Herbarium from the building of the Department of Agriculture to the care of the Smithsonian Institution, and its storage in the National Museum, is a movement that commends itself to every botanist. That this great collection should so long have been exposed to destruction by fire does not reflect much credit upon our Congresses; and as the present arrangement seems to have been easily effected without any congressional action the long time exposure does not reflect much credit upon previous administrations of the Department of Agriculture. The Smithsonian Institution does not furnish more room, for the National Museum is already overcrowded, but it furnishes safety, and is the proper depository of government scientific collections. In the transfer, the collections of the Divisions of Vegetable Pathology and of Forestry are not included, and the Department of Agriculture also wishes to retain the grasses. In our judgment all of these collections should pass under the care of the Smithsonian Institution, for the same reasons obtain for their transfer as for the transter of the other collections. The botanist of the Department of Agriculture retains his position of Curator, so that a transfer does not put any obstacle in the way of use. The collections of the Division of Vegetable Pathology and of Forestry are in charge of other curators, so that it may be well to preserve their autonomy, but the great and in many respects unique collection of grasses should certainly be included in the transfer.

THIS COMMENDABLE movement, however, is but a temporary expedient, for it means storage rather than working room. The Botanical Club, and the other organizations comprising the same body of botanists, through their annual resolutions on this subject, seem to have been effective thus far, and should be encouraged to continue their effort until a suitable building is provided on Smithsonian grounds. Much has already been done in the elimination of congressional clerks and replacing them with botanists. A building and an adequate corps of competent investigators are due such a collection as the National Herbarium. We trust that this matter will be taken up at every meeting of botanists, until the National Herbarium has a proper equipment of room and of men.

CURRENT LITERATURE.

Field, Forest and Garden Botany.[1]

Of all the books which Dr. Gray found time in his busy life to prepare, none has been so widely used in schools as the manual which included the common cultivated plants. Although the first edition appeared in 1868, at the time of his death he was only hoping to find time to revise it. Shortly after his death, provisional arrangements were made by Dr. Watson for its revision, which was begun by Professor Barnes. A change in his plans, and a growing conviction that he could not do the work satisfactorily under the limitations imposed, impelled him to ask after Dr. Watson's death for release from the agreement. At that time a preliminary list of the species to be included had been made, and also the first draft of the manuscript through the Leguminosæ. The corporation of Harvard College then placed the prosecution of the work in the most competent hands of Professor Bailey, to whom therefore belongs the credit for the whole revision.

The book appeared early in the present year. It is really much more than a revision, since it now includes eighty-two genera and 553 species more than the original. This increase is partly due to extension of territory west to the 100th meridian and more largely to the great increase in the number of plants now in common cultivation. In plan, arrangement, and style of description, as well as nomenclature, the book is still Dr. Gray's; the reviser's aim being to bring it down to date. The only noteworthy innovation is the placing of the gymnosperms after the angiosperms, instead of between the dicotyledons and monocotyledons, a change to which Dr. Watson's reluctant consent was obtained.

The most difficult part of the work of revision naturally is to determine what to leave out. Prof. Bailey has been happy in the omissions he has made as well as in the choice of species to be included. In fact throughout the revision his wide knowledge of cultivated and wild plants is apparent.

If any criticism is to be made upon the book it is that Prof. Bailey has not revised it enough. Dr. Gray always considered it the most

[1] GRAY, ASA:—Field, forest, and garden botany, a simple introduction to the common plants of the United States east of the 100th meridian, both wild and cultivated; revised and extended by L. H. Bailey. 8vo. pp. 519. American Book Co. 1895.

crude of his books because it was made in an incredibly short time; it would have been wise therefore for the reviser to give more attention to unifying its descriptions and because of their brevity to make sure that contrasted characters were used in related species as well as in section characters. In both these points the original was conspicuously defective and the revision therein is not materially better, as will be evident to any one by even casual comparison. Considerable space might have been saved also in remarks under each genus by condensing the explanation of the name. It may be objected that these changes would have made the book mechanical and have eliminated the peculiar happy touches characteristic of Dr. Gray. Yet they are just such changes as Dr. Gray would probably have made himself; and in a manual one expects formality.

In typography a marked improvement has been made in indicating indigenous and exotic species and horticultural forms by special type. Though having the same sized "body" as the first edition the type of the new book has a larger and clearer face and makes a fair page. It is quite certain that the revision and extension of this book will insure for it a new lease of life and a still wider use. We wish the Herbarium whose property it is a large income from its sale.

Minor Notices.

THE SECOND EDITION of Spalding's "Introduction to Botany"[1] has recently been issued. It has been improved by the addition of a chapter on fungi, and a glossary and index. There have been some minor changes made here and there, but the arrangement and mode of treatment have not been altered. We can recommend this edition even more heartily than we did the first. It contains too much work for the ordinary high school, but the teacher who can not from it select a suitable course, or who finds it "too advanced" for his class may well question his fitness to teach botany as it ought to be taught in a high school laboratory.

THE "BUSHBERG CATALOGUE" is by no means merely a trade catalogue, but is widely and most favorably known as a comprehensive and reliable manual of grape culture. So important is it, particularly in its descriptive list of varieties that earlier editions were translated into French, Italian, German and several other languages. The fourth

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[1]SPALDING, V. M.—Guide to the study of common plants, an introduction to botany. Ed. 2. 12 mo. pp. xxiii + 294. Boston, D. C. Heath & Co. 1895.

edition has now been issued,[1] twenty-five years after the publication of first. Although the third edition, issued eleven years ago, was soon ex hausted the publication of this has been delayed until the perfecting of the remedies for grape diseases has given renewed confidence in the success of grape growing. The firm of Bush & Son & Meissner have had the cooperation in preparing this work of various gentlemen. B. T. Galloway, contributed the article on fungous diseases and their treatment; T. V. Munson, whose studies of the grape have extended over fifteen years, furnishes a classification of the grapes, though the article by Dr. Geo. Engelmann in previous editions has been continued; C. V. Riley has revised the article on insects. The descriptive list of varieties occupies over 100 pages, and by its typography shows the rank of each. The pamphlet is profusely illustrated.

THE DRUG DAMIANA is treated in its botanical features by John S. Wright, with illustrations, in *Lilly's Bulletin* No. 25. It is composed of the dried leaves, young shoots, and occasional flowers and pods of *Turnera diffusa aphrodisiaca*, a suffrutescent plant of western Mexico, also reported from Texas. *Aplopappus discoideus* has sometimes been substituted for it. The drug has been known in this country for only about twenty years, but on account of strong tonic character has gained favor rapidly among physicians.

THE LABORATORIES of Natural History of the State University of Iowa have devoted the first part of volume 3 of their *Bulletin* to the narrative of the Bahama expedition sent out by the institution in 1893. The number contains 250 pages and many plates.

FOUR STATION BULLETINS upon weeds are as follows: The Russian thistle in Ohio, with poster supplement, by A. D. Selby (Ohio, no. 55), general account, and a copy of the state weed laws: Five farmers' foes by Moses Craig (Ore., no. 32), brief account of Cnicus arvensis, C. lanceolatus, Sonchus arvensis, Xanthium spinosum and Salsola Kali tragus, with copy of state weed laws; New Mexico weeds, I, by E. O. Wooton (N. M., no. 13), some account of weeds and their treatment, with descriptions of eighteen of the worst kinds, finely illustrated from photographs; Distribution of weed seeds by winter winds, also effect of seed exchange upon the culture of wheat by H. L. Bolley (N. D., no. 17), observations on the number of seeds in snow drifts and the action of winds in carrying free seeds.

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[1] BUSH & SON & MEISSNER:—Illustrated descriptive catalogue of American grape vines; a grape growers' manual, 4th ed. 8vo. pp. 198. The authors, Bushberg, Mo. 1895. Fifty cents.

NOTES AND NEWS.

THE BOTANICAL SOCIETY OF ITALY celebrated the centennial of its establishment April 15–23d.

DR. ALFRED KOCH has been appointed a.-o. professor of vegetable physiology in the University of Göttingen.

THE FORTHCOMING supplementary volume of Saccardo's Sylloge Fungorum will be XI, and not IX as stated in the April GAZETTE.

DR. V. HAVARD has published, in *Bull. Torr. Bot. Club* (March), a very interesting paper on the food plants of the North American Indians.

PROF. L. H. BAILEY contributes to the special spring trade edition of the *Florist's Exchange* (7: 387. 30 Mr 1895) an account of the evolution of American horticulture.

GASTON, MARQUIS DE SAPORTA died at Aix, Provence, on January 26, at the age of 72. He was pre-eminent among students of the fossil flora of Tertiary and Mesozoic formations.

PROF. LEON GUIGNARD has received the high honor of election to the French Academy, succeeding the late Duchartre. Botanists will heartily approve this action as a recognition of genuine merit.

MR. E. H. ACTON, who has become known to American botanists chiefly through his book (in conjunction with Mr. Francis Darwin) entitled "Practical Physiology of Plants," died suddenly at Cambridge, England, from heart disease, on February 15th.

A NEW PLANT HOUSE over 170 feet long, and of handsome construction, has been erected at the Central Experiment Station of California. It cost about $13,500. It is located beside the botanic garden of the University, which has now become an important adjunct of the botanical department.

THE "SPRAY CALENDAR," sent out by the horticultural department of the Cornell Experiment Station, both last year and this, giving directions for combating plant diseases, has beeen reprinted by the Missouri Station and variously imitated by others. It is a model in way of concise statement.

THE DEATH OF ISAAC SPRAGUE, which occurred March 15th at his home in Wellesley Hills, Mass., removes a botanical artist whose name will always be closely associated with that of Dr. Asa Gray. There was nothing finer at the time than Sprague's illustrations, and his studies set the pattern for later botanical artists.

THE NEW YORK UNIVERSITY announces summer courses to continue from July 9th to August 17th, consisting of mathematics, physics, chemistry, biology, experimental psychology and pedagogy. The course in "biology" has not the faintest trace of a botanical side to it, or any indication that the organic world contains any other forms than those of animals. The vegetable world can not be said to be ignored by the professor in charge, but rather undiscovered.

M. ED. BUREAU has announced the publication, under his direction, of a series of French colonial floras, of the same general style as the colonial floras prepared at Kew. The work has been assigned to several botanists, and the material for study is contained in the great herbaria of the Museum. Some of these floras have already appeared.

PROF. F. LAMSON-SCRIBNER has just published, from the Department of Agriculture, accounts of "the flat pea" (*Lathyrus sylvestris Wagneri*) and "sachaline" (*Polygonum Sachalinense*), both of them forage plants, concerning which large claims have been made. Accounts are given which should temper enthusiasm, and at the same time inform concerning the possible service of these plants.

PROF. LESTER F. WARD, in *Science* (March 29th), has compared the Mesozoic flora of Portugal with that of the United States (Potomac beds), finding a remarkable parallelism. The occasion of the paper is the appearance of Marquis Saporta's "Flore fossile du Portugal." The archetypal angiosperms, "Protangiosperms," are also discussed, which seem to be remarkable illustrations of what were once called "comprehensive types."

AMERICAN WOODS prepared and published by R. B. Hough of Lowville, N. Y., has reached the sixth volume. The work consists of thin sections of wood, mounted in book form, and accompanied with explanatory text. Each volume embraces twenty-five species. The first four volumes include most of the woods of New York and the adjoining states, volume five is devoted to Florida woods, and volume six to those of California.

EXPERIMENTS with cultures of algæ (Conjugatæ), by Bokorny, to determine the effect of the absence of calcium and magnesium on the cell organs, lead him to the conclusion that the absence of Ca occasions a poorly developed chlorophyll apparatus, while the want of both Ca and Mg entails a shrinkage of both nucleus and chlorophyll bodies. A decided diminution in the size of the nucleus seemed also to result from the lack of Mg alone. (Cf. Bot. Centralb. 62: 1. 1895.)

PLANT MODELS, showing the course of the fibrovascular bundles in the stem, forms of the embryo, arrangement of the apical cells, mechanical system of leaves and stems, reproductive organs of liverworts, stomata, arrangements of flowers for pollination, and many other structures, are offered for sale by Heinrich Gasser, whose address is Graz III, Leechgasse 22 E, Austria. The models of stomata and flowers have movable parts, to show the natural automatic movements. A price list will be sent on application.

EVEN THE *Index Kewensis* is held up to obloquy *in re* nomenclature! In a paper (from Proc. Cal. Acad. Sci. II. 4: 559. 19 Mr 1895) on two species of Aquilegia Miss Alice Eastwood remarks anent her *A. ecalcarata*, "According to the Index Kewensis, A. ecalcarata is a synonym of *A. vulgaris* L. As I am not in sympathy with the movement that is producing such chaos in nomenclature and do not care to become a name changer myself, I leave it with the name under which it has been described." How easy!

THE FIRST FASCICLE of *Musci Europaei Exsiccati*, issued by MM. F. Renauld and J. Cardot has been distributed. American bryologists who desire European species for comparison with our own are advised to procure this set of exsiccati. The specimens are ample and well prepared, while the names of the authors are a guarantee of care and accuracy in the determinations. Prof. J. M. Holzinger, Winona, Minn., is the author's agent in this country.

THE *Bull. de l'Herb. Boiss.* for February contains a list, with descriptions of many new species, of the *Graphideæ* of Eckfeldt collected in Louisiana and Florida, by Dr. J. Müller; a continuation of the fungi of equatorial regions (with plate), by Patouillard and Lagerheim, containing numerous new species and two new genera (*Punctularia*, a hymenomycete, and *Xylobotryum*, a pyrenomycete); and descriptions of new oriental caryophylls, by J. Freyn.

ANOTHER SERIAL PUBLICATION! Alas the day! The first volume of the Memoirs from the Department of Botany of Columbia College, now in press, contains *A monograph of the North American species of the genus Polygonum*, by Mr. John K. Small. It is illustrated by life-sized figures of all the species and by figures of the stem anatomy of the several subgenera. There are eighty-six plates in all and about two hundred pages of text. The Memoirs will be issued at irregular intervals—probably at long intervals—and each volume or part will be published at a fixed price.

PARTS 113, 114, 115 and 116 of *Die natürlichen Pflanzenfamilien*, just issued, contain the completion of Guttiferæ by Engler, Dipterocarpaceæ by Brandis and Gilg; Ancistrocladaceæ by Gilg; Elatinaceæ and Frankeniaceæ by Niedenzu; the completion of Borraginaceæ by Gürke; the beginning (55 genera) of Verbenaceæ by Briquet; the completion of Bignoniaceæ by Schumann; Pedaliaceæ and Martyniaceæ by Stapf; Globulariaceæ by Wettstein; and the beginning (122 genera) of Acanthaceæ by Lindau.

DR. F. W. KLATT, in *Ann. k. k. naturhist. Hofmuseum* (9: 355), describes forty new Compositæ from tropical America (Mexico, Central America, and the northwestern South American states) from material in the herbarium at Vienna. As this region is just now receiving large attention from American botanists it is well to note that this fascicle contains new species of the following genera: Eupatorium (10), Brickellia (1), Heterotheca (1), Aster (1), Baccharis (1), Lagascea (1), Baltimora (1), Schizoptera (1), Sclerocarpus (1), Viguiera (1), Verbesina (2), Liabum (2), Culcitium (2), Senecio (10), Gynoxys (1), Werneria (2), Othonna (1), Crepis (1).

BULLETINS 5 and 7 of the North Carolina Geological Survey are devoted to forestry. No. 5 treats of the forests, forest lands, and forest products of eastern North Carolina; and no. 7 of forest fires, their destructive work, causes, and prevention; both by W. W. Ashe, who is in charge of the forest investigation. The reports are exceedingly well prepared and deal with one of our most important forest areas. Attention is specially called to the continued and unnecessary destruction of the forests of the eastern counties by fires and stock and the importance of remedying the evil before it is too late; and also to the fact that the quality and value of the "naval store" products may be increased some $200,000 per year by the adoption of the French system of gathering the turpentine.

PROF. L. M. UNDERWOOD, in *Bull. Torr. Bot. Club* (March), makes a plea for uniformity in the names of the larger plant groups, illustrating his suggestion by outlining the archegoniates. There has been great variance in usage among the systematists who have dealt with phanerogams, while the cryptogamists and zoologists have been more uniform. The proposition is to conform to the long established zoological usage, and to use as primary divisions the following terms and sequence: sub-kingdom, class, order, family, genus, species. This does away with such terms as "branch," "series," "cohort," which have crept in among phanerogams, and makes an "order" stand for a group of related families. Professor Underwood would recognize four sub-kingdoms: Mycetozoa, Thallophyta, Archegoniata, and Spermatophyta, the first two sub-kingdoms being as yet essentially tentative. Under Archegoniata the author would include three classes, Bryophyta, Pteridophyta and Gymnospermæ. Under Bryophyta he would recognize seven orders, abandoning the long-used sub-class names, Hepaticæ and Musci, as meaningless. The general suggestion certainly has very much in its favor.

VEGETABLE PATHOLOGY is treated, in some of its phases, largely or exclusively in the following bulletins from the experiment stations: Potato scab by H. J. Wheeler, J. D. Towar and G. M. Tucker (R. I., no. 30) gives the results in the development of scab when the soil conditions are varied; Potato blight and scab by F. Wm. Rane (W. Va., no. 38); Potato scab and its prevention, also Bacteriosis of rutabaga by L. H. Pammel (Iowa, no. 27) giving results of experiments and microscopic study; Field experiments with fungicides on turnips, cabbage, tomatoes, potatoes and beans by B. D. Halsted and J. A. Kelsey (N. J., no. 108); Treatment of smut in wheat and potato scab by H. L. Bolley (N. D., no. 19), a condensed statement with directions for field use; Grain smuts and potato scab by Aven Nelson (Wy., no. 21), outline of the subjects for information of the cultivator; Spraying orchards and potato fields by L. R. Jones (Vt., no. 44), embodies experiments of 1894; Some fungous diseases of beets by B. D. Halsted (N. J., no. 107), describes three common and three rare diseases; Spraying pear and apple orchards by S. A. Beach (N. Y., no. 84) gives results of experiments; Black knot by E. G. Lodeman (Cornell, no. 81) includes observations on mode of entrance of the spores, results of spraying and a bibliography; The quince in western New York, also Recent apple failures in western New York by L. H. Bailey (Cornell, nos. 80 and 84), both partly devoted to diseases, the latter especially treating of apple scab (Fusicladium) with good illustrations, including a colored plate.

BOTANICAL GAZETTE

JUNE, 1895.

Contributions to the embryology of the Ranunculaceæ.[1]

WITH PLATES XVII–XX.

DAVID M. MOTTIER.

Various representatives of the Ranunculaceæ have been subjected to much careful study from the standpoints of morphology, histology and embryology. The well known resemblance to the monocotyledons in the structure of the vascular bundle, secondary growth of the stem and the large size of their meristematic cells, has brought to several species of this family much of that careful investigation that is usually centered upon transitional characteristics. Of all the dicotyledons certain species of the Ranunculaceæ resemble more closely the monocotyledons in the large size of their embryonic cells.[2] For this reason certain species are especially favorable for embryological studies. From a desire to know more about the development of the embryo-sac, a study of one or more species of several available genera was begun.

Prantl[3] arranges the genera of this family under three subdivisions, Paeonieæ, Helleboreæ and Anemoneæ. Of the Paeonieæ no representative was available for study; of the Helleboreæ the following species were investigated: *Delphinium tricorne* Michx., *Caltha palustris* L., *Aquilegia Canadensis* L.; of the Anemoneæ, *Ranunculus abortivus* L., *R. recurvatus* Poir., *R. septentrionalis* Poir., *Anemonella thalictroides* Spach, *Thalictrum dioicum* L. and *Hepatica acutiloba* DC.

The subject naturally embraces three phases, namely; the development of the embryo-sac, the process of fertilization, and the development of the embryo.

The following pages will be confined almost exclusively to

[1]Contributions from the Botanical Laboratory of the University of Indiana.
[2]Strasburger, Histologische Beiträge 5: 118. 1893.
[3]Natürlichen Pflanzenfamilien.

the development of the embryo-sac and its behavior previous to fertilization. The different species will be taken up in the order indicated above.

Delphinium tricorne.—As is well known the ovules of Delphinium arise as nipple-like protuberances from the infolded margins of the carpophyll. The epidermal and hypodermal rows of cells of the carpophyll pass uninterruptedly over this rudiment of the ovule. At the apex of the protuberance may be seen one or frequently more hypodermal cells distinguishable by their larger size (fig. 2). The cell which ultimately gives rise to an embryo-sac will, for greater clearness, be spoken of in this paper as the initial cell of the embryo-sac, while the term mother-cell will be reserved for the lower one of the longitudinal row of cells arising from subsequent divisions of this cell. In the very young rudiment of the ovule (fig. 1) in a large number of cases the initial cell of the embryo-sac is not perceptibly different from the other hypodermal cells nor the cells of the young ovule in general. It is usually stated that the initial cell of the embryo-sac is the terminal one of an axial row of cells of the nucellus, especially in monocotyledons which possess small ovules. In larger, small-celled ovules, those of the dicotyledons particularly, proof of an axial row is indeed difficult, if not quite impossible. In few cases in Delphinium an axial row could be determined (fig. 2); but it is very evident, even in the most favorable cases, that the initial cell or cells sustain a closer genetic relationship with the hypodermal layer than with any other cells of the nucellus (figs. 1–3).

The initial cell now increases in size, and divides by a transverse wall into two cells, the lower being frequently a little larger than the upper (figs. 4, 5, 7). When the first division is completed in the initial cell, the epidermal cells of the nucellus have divided by periclinal walls, and the inner integument has attained a level with the apex of the nucellus. Each of the two resulting cells (fig. 5) now divide by a wall parallel to the first, thus giving rise to four cells by two successive divisions of the initial cell of the embryo-sac. These transverse walls are very thin membranes without being the least swollen in the instances figured. As far as observation extended, the division of the lower cell preceded that of the upper, as will be seen in figs. 6 and 7. These divisions follow as a rule in rapid succession. The lower one of the

MOTTIER on RANUNCULACEÆ.

MOTTIER on RANUNCULACEÆ.

row of four cells now becomes a mother-cell of the embryo-sac. It increases in size, gradually absorbing the three cells above and also the adjacent cells of the nucellus, a process that almost invariably obtains in all angiosperms. In fig. 8 the mother-cell may be seen separated from the disorganized remains of the three superposed cells by an arched wall which is somewhat swollen.

The nucellus here has elongated, so that at this stage of development the three disorganized cells do not appear as flattened caps above the encroaching mother-cell, but seem to form only a narrow cavity containing a structureless substance which stains deeply. I have not been able to show this accurately in the pen drawing. This cavity is made narrow both by the increase in length of the nucellus and by the turgor of the cells immediately surrounding it. The walls of the turgid cells here in question, which border upon the cavity, are usually much swollen. The mother-cell now develops into the embryo-sac in the normal manner. The mature embryo-sac is covered by the nucellar cap varying from two to four cells in thickness. The antipodal cells attain an extraordinary size compared with that of the egg-apparatus, as a glance at figs. 10*a* and 10*b* will plainly show. This condition of affairs exists in the embryo-sac at the time of anthesis or shortly before. The three cells almost always lie side by side in the same horizontal plane, consequently only two are shown in the figure, the other being in the next successive section. They gradually increase in volume with the subsequent growth of the embryo-sac, and persist for a time after fertilization, when they are finally absorbed. About the time of fertilization they may be seen upon a projection of the chalaza at that end of the sac which has now become very broad. However, the position of the antipodal cells varies considerably in different ovules. Strasburger has called attention to the enormous size of the antipodal cells in *Delphinium villosum.*[4] In Delphinium tricorne the writer did not find the difference to be quite so great. We shall return to this phenomenon further on.

The only account of the development of the embryo-sac in any representative of the Ranunculaceæ to which I have access is that given by Strasburger[5] for *Myosurus minimus.* In

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[4]Strasburger, Ueber Befruchtung und Zelltheilung 38. 1878.
[5]Strasburger, Die Angiospermen und Gymnospermen 13. 1879.

this plant the author finds that the initial cell gives rise to a row of only three cells, the lower one of the series developing into the embryo-sac in the normal way. It will be seen that Delphinium differs from Myosurus in that four cells result from two successive cell divisions of the initial cell, of which the lower one gives rise directly to the embryo-sac. It is not improbable, however, that occasionally only three cells are formed here as in Myosurus, a phenomenon that was observed in other genera to be mentioned later.

The most remarkable phenomenon met with here is the presence of two and sometimes more initial cells and their development into mature embryo-sacs. In figs. 1 and 3 may be seen two initial cells of about equal size. In a number of cases one of the cells was somewhat larger than the other. The larger would in all probability take the upper hand of the smaller, thus crowding it out when only one embryo-sac would be the result. Frequently two cells were observed in later stages of development (fig. 7), both of which would, without doubt, produce mature embryo-sacs. As a rule one cell is a little in advance of its neighbor in development (fig. 7, the cell on the left). This state of things is not exceptional, but in some carpels a large number of ovules presented two, and occasionally three, initial cells. It is certain that every initial cell does not ultimately result in a mature embryo-sac, for it seems that there is unquestionably a "struggle of the parts" here as elsewhere. No more than two embryo-sacs were observed in one ovule. In fig. 9 are shown two fully developed embryo-sacs, apparently of equal size and importance. The antipodal cells lie side by side in a plane at right angles to the plane of the section. By focusing deeper other nuclei could be seen, and in an adjacent section the other antipodal cells were visible. The two embryo-sacs were contiguous for their whole length, separated only by a very thin and indistinct membrane. For lack of time a very large number of ovules was not examined to ascertain the frequency of the phenomenon, nor is it known to the writer whether more than one embryo-sac is fertilized, and in that event whether more than one embryo ever reaches maturity in a single seed of Delphinium.

We do not have to do here with an isolated phenomenon, for the presence of more than one embryo-sac in one ovule has been observed several years ago by Hofmeister,[6] Tulasne, Schacht and others.

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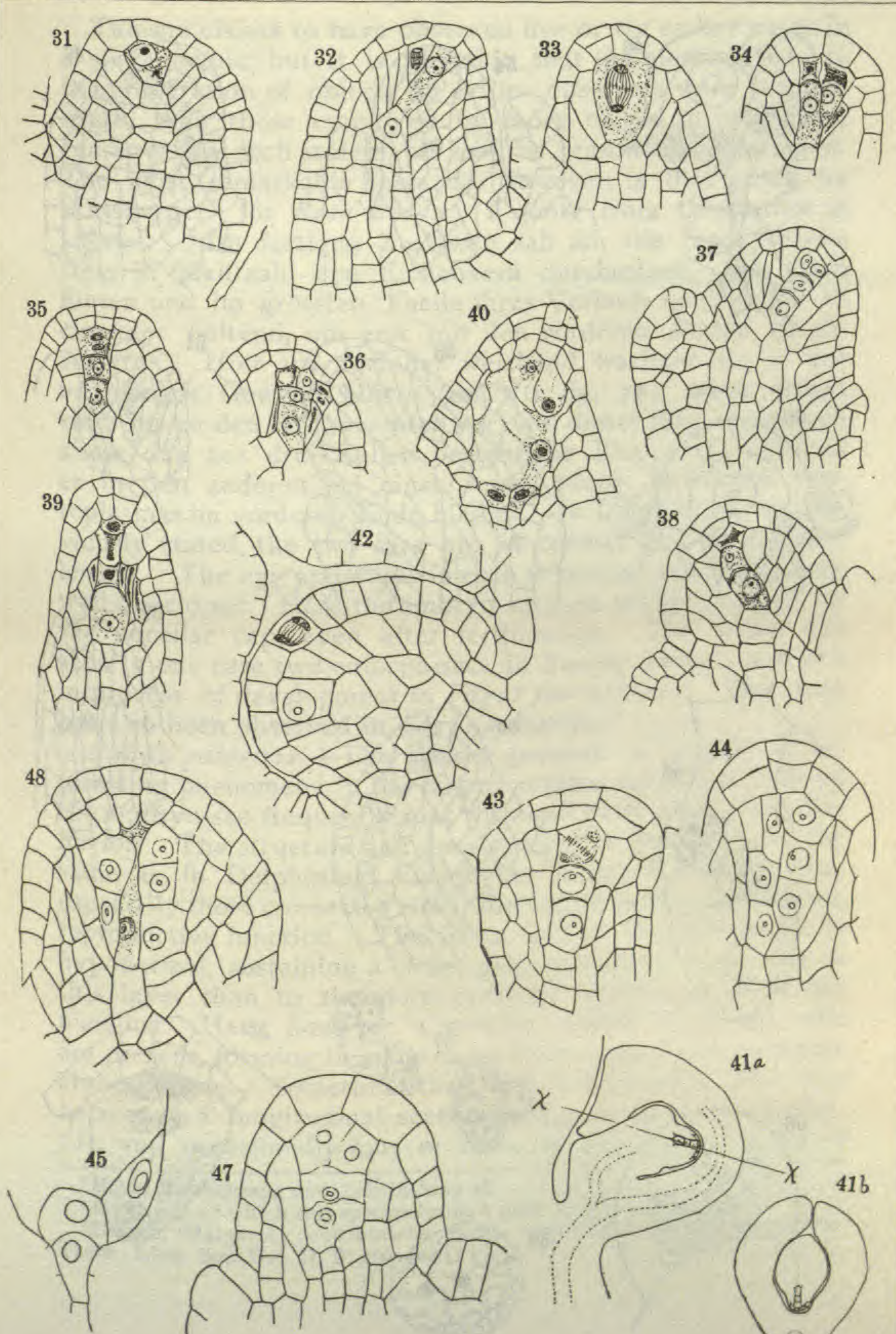
[6]Strasburger, Ueber Befruchtung und Zelltheilung 36 and foot note.



MOTTIER on RANUNCULACEÆ.

MOTTIER on RANUNCULACEÆ.

Tulasne claims to have observed five or six embryo-sacs in a single ovule; but it is probable that the methods used in the preparation of objects by earlier observers were less accurate than those employed by more recent investigators, consequently such statements may be reasonably questioned. The most remarkable instance, however, is that noted by Strasburger[7] for *Rosa livida.* I quote from this author as follows: "Im fertigen Zustande sah ich die Embryosäcke stets in Mehrzahl den Eichenkern durchsetzen, sich nach hinten und im grössten Theile ihres Verlaufs unmittelbar an einander haltend, um erst mit den vorderen Enden zu divergiren. Hier aus einander weichend wachsen sie in das umgebende Gewebe hinein (taf. VII, fig. 72), meist dringt einer bis zu den Integumenten vor, und dieser führt dann auch allein den aus drei Zellen bestehende Eiapparat, während es in den anderen bei einer Ansammlung formlosen Protoplasmas im vorderen Ende bleibt." In Delphinium, as previously stated, the two sacs are in contact for their entire length. The egg apparatus in each is normal and apparently well developed. Here the embryo-sacs are always covered by the nucellar cap, even after fertilization. The writer has seen in one case two embryo-sacs in *Senecio aureus*, and two in process of development in *Fagus ferruginea.*[8] The same has also been observed in *Fagus sylvatica.*[9]

Caltha palustris.—This species presents a number of interesting phenomena in the larger number of initial cells of the embryo-sac frequently met with and their subsequent behavior. The structure and development of the ovule is the same as in Delphinium, except the larger size of its cells, especially those connected either directly or indirectly with the reproductive function. The initial cell of the embryo-sac is hypodermal, sustaining a closer genetic relation apparently to this layer than to the more centrally situated cells of the nucellus. Here, however, a greater number of initial cells are present, forming in many cases what seems to be a massive archesporium. Sometimes three rather large initial cells may be seen in a longitudinal section of the ovular rudiment (fig. 11), and occasionally four or more forming a small group of

[7] Ueber Befruchtung und Zelltheilung 36.

[8] My paper, of which this species forms a part, is now in preparation.

[9] Benson, Margaret, contributions to the embryology of the Amentiferæ. Trans. Linn. Soc. Bot. II. **3**: 409–424.

cells more loosely arranged (fig. 12). The latter state of things was observed in one case only. Frequently only one initial cell could be seen, yet two were usually present. The initial cell divides by a transverse wall into two unequal cells, the lower being the larger (fig. 13). Very soon a division takes place in the lower cell (fig. 14) thus giving rise in all to three cells. It can not be said with certainty that this is always the order of division, but in the particular instances figured, there can be little doubt, for in fig. 13 the nucleus of the lower cell is in the skein stage of the prophases. In fig. 14, it will be observed that the middle cell is somewhat compressed by the enlarging mother-cell of the embryo-sac. Sometimes, however, the first division wall in the initial cell is inclined at an angle of about forty-five degrees; in other cases it was greatly arched downwards, *i. e.*, away from the apex of the nucellus, making the upper cell the larger; again a division may take place in the nucleus of the upper cell without being followed by cell-division (fig. 19). All this may take place before any sign of an integument is visible. In fig. 15 it is clear that cell-division did not follow nuclear division in the lower cell resulting from the first division of the initial cell. The two nuclei lie in opposite ends of the cell, separated by two large vacuoles. From the fact that growth is here very rapid, it may be suggested that the forces controlling nuclear division and the formation of the new cell wall were proportionately weaker than those which, at the same time, bring about the growth in size of the dividing cell. Usually the lower cell of the three becomes the embryo-sac, as in the vast majority of phanerogams, but the uppermost cell of the row may probably become the mother-cell of the embryo-sac (fig. 16). Of course, it is impossible to state definitely what would be the final result of such a condition here figured, as it was the only instance of the kind observed. The lower cell which is slightly disorganized is partly hidden by the cell above it, which in turn is somewhat overlapped by the terminal cell of the row. In this ovule the inner integument has just begun its development.

The mother-cell now develops rapidly into the embryo-sac. In fig. 17 will be seen such a cell with the remains of the disorganized cells above it. The large cell just beneath this is evidently one of the axial row of the nucellus, which failed to divide, and has become, as a result, larger than the neighboring cells of the nucellus. Fig. 18 presents a sac with two nuclei in each end. The outer integument has now put in an appearance on the side turned from the funiculus (on the right in the figure), and the epidermis of the apex of the nucellus has given rise by periclinal divisions to a layer of three or four cells in thickness. This layer may be formed earlier in the development of the ovule (fig. 17). The embryo-sac is not infrequently mature when the inner integument has reached the apex of the nucellus. In regard to this point there is considerable variation, for both integuments may exceed the nucellus before the maturity of the embryo-sac.

The embryo-sac presents nothing abnormal. In the antipodal cells, which become quite large, the nuclei undergo fragmentation, so that each cell at the time of anthesis, contains three or four nuclei.

On account of insufficient material only a limited study of the mature sac was made. In all cases examined only one embryo-sac was found in each ovule, yet the probability is not excluded that more than one may reach maturity as in Delphinium.

Aquilegia Canadensis.—This genus, in the species investigated, presents variation in the behavior of the initial cell of the embryo-sac, along a line different from either Delphinium or Caltha. It may be stated first of all that the most striking histological phenomenon here is the smallness of the cells and consequently the small dimensions of the young ovules as compared with those of the preceding genera.

The initial cell which, of course, is hypodermal in origin, is distinguished from its neighbors of that layer only after a marked increase in size. With the growth of the nucellus it increases perceptibly in length accompanied by a similar growth in the adjacent hypodermal cells, and, in several instances observed, cuts off a small cell from the top, which seems to be a tapetal cell (fig. 20). The lower and larger cell now divides transversely (fig. 21), each of the resulting cells dividing in a similar way (fig. 22). More frequently, however, no such tapetal cell is formed, the initial producing a series of four cells in the manner described for Delphinium (figs. 23, 24). In fig. 23 the upper cell has just divided. The transverse walls are very delicate and the nuclei poor in chromatin, facts which seem to indicate that the two divisions followed in rapid succession. The lower cell (fig. 24) has increased in size apparently by keeping pace with the elongation of the nucellus, as the cross wall separating it from the cell above is horizontal. Its nucleus is a little larger than those of the cells above, and a large vacuole occupies the upper third of the cell.

In fig. 25 it is evident that five cells have been formed from the initial cell. It is quite impossible to determine the exact order of cell-division in this case. It may have been in the manner indicated in figs. 20, 21, and 22, or the uppermost cell of the four resulting from the two successive cell-divisions (fig. 23 or 24) may have undergone a further division. Judging from my experience in this work and the appearance of the preparation from which fig. 25 was drawn, I am inclined to regard the latter process as the correct one. The condition presented by fig. 26 seems to support this view, for there can be little doubt that the uppermost cell of the series divided again at almost right angles to the usual plane of division.

The mother-cell now develops in the usual manner. When the nucellus, by lateral pressure and growth, becomes more elongated, the space occupied by the remains of the disorganizing cells is almost obliterated by the turgor of the surrounding cells (compare figs. 27 and 28). The mother-cell continues its growth mainly at the expense of the cells in front of it, and when it has reached the epidermis, whose cells have now been doubled by periclinal divisions, a nucleus occupies each end with a large vacuole between them. The further development is perfectly normal.

In the newly formed embryo-sac the antipodal cells, which are always surrounded by very evident membranes, taken together have about the same volume as the egg-apparatus (fig. 29). With the gradual increase in size of the embryo-sac prior to fertilization and some time afterwards, the antipodal cells become enormously enlarged, being very rich in protoplasm, with numerous vacuoles especially in their broad upper ends. The nuclei multiply by fragmentation.

A glance at fig. 30*a*, a small embryo with a cell by its side, probably one of the synergidæ, and fig. 30*b*, two antipodal cells taken from the same embryo-sac, will give one some idea of the phenomenon just mentioned. In this embryo-sac the endosperm consisted of many free nuclei regularly disposed in the protoplasmic lining of its cavity, *i. e.*, the endosperm is a single layer of free cells.

(To be concluded.)

The development of botany in Germany during the nineteenth century.

EDUARD STRASBURGER.

AUTHORIZED TRANSLATION BY GEORGE J. PEIRCE.

[*Concluded from p. 204.*]

The new development which systematic botany has taken on in Germany during the last decades began when new life was given to morphology by its close union with the study of the cell, with anatomy, and embryology. Schleiden had already attempted in 1845 in his "Grundzüge der wissenschaftliche Botanik," in contrast to P. de Candolle, exhaustively to characterize the main groups of the vegetable kingdom in accordance with their morphology and development. He thus gave the method which is now being employed.

It was especially Alexander Braun and his school, however, who zealously sought to develop comparative morphology, especially of flowers and flower-clusters, and to make these available for systematic botany. Among the followers of Braun, Eichler made the most important advances in the development of the system by his "Blüthendiagramme" (1875–78). Eichler improved the system established by Braun, and gave in his Syllabus a review of the whole, and an arrangement which has since then formed the basis of most lectures on systematic botany at German and foreign universities, and which is followed in botanic gardens, collections, and herbaria. Systematic botany received a mighty impulse when, at the beginning of the sixties, Darwin's works re-established the theory of descent and won for it general recognition. The construction of a system based on phylogeny now became the ultimate goal of systematic botany, and the best means of attaining this was shown to be comparative morphology. The establishment of homologies, which alone can settle systematic relationships, was now striven after. Systematic botany immediately ceased to be limited by outward form, and brought to its aid internal structure also. The main groups were characterized with a view to their anatomy, and attention was given in due proportions, even in the single systematic tribes, to a study of the different sorts of tissue and their different modes of formation. Hugo von Mohl and Anton de Bary, the founders of comparative anatomy, may be regarded as also the founders of the anatomical method in systematic botany, the value of which was then fruitfully recognized by the systematists themselves, especially by RADLKOFER (of Munich) in Germany, and before him, though not with such insistence on this point, by Engler, Count SOLMS-LAUBACH (Göttingen, Strassburg), and Pfitzer.

The most important German contribution of recent years to systematic botany is the work edited by Engler and PRANTL[7] (Breslau) which has been in course of publication since 1889, "Die natürlichen Pflanzenfamilien." Many, for the most part German, systematic botanists united to work up the material which has been accumulated in course of time and by their own exertions, and to give a uniform presentation of the numerous families of plants in accordance with the new points of view, combining comparative morphology, development, anatomy, and the results of biological research.

The systematic study of the cryptogams shows no less advancement during recent decades than that of the phanerogams. The algæ were especially worked up by TRAUGOTT KUETZING (teacher in Nordhausen) in his "Tabulæ Phycologicæ," published from 1845 to 1870 in twenty volumes, and in numerous other works; the fungi by P. MAGNUS (Berlin), G. WINTER (a scientific man in Leipzig who held no public office, and who died in 1887), and J. SCHROETER[8] (high military surgeon in Breslau). We must thank the latter for a fungus flora of Silesia which is now nearing completion. The mosses received fundamental treatment at the hands of W. PH. SCHIMPER (Strassburg, died in 1880), and finally the vascular cryptogams by MILDE (Breslau, died in 1871) and LUERSSEN (of Königsberg).

The study of plant-geography in the German Universities attained to greater importance first under GRISEBACH (Göttingen, died in 1879). His most famous work undoubtedly is "Die Vegetation der Erde," which was published in two volumes in the year 1872. Grisebach considered climate to

[7] Died February 24, 1893.—G. J. P.

[8] Died December 12, 1894, leaving the flora still unfinished.—G. J. P.

be the most important factor in the distribution of plants. That there is, in addition to climate, a second and at least as important factor, namely the geological,—that, in other words, in order to understand the present distribution of plants, we must turn back to the floras and climatic conditions of former periods—was indeed admitted in principle by Grisebach though he scarcely noticed it in practice. This is readily explainable, since he regarded the species of plants as independent creations, and considered that variations in the species had only a limited and subordinate significance. On the other hand, the great excellences of the work were, that it gave for the first time a coherent presentation of the vegetable covering of the earth, that it divided the various floral territories into formations, and that it described the characteristic plants of each territory and formation. The later works of German investigators into the geographical distribution of plants, in contrast to those of Grisebach, are based on the theory of transformation, which here as elsewhere has shown itself to be extraordinarily fruitful. At the same time, the subject became divided into what may be called the geological or developmental, the systematic, and the biological sections. These do not antagonize one another but, on the contrary, supplement each other in giving a many-sided yet harmonious treatment of the whole.

The most important work in the geological section is by ENGLER (Kiel, Breslau, Berlin), published in two volumes in 1879 and 1882, under the title "Versuch einer Entwicklung der Pflanzenwelt." In contrast to Grisebach, the author of this book puts the factor of development in the foreground, and seeks in the past history of the present flora, the explanation of many phenomena of distribution which cannot be accounted for by the present climatic conditions alone. The purely systematic direction, which concerns itself with the present conditions of the geographical distribution of plants, and seeks to define the limits of the floral kingdom, to mark the areas of species, is cultivated mainly in the Botanical Museum at Berlin, which contains the richest herbarium in Germany. Through the activity of our explorers and colonial officials, a mass of material, rich in African species, has been gathered together in recent years, which is now being worked up by Engler, with the assistance of other experienced botanists. The results up to this time are published partly in Engler's "Ueber die Hochgebirsgsflora des tropischen Afrikas," partly in his "Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie," which is the most important organ of this department of science. The flora of the German protectorate in southwest Africa has also been studied by SCHINZ (of Zürich). WARBURG (docent in Berlin) is the chief student of the flora of New Guinea, both as to its systematic and geographical aspects.

Still another important geographical undertaking is being directed at Berlin, namely the "Flora Brasiliensis," begun by VON MARTIUS (Munich, died in 1868), continued by Eichler, and now, under the direction of URBAN (sub-director of the Botanic Garden at Berlin), rapidly nearing completion. We are indebted for an important summary of the systematic geography of plants to a work published in 1884 by DRUDE (professor in the Institute of Technology at Dresden). By the same author, there appeared in 1890, a comprehensive "Handbuch der Pflanzengeographie" in which all parts of the field are uniformly treated.

The biological tendency in plant-geography, to explain the physiognomy of the single floras as adaptations to external conditions, was already visible in Grisebach's "Die Vegetation der Erde," but it has not received comprehensive expression. Single monographs, based on observations made in other than European countries, have been published in Germany by Schimper, Volkens, Schenck and Göbel. W. Schimper has done the most eminent work in this direction, and his experiences on his extended travels in the tropics are recorded in important and suggestive papers. The publication of these papers has followed since 1888 in the successive numbers of his "Botanische Mittheilungen aus den Tropen."

The means of aiding botanical investigation have increased remarkably in Germany during the last decades. Botanical laboratories which, in the fifties, did not exist at a single university, are now found at the agricultural schools and institutes of technology as well. The older botanists have brought about, and lived through, this transformation. De Bary, about whom in the sixties the majority of the young investigators gathered for further instruction, was the first to establish a botanical laboratory. At first at Freiburg, about 1858, it was in a low-studded room reached only by a steep dark stairway, where de Bary worked with his students Woronin, Famintzin, and later Count Solms-Laubach. This laboratory was without separate endowment. Then, in the middle of the sixties, de Bary arranged a laboratory at Halle, roomy but as simple as possible in its arrangement, and quite unadorned. Finally, early in the eighties, he erected the laboratory at Strassburg, a handsome building, well adapted to advance scientific investigation, and expressing in its external appearance the great importance to which natural history had in the meantime attained.

Early in the sixties the botanical laboratories at Breslau, Munich and Jena were also built, and soon not only the other universities, but also other institutions of learning, followed their example. These laboratories now possess not only their own departmental libraries and the best optical instruments, but also the physical apparatus which physiological researches demand, and most of them have in addition small special green-houses connected with the buildings.

At most German universities[9] two main courses of botanical lectures are given each year, in alternate semesters: the so-called general botany, which treats of the whole field of botanical knowledge, and is designed especially to meet the needs of the medical students; and special botany, in which all the groups of the vegetable kingdom are successively treated with a view to their morphology, and also generally as regards their physiological development. Together with these main courses, which are given by the full professors, others are given by the assistant professors and the docents, on the more important families of plants or on geographical botany, with practice in the determination of plants, some also on officinal plants and on pharmacognosy especially to meet the needs of the students of pharmacy. In the free courses[10] subjects of more general interest, fertilization, pollination, adaptations, the more recent advances in the science, et cetera, are considered. Once a week, the professor or assistant professor is accustomed to conduct a botanical excursion. In the laboratory, generally twice a week, and each time for several hours in succession, there is given a practical exercise for beginners in which, at most universities, the important questions of histology are successively studied and the students are taught the use of the microscope

[9] A paper on the teaching of botany at German universities, by the translator, may be found in the Educational Review, January, 1895.

[10] For the others fees are charged.—G. J. P.

and the methods of micro-technique. For advanced students the laboratory is daily open, and there, under the direction of the teacher and his assistants, they attempt independently the solution of special problems.

Schleiden's "Grundzüge der wissenschaftliche Botanik" drove all other text- and hand-books from the field, and held for a long time its supremacy. The material to be worked over increased so remarkably during the forties and fifties, and so many new problems presented themselves, that it seemed indeed no easy task to bring everything together into a text-book. Schacht's "Lehrbuch der Anatomie und Physiologie," published in 1856, and Wilkomm's "Anleitung zum Studium der wissenschaftlichen Botanik," could not lay claim to having filled the gaps. This was first accomplished in 1868 by Sachs's "Lehrbuch der Botanik," which soon, in foreign lands as in Germany, gained the supremacy. The editions of this book followed in rapid succession, until Sachs refused to work the the book over again. A summary of Sachs's text-book by Prantl, which in its successive editions adapted itself to the developments of the science, may be regarded as the text-book which is now most widely distributed among those who are learning the science. The number of such text-books has increased remarkably of late, and an exhaustive revision of Sachs's book has been recently undertaken by Frank.[11]

The charts which now beautify the walls of almost every botanical lecture-room are indisputably important aids in teaching botany. Of these, certainly those by Kny are models. They were drawn either by himself, or under his direction, especially for teaching purposes, and were often preceded by special studies of the objects represented. The results of these investigations are presented in special pamphlets that serve at the same time as descriptions of the plates which they accompany. The wall-charts by Dodel-Port, and also those by Frank and Tschirch, are commendable and widely used. In most lecture-rooms microscopic preparations are demonstrated, and in many places, for example, at the University in Bonn, occasional hours are devoted to reviews, when the microscopic figures are projected by means of a solar microscope. In other places, the electric light is used for the same purpose, or the photogrammes by L. KOCH (of Heidelberg), are thrown upon the screen by the sciopticon.

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[11] This has now appeared in two volumes.—G. J. P.

Hugo Mohl was himself able to grind lenses. In various papers he instructed his contemporaries as to the manipulation of the microscope, and finally in his "Micrographia" gave exhaustive directions for its use. Schacht published a book on the microscope in 1862, whose chief value lay not so much in its optical part as in the directions for the study of specified vegetable objects. On the contrary, in Naegeli and Schwendener's "Das Mikroskop" the optical and purely physical portion of the subject was put in the foreground, while Dippel's work, "Das Mikroskop," published in 1867 and 1869, occupies the middle ground between the two preceding. Strasburger confined himself to the botanical part of the problem in "Das botanische Praktikum," which appeared in 1884 in a large edition for advanced students, and in a smaller one for beginners. This practical botany attempts to conduct the learner through a series of problems covering the entire field of microscopical botany, and to make him familiar with the use of the instrument and with microscopical technique. The structure and use of the microscope and botanical microtechnique are taught without the consideration of special objects for study by Behrens's "Leitfaden der botanischen Mikroskopie," published in 1890. His "Tabellen zum Gebrauch beim mikroskopischen Arbeiten," treat only of technique, and the same may be said of the "Botanische Microtechnique,"[12] by ZIMMERMAN[13] (docent in Tübingen), published in 1892.

The numerous botanical journals now appearing give eloquent testimony to the activity of botanical research in Germany. "Flora" has been published since 1818 by the Botanical Society in Ratisbon.[14] The "Botanische Zeitung" was founded in 1843 by Mohl and Schlechtendal. The "Jahrbücher für wissenschaftliche Botanik," for more comprehensive papers, have been published since 1858 by Pringsheim and are now before us in twenty-three constantly enlarging volumes. In the seventies most of the botanical laboratorios of the German universities began to publish their researches in journals of their own. In addition, many botanical papers have been, and continue to be, published in the Nova Acta of the Leopold-Caroline Academy and in the Proceedings of other Academies. Since 1881 the "Botanische Jahrbücher für System-

[12] Translated by J. E. Humphrey, and published by Henry Holt & Co.—G. J. P.
[13] Now raised to the rank of assistant professor. —G. J. P.
[14] Edited since 1889 by Professor Karl Goebel of Munich.—G. J. P.

atik, Pflanzengeschichte und Pflanzengeographie" have regularly appeared under Engler's editorship, and have already reached the imposing number of thirteen volumes. It presently became impossible for any one to master the whole botanical literature, and so there was established in 1873 an organ for reviews, Just's "Jahresbericht," which appears yearly in two volumes and gives accurate abstracts of the contents of those botanical writings which have appeared in the course of a year. The "Botanisches Centralblatt," edited by Uhlworm, began in 1880, and is now completing its fifty-second volume. Owing to the enormous amount of material for publication, it has just been decided to issue supplements to this.

An important event in the life of botanical science in Germany was the founding, at Pringsheim's suggestion, of Die deutsche botanische Gesellschaft, of which Pringsheim has since been the President. German botanists, almost without exception, have joined this society, and many notable foreign botanists also, in addition to those who have been selected by the society as honorary or corresponding members. The society holds its regular monthly meetings in Berlin, the chairman of which is chosen yearly from among the Berlin botanists. A general meeting is also held each year, which until now has always been in conjunction with the Versammlung deutscher Naturforscher und Aerzte. The papers read or presented at the meetings are published in the "Berichte der deutschen botanischen Gesellschaft." A special commission under the chairmanship of C. ASCHERSON (Berlin), well known for his knowledge of the German flora, makes its yearly report on this subject at the general meeting. Der botanische Verein für die Provinz Brandenburg, also maintained in Berlin, especially cultivates the interests of systematic botany and publishes its proceedings.

The botanical laboratories, which soon became the centers of botanical work in the higher institutions of learning, at first somewhat overshadowed the botanic gardens in importance. Since then, however, most of the German botanic gardens have adapted themselves to the new problems of the science, and now actively supplement the physiological teaching by special displays of so-called biological groups of plants. The increasing interest in systematic botany has revived the interest in the plants themselves, and it is the botanic gardens which aid one to form a conception of the most varied plant-forms of our globe. As experimental and acclimatization gardens they are now called upon to advance colonial interests, and have as their model the magnificent achievements in which the Botanic Garden at Kew, near London, may justly take pride. The botanic gardens must not be underestimated as a means of educating the general public; for it is by such establishments that our institutions of learning may keep in closest union with the unprofessional world which seeks further instruction.

The imposing edifice of the Botanical Museum at Berlin gives highly honorable testimony, as do the other museums established during the last ten years, to the noble efforts of the Prussian ministry. This botanical museum, scientifically arranged by Eichler, is now brilliantly developing under Engler's direction. It furnishes the center of fruitful opportunities for the growth of all botanical science in Germany, and, what will contribute not a little thereto, preserves for Germany the botanical treasures from foreign lands.

Bonn, Germany.

Musineon of Rafinesque.

JOHN M. COULTER AND J. N. ROSE.

In studying some recent Mexican collections of *Umbelliferæ* we were led to an investigation of the genus commonly known as *Musenium* of Nuttall by the discovery of what seems to be a Mexican representative of it. The Nuttallian genus of 1840 had been replaced by Rafinesque's *Adorium* of 1825 in Kuntze's *Revisio*, and this name appears in the recent "Check list" published under the auspices of the Botanical Club. As the validity of this substitution must rest upon a thorough examination of Rafinesque's writings, advantage was taken of the unusual facilities offered by the various libraries at Washington to examine into the matter. The result is stated in the following history:

In 1819, in *Journal de Physique, de Chimie et d'Histoire Naturelle* (**89:** 101), Rafinesque established the genus *Marathrum*, basing it upon *Seseli divaricatum* Pursh.

In 1820, in the same journal (**91:** 71), having discovered a previously described *Marathrum* Humb. & Bonp. (1808), he substituted *Musineon* for his *Marathrum*, and as this publication seems to have escaped the notice of recent bibliographers, Rafinesque's statement is quoted in full as follows:

1. Dans le prodrome de 50 nouveaux genres de plantes d'Amérique, j'ai décrit deux nouveaux genres sous les noms de *marathrum* et de *pythagorea;* je me suis apercu depuis lors, que ces noms avaient déjà été employés, le premier par Robert Brown, et le second par Loureiro; et comme je súis convaincu de l'importance et de la nécessité d'éviter des doubles emplois en Botanique, je m'empresse de rectifier cette erreur, et de proposer les noms suivans en place.

Mon G.[1] *marathrum* devra se nommer *musineon.* Ces deux noms sont des synonymes de fenouil.

In 1825 Rafinesque suggested still another name, *Adorium*, which was taken up by Dr. Otto Kuntze as the oldest tenable name, who states that the *Musineon* Raf., referred to in DeCandolle's Prodromus (**4:** 146), must be an error. Dr. Kuntze certainly did not find it in the place cited in the *Revisio*, for it is the citation of *Marathrum.*

[1] With Rafinesque the abbreviation "G" stands for genus.

In 1840, among Nuttall's manuscript genera, Torrey and Gray published *Musenium*, which was evidently simply a Latinizing of Rafinesque's *Musineon*, with which Nuttall was certainly familiar.

It seems clear, therefore, that the generic name *Musenium* must stand, but that it is not Nuttall's, and should retain the form *Musineon* originally published by Rafinesque.

Our present understanding of the genus and its species is as follows:

MUSINEON Raf. Jour. Phys. **91:** 71. 1820.

Marathrum Raf. Jour. Phys. **89:** 101. 1819. not H. & B. 1808.
Adorium Raf. Neogenyt. 3. 1825.
Musenium Nutt. Torr. & Gray, Fl. **1:** 642. 1840.

**Calyx-teeth prominent: carpophore entire.*—Rocky Mts. and plains to the eastward from Colorado northward.

+ *Stems dichotomously branching from the base: leaf-segments toothed.*

++ *Stems glabrous: fruit smooth, about* 4^{mm} *long.*

1. MUSINEON DIVARICATUM (Pursh.) Raf. Journ. Phys. **91:** 71. 1820.

Seseli lucidum Nutt. Fras. Cat. (1813), name only.
Seseli divaricatum Pursh. Fl. 723. 1814.
Marathrum divaricatum Raf. Journ. Phys. **89:** 101. 1819.
Adorium crassifolium Raf. Neogenyt. 3. 1825.
Adorium lucidum Kuntze, Rev. Gen. Pl. 264, 1891, name only.
Adorium divaricatum Rydberg, Bot. Surv. Nebr. **3:** 37. 1894.

++ ++ *Stems scabrous: fruit scabrous, shorter and broader than in the former.*

2. MUSINEON HOOKERI (Nutt.) Torr. & Gray, Fl. **1:** 642. 1840.

M. divaricatum Hookeri T. & G. l. c.
M. trachyspermum Nutt. l. c.
M. angustifolium Nutt. l. c.

+ + *Acaulescent, the simple peduncles much exceeding the leaves: leaf-segments narrowly linear and entire.*

3. MUSINEON TENUIFOLIUM (Nutt.) Torr. & Gray, Fl. **1:** 642. 1840.

Adorium tenuifolium Kuntze, Rev. Gen. Pl. 264. 1891.

* * *Calyx-teeth obsolete: carpophore two-parted.*—High mountains of southern Mexico.

4. **Musineon alpinum,** n. sp.—Acaulescent, in dense mats, from a thick branching caudex, 5 to 10^{cm} high, glabrous throughout, or nearly so: leaves once to twice pinnate, somewhat shorter than the peduncles, the primary segments ovate and more or less lobed or pinnately parted, and usually with a pubescent ring on the rhachis at the junction: peduncles thick, bearing a few-flowered 4- to 6-rayed umbel, with no involucre and involucels of few linear bractlets longer than pedicels: rays unequal, 6 to 12^{mm} long: pedicels 2 to 4^{mm} long: flowers not seen: fruit glabrous, oblong-ovate, with notched base and blunt apex, 3^{mm} long, with filiform ribs and long, flat (strap-shaped) styles.—Cold summit slopes, Nevada de Toluca, state of Mexico, alt. $14{,}000^{ft}$, September 2, 1892, *Pringle's* no. 4,247 of 1892.

This species is referred to ***Musineon***, although it is widely separated geographically from the other species, which belong to the northern plains region. Its habit and general characters are those of the genus as already known, but the obsolete calyx-teeth, two-parted carpophore, and peculiar styles, as well as the wide geographic separation, suggest a possible generic separation if supported by further Mexican material. The fact that it occupies the high mountain region of Central Mexico makes its claim to be congeneric with the northern forms more reasonable.

Lake Forest and *Washington.*

The nomenclature question.

On the application of "once a synonym always a synonym" to binomials.

Reviewing in the March number of the GAZETTE the recently published "List of Pteridophyta and Spermatophyta," I made the following statement: "It will always be possible for an erratic botanist to throw together large genera like *Aster* and *Erigeron*, *Bidens* and *Coreopsis*, *Panicum* and *Paspalum*, thereby displacing [in accordance with the Madison rules] many specific names which according to the rule of once a synonym always a synonym can never be revived." Criticising my position Mr. Coville in the April number of this journal pronounces this a lamentable error. Although he has quoted my statement accurately he appears to have overlooked the important word "*specific*," which it contains, since to prove its deplorable inaccuracy he advances merely some well-known and wholly irrelevant generalizations regarding *generic* names. Although it should have been clear to every careful reader that the case under discussion had to do with specific names, the point which I wished to make is somewhat technical and perhaps should have further elaboration.

When two large genera, like *Cacalia* and *Senecio*, or *Carduus* and *Cnicus*, are united, a certain number of valid species of like specific name are brought under the same generic name and a part of them of course must receive new specific names. If now the same genera are separated the question of the restoration of the displaced specific names arises at once and on this point the Rochester and Madison rules appear to lead to a curious dilemma. This can only be made clear by examples.

Let us suppose that *Panicum* and *Paspalum* are united by A in 1895 under the former name. As there are at present both a *Panicum dissitiflorum* Steudel (1841) and a *Paspalum dissitiflorum* Trinius (1826), it is evident that one must be renamed. At Madison it was decided that in such cases it is not the age of the combination but the age of the specific name which should be the determining factor, so that the *dissitiflorum* of Trinius would have preference even under the changed generic name, and A would accordingly rename *Panicum dissitiflorum* Steud.; the two species thus becoming, we will say, 1. *Panicum dissitiflorum* (Trinius) A. 1895. = *Paspalum dissitiflorum* Trinius. 1826. 2. *Panicum Steudelii* A. 1895. = *Panicum dissitiflorum* Steudel. 1841.

Suppose that in 1896 B separates the two genera. May he, according to the Rochester and Madison rules and the principle of once a synonym always a synonym, re-instate *Panicum dissitiflorum* Steud.? Discussing this point at Madison with a member of the nomenclature committee, I was informed that a name so displaced could never be re-established, since, to continue our example, there exists in 1896 a *Panicum dissitiflorum* (Trin.) A, with an older specific name than *Panicum dissitiflorum* Steud. Now this interpretation of the rules must be either right or wrong. If it is correct I must reiterate that it would give to any erratic writer the power of forever displacing valid specific names, since there is no limit to which large related genera can be brought together, and the Rochester and Madison codes do not permit exceptions and least of all personal distinctions in the application of their rules, so that it would make no difference whatever who united the genera or whether he had any real scientific basis for his judgment. If, on the other hand, the interpretation is wrong and my informant was in error, it is certainly an unfortunate rule which is not uniformly understood even by all the members of the committee that frames it. And furthermore, if we admit that *Panicum dissitiflorum* Steud. could be restored, does it not show inconsistency in the application of the rules? For in uniting the two genera it is the age of the specific names, as we are told, that determines which of two specific homonyms may stand. In separating the same genera and applying the principle of once a synonym always a synonym this factor would be totally neglected and a species would be re-instated notwithstanding the fact that there would be an older and identical specific name at that time in the genus. It is worthy of note that in this matter as in some others the uniform adoption of the first correct combination—a most healthful check to the undesirable effects of unlimited priority—would readily obviate the difficulty.

Considering the fact that the "List of Pteridophyta and Spermatophyta" has not, to my knowledge, received as yet the formal sanction of any considerable or representative body of

American botanists, and that its intent, as understood by many members of the Botanical Club of the American Association and by some at least of the nomenclature committee, was not to establish the Rochester and Madison rules but to show their outcome and give a better basis for their discussion, I must express considerable surprise at the following sentence of Mr. Coville's criticism of my review: "Now that they [the principles] have been adopted by overwhelming majorities in democratic botanical assemblages, we may ask whether Dr. Robinson's protest is not out of place." Certainly to object to the discussion of this subject and to rule out the expression of any opinion at variance with the new rules is as unscientific as it is undemocratic.—B. L. Robinson.

Recommendations regarding the nomenclature of systematic botany.

[A circular with the above title has recently been issued by Dr. B. L. Robinson, curator of the Gray herbarium. We republish the recommendations, omitting the prefatory remarks and arguments. The paper is signed by seventy-four botanists "of various degrees of repute"—to use Mr. Rand's expression regarding the supporters of the Rochester agreement.—Eds.]

1. Ordinal names, having been established by long usage, should not be subjected to revision upon theoretical grounds.

2. Long-established and generally known generic names . . should be retained. The scope of this rule is left to the discretion of writers. . . .

3. In specific nomenclature the first correct combination is to be preferred. . . . For these reasons it seems best to adopt the principle of priority under the genus. It is to be emphasized, however, that this ruling does not lessen the obligation of botanists of the present and future in making a transfer of a species from one genus to another to preserve scrupulously the specific name without alteration, except in the case of an existing homonym.

4. The varietal name is to be regarded as inferior in rank to the specific. . . . No specific name should be altered, because of preexisting varietal names for the same plant. Nevertheless, it is recommended as a working rule that whenever a variety is raised to specific or a species depressed to varietal rank the name should be preserved whenever possible.

5. The principle of "once a synonym always a synonym," while recommended as an excellent working rule for present and future, may not justly be made retroactive.

The botanical work of the government.

JOHN M. COULTER.

The amount of botanical work that has been undertaken by the national government is perhaps unknown to all except those who come in direct contact with it. Thinking that such information would not only be of interest to botanists in general, but would also be of service to the work itself, the chiefs of the various divisions were asked to furnish the following information, which was given very promptly and courteously. At present four distinct divisions of botanical work are organized under the Department of Agriculture, although other divisions also do a certain amount of work that may be fairly called botanical.

1. DIVISION OF BOTANY. The total appropriation for the Division of Botany for the year ending June 30, 1895, is $38,-600. The appropriation made for the year ending June 30, 1896, is $33,800, the new Division of Agrostology having been separated from the Division of Botany, as indicated below. The employees who are engaged in strictly scientific work, exclusive of those engaged in semi-technical, editorial and clerical work, and the temporary field agents, who are employed only during the collecting season, are as follows:

Mr. Frederick V. Coville (Cornell University), as chief of the division, is engaged principally in its administrative work but is also doing some monographic and local botanical work on plants of eastern Washington and eastern Oregon.

Mr. J. N. Rose (Wabash College), as assistant botanist and honorary assistant curator, has general charge of the herbarium, makes the majority of critical miscellaneous identifications, and is also engaged in working upon collections of Mexican plants.

Mr. L. H. Dewey (Mich. Agric. College) is engaged upon investigations of weeds, collating information of all kinds regarding them; and combining this information into form for popular use.

Mr. G. H. Hicks (Mich. Agric. College; Univ. of Michigan) has charge of the pure seed investigations of the Division, maintaining and adding to the collection of seeds, and testing commercial samples with reference to their purity and germinative capacity.

Mr. C. L. Pollard (Columbia College) is acting as assistant curator of the herbarium, and is engaged at present in numbering specimens already mounted, distributing newly mounted material, and arranging the plants properly upon the shelves.

Mr. A. G. Pieters (Mich. Agric. College; Cornell Univ.) is acting as an assistant of Mr. Hicks, and is engaged particularly in making germination tests of commercial seed.

Mr. V. K. Chesnut (Univ. of Calif.; Univ. of Chicago) is engaged upon an investigation, both pharmacological and physiological, of poisonous and medicinal plants.

Mr. Marcus E. Jones (Iowa College) is engaged in working up a report on the collection of plants made by him in southern Utah and northern Arizona during the season of 1894.

Messrs. Scribner, Kearney and Smith are also connected with this Division until July 1, but their work will be mentioned in connection with the new Division of Agrostology.

The work of the Botanical Division during the coming year will in the main be an amplification of the lines of work already under way, and possibly the assumption of one or two additional investigations.

2. DIVISION OF VEGETABLE PHYSIOLOGY AND PATHOLOGY. It will be noted that "Physiology" has been added to the title of this Division by the last Congress, enabling work which had already been begun to be prosecuted upon a broader basis, and recognizing the fact that in the study of diseased plants the normal life processes must first be understood before the diseased organism can be studied intelligently. The appropriation for the year ending June 30, 1895, was $26,100; for the year ending June 30, 1896, it is $26,300. The care of the extensive collection, correspondence and system of indexing is shared by all the staff at Washington. The laboratory investigations are conducted at Washington, Eustis (Fla.) and Santa Ana (Calif.), and are in charge of the following staff:

Mr. B. T. Galloway (University of Missouri), as Chief of the Division, has charge of the administrative work, general direction of all investigations, and edits all bulletins and reports. In such time as is left to him, he is investigating the conditions affecting the health of plants under glass, and also one or two groups of fungi.

Mr. Albert F. Woods (University of Nebraska), Assistant Chief, is engaged in an investigation of the growth of potatoes as affected by spraying with Bordeaux mixture, it having been found that the effect is wholly distinct from that resulting from the prevention of insect and fungus attacks, often causing an increased yield of from 30 to 50 per cent.

Mr. Erwin F. Smith (University of Michigan) is a student of peach yellows and bacterial diseases, and is now continuing his investigations of the melon diseases, especially those prevailing in the south.

Mr. M. B. Waite (University of Illinois) is investigating diseases of pomaceous fruits and is now studying pear blight, chiefly with reference to the effect of different fungicides, the effect of different degrees of heat and cold, and is making bacteriological studies of insects found on the pear or known to visit it.

Mr. W. T. Swingle (Kansas Agric. College), stationed at Eustis, Florida, is studying the diseases of citrus fruits and other subtropical plants, and is now investigating the blight, die-back, sooty mold and scab of the orange and other citrus fruits.

Mr. H. J. Webber (University of Nebraska) is associated with Mr. Swingle in these studies.

Mr. Newton B. Pierce (University of Michigan), stationed at Santa Ana, California, is investigating the diseases of the grape and other fruits on the Pacific Coast.

Mr. M. A. Carleton (Kansas Agric. College) is investigating the diseases of cereals, especially the rusts and smuts.

Mr. Theo. Holm (University of Copenhagen) has charge of anatomical work, is now examining the anatomy of galls, and will soon take up a study of the anatomy of cultivated wheats in relation to rust-resisting qualities.

Mr. Joseph F. James has charge of the herbarium, and also general supervision of the index work.

Mr. P. H. Dorsett (University of Missouri) has charge of field work with fungicides.

Nearly all of this staff are also interested in various groups of lower plants, but no attempt is made to push this work to the front. Primarily the work is on the physiology and pathology of plants in relation to agriculture, purely systematic studies being secondary.

3. DIVISION OF AGROSTOLOGY. This is a new division

established by the last Congress, but the act does not go into effect until the first of July. Until that time the work is a part of that of the Division of Botany. The function of the new division, which deals with forage plants as well as grasses, is to instruct and familiarize the people with the habits and uses of these plants, to conduct investigations relative to their natural history and adaptability to different soils and climates, to introduce promising native and foreign kinds into cultivation, to identify all grasses and forage plants sent in for identification, and reply to all correspondence relative to these plants. For this work $15,000 has been appropriated, and the following staff has been provided:

Professor F. Lamson-Scribner, Chief of the Division. Professor Scribner is now engaged in the preparation of a Handbook of the Grasses of the United States, in which it is designed to describe and illustrate all of our species of grasses. The illustrations thus far prepared are of the highest order of excellence.

Mr. T. H. Kearney, Jr. (Univ. of Tennessee; Columbia College), is assisting Professor Scribner on the Handbook.

Mr. Jared G. Smith (Univ. of Nebraska) will have direct charge of the outside work of the Division.

4. DIVISION OF FORESTRY. This Division is in a somewhat different position from all other Divisions in that they deal with existing interests, while the Forestry Division has still to create an interest in its subject. Besides scientific investigations, therefore, a considerable amount of propaganda work is carried on and the scientific work has until lately been rather on uncertain lines and desultory. Within the last three years, however, a more definite policy in this respect has been inaugurated and systematic work is carried on, having in view the laying of a theoretical basis for future forestry practice.

Mr. B. E. Fernow, as Chief of the Division, has charge of the administrative work, and also is very actively engaged in arousing and organizing public sentiment in favor of a rational forestry policy.

Mr. Chas. A. Kieffer (Iowa Agric. College) is Assistant Chief, and in addition to his official duties is charged with all questions relating to western tree planting, and especially with conducting a series of forest planting experiments in co-operation with agricultural experiment stations in Kansas, Nebraska, the Dakotas and Colorado.

Mr. Geo. B. Sudworth (Univ. of Michigan) has charge of the strictly botanical work, identifying all species, and answering economic questions of adaptation of species to climate and soils.

Dr. Charles Mohr is a field agent, who has not only collected material for timber test work, but has also prepared monographs on the southern coniferous trees of commercial value.

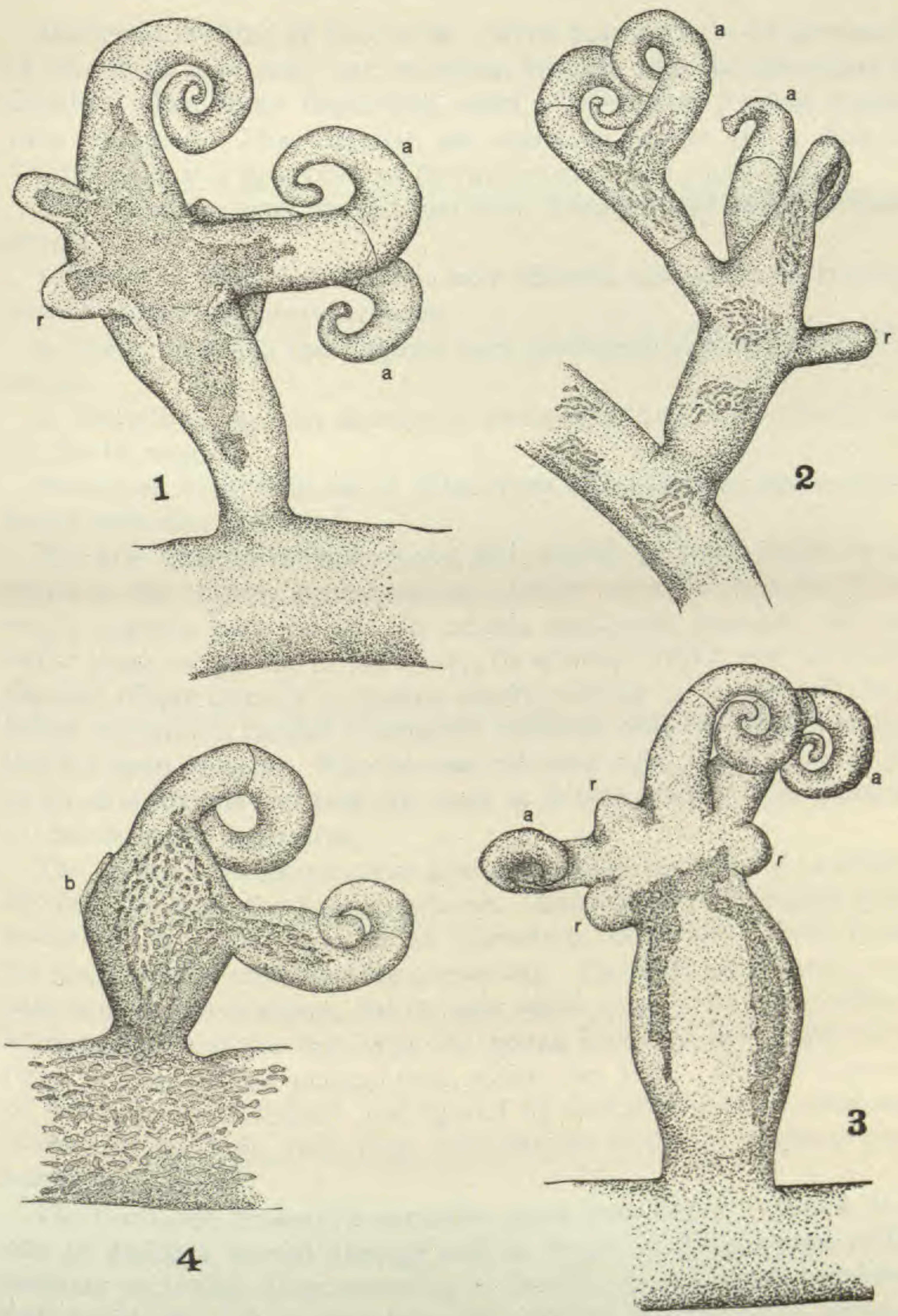
Mr. Austin Cary (Bowdoin College) is also a field agent, who has been engaged on tree measurements to establish the rate of growth and wood production of various species, notably the black spruce in Maine and New Hampshire, and the white and Norway pine in Michigan and Wisconsin.

The main work of the Division for the last three years has been in the line of "timber physics," *i. e.*, the study of the character and value of the wood of our merchantable species. For this purpose logs and disk pieces are collected with care of the various species from the various localities and soil conditions in which they occur; the two field agents, Dr. Mohr and Mr. Cary, having done most of the collecting. The log material goes to the Testing Laboratory of the Washington University of St. Louis, where it is subjected to various tests systematically under the direction of Mr. J. B. Johnson, the professor of engineering in the University. The physical examination is in charge of Mr. Filibert Roth (Univ. of Michigan).

The monographs of Professor Spalding on the white pine, Professor Prentiss on the hemlock, Professor Flint on Pinus resinosa and P. rigida, and Miss Kate Furbish on Picea nigra, still await publication.

Such is a bare outline of the botanical work carried on by the Department of Agriculture, but it will serve to show its general scope. It will also serve to direct inquiry concerning various subjects to the proper sources of information, and indicate in many cases the proper destination of material.

Lake Forest, Ill.



NICHOLS on VAUCHERIA.

BRIEFER ARTICLES.

Abnormal fruiting of Vaucheria. (WITH PLATE XXI.)—In specimens of *Vaucheria geminata*, var. *racemosa*, brought into the laboratory in October, 1894, some interesting cases of abnormal fruiting organs were observed. The material was collected in the grassy flats of Cayuga lake, at a spot covered by the overflow of a small stream.

The variations from the normal were frequent, and included three general types:

1. Those in which the oogonia were aborted, leaving on the fruiting branch stump-like protuberances.

2. Those in which the oogonia were prolonged into vegetative filaments.

3. Those bearing fully developed antheridia in places normally occupied by oogonia.

Numerous combinations of these types with different intermediate forms were also present.

The first case is inconspicuous, and admits of some doubt, inasmuch as the stumpy protuberances closely resemble branches from which oogonia have fallen. In certain specimens, however, the peculiar shape of the end of the stump, its unusual length, and the entire absence of any trace of a broken sheath, such as is usually left by a fallen oogonium, furnish conclusive evidence that the female organ has not been present. Whether the rudiment represents an oogonium or an adventitious antheridium, such as is described in type three, it is impossible to determine.

The second type shows close analogy to conditions found in different fungi, notably the Saprolegniaceæ. The vegetative filaments arise sometimes from the apex of an oogonium, sometimes directly from the pedicel, thus replacing the oogonium. They are usually narrower than the mother filament, but in cases which seem to be intermediate between this and the first type, the young filaments have a diameter equal to that of the pedicel from which they arise. Different forms of this type are described and figured by Campbell in the *American Naturalist* for June, 1886, from observations made on artificial cultures.

The third case presents a somewhat more remarkable condition, but one to which a partial analogy may be found in ferns, where rudimentary prothallia, from crowding or insufficient nutriment, produce only antheridia. Reasoning from this analogy, we are led to assume that the filaments of Vaucheria upon which such fruiting organs are produced must have grown under starved conditions, or, for some other reason, have not exercised a normal vegetative function. In the appearance of the plants we find nothing either to confirm or deny this assumption. In some cases, it is true, the filaments bearing such organs were more or less disorganized, the chlorophyll scanty and aggregated in broken masses. In other filaments, however, upon which the fruiting branches were equally deformed, the chlorophyll was in a healthy condition, and the filaments had every appearance of thrift and vigor. Moreover, on filaments wholly destitute of chlorophyll and partially disorganized, perfectly normal fruit bodies appeared. But these appearances become totally irrelevant to our conclusions when we remember that the non-septate structure of these plants permits free circulation from filament to filament through long distances, and hence the chlorophyll conditions may become conspicuously altered, in a certain part of the plant, after the development of the fruit branch.

In order, then, to prove the relation of growth conditions to this abnormal development, it remains to be shown, first, what were the conditions of growth under which this occurred; second, that similar conditions will produce similar results; and, third, that opposed conditions tend to prevent such development. As to the first we know only that the plants grew floating in the water of a flooded marsh, not in contact with the soil, and bathed, presumably, by comparatively clear water, since they floated above a toughly sodded bed. We also know, from experiments, that these same plants grown in vessels of clear water in the laboratory, continued to produce abnormal fruit. No experiments have been made to prove that normal plants would degenerate if grown in the same way.

As to whether the same material grown on moist earth or in less crowded masses would behave differently, we have no definite experimental knowledge, and hence, on the whole, are not warranted in asserting conclusively the relation of this peculiar development to growth conditions.—MARY A. NICHOLS, *Cornell University.*

EXPLANATION OF PLATE XXI.—Fig. 1 shows a mixed type, *r*, *r*, being rudimentary organs either male or female, described under type 1, and *a*, *a*, antheridia developed in place of oogonia (type 3).

Fig 2 illustrates another form of types 1 and 3. *r*, rudiment; *a*, *a*, antheridia.

Fig. 3 shows type 3 bearing three antheridia, and no oogonia, or perhaps very rudimentary ones, at *r*, *r*, *r*.

Fig. 4 shows parent branch and lateral bud, each bearing one antheridium only; *b*, a broken branch, leaving no indication of its nature.

NOTE.—Such cases as that shown in Fig. I leave room for suspicion that the branches *a*, *a*, are not simple antheridia, but lateral buds similar to that of

Fig. 4, upon which no oogonia have developed. Cases like that shown in Fig. 3, however, and another case observed (of which, unfortunately, no camera-lucida sketch could be secured), which bore a whorl of six antheridia, exactly corresponding in position to the normal oogonia, belong certainly to type 3, as given.

Astragalus Blakei n. sp.—*A. Robbinsii borealis* n. var. in MS. and herbarium, 1894.

A. Robbinsii Gray's Man., 2nd ed. (1856.)

A. alpinus L. Gray's Man., 3rd ed. (1862.)

Perennial, *few* to many stemmed, from a fibrous knotty root deeply fixed in the cliffs.

Stems $3–5^{dm}$ high, *erect*, sometimes slightly decumbent at base, sparsely pubescent, slightly angular, twisted, striate.

Stipules erect, upper ones becoming deflexed, triangular ovate, acute or obtuse, $4–6^{mm}$ long; leaves $3–10^{cm}$ in length, with from 5–8, generally 6–7, pairs of leaflets; leaflets opposite or nearly so, on petioles about 2^{mm} long, oblong, elliptical, the middle ones larger and the upper ones generally decreasing in size faster than the lower, obtuse and frequently emarginate, green and glabrous above, mealy pubescent beneath, with white appressed hairs, becoming more glabrous with age.

Peduncles *one or two*, $10–25^{cm}$ in length, very erect, twisted striate, nigrescently pubescent.

Raceme ovate, becoming oblong and loose, 5–15 flowered.

Flowers about 8^{mm} long, pedicels often equalling or exceeding the length of the calyx.

Bracts linear, acute about half as long as the pedicels, calyx tubular campanulate, nigrescently hairy, the linear bluntish teeth more hairy and one-third the length of the calyx. Corolla strongly resembling that of *A. Robbinsii*, light violet or sometimes white with the keel tinged with violet or purple. Legume $8–25^{mm}$ in length, *horizontal, triangular-turgid*, oblong and obtuse or acute at both ends.

·Stipe shorter than calyx, thickly pubescent with whitish or nigrescent hairs slightly transparent, tipped with the recurved persistent style, *both sutures* curved, *dorsally* sulcate, often but slightly so, 4–8-seeded.

Type stations: Willoughby Mt., Smuggler's and Nebraska Notches, Vt., Willoughby Mt., Westmore, Vt. Rev. Joseph *Blake* (previous to 1856), etc. Smuggler's Notch, Mt. Mansfield, Stowe, Vt., C. G. *Pringle*, etc., Nebraska Notch, Mt. Mansfield, Underhill, Vt., C. G. *Pringle* and F. H. *Horsford*. Fort Kent, St. John River, Maine, Miss Kate *Furbish*.

Specimens of the Rev. S. R. *Butler* from Forbeau, Labrador, of J. *Macoun* from the western mountains, and of W. H. Dall from Alaska appear to be of this species.—W. W. EGGLESTON, *Rutland, Vt.*

EDITORIAL.

PROFESSOR GREENE indulges in some characteristic hypercriticism in connection with the rules for citation adopted by the Madison Botanical Congress and Section G, A. A. A. S. Without finding fault with the rules themselves (for which relief much thanks), he takes a page to pick flaws in the abbreviations used in the examples which are supplied for the convenience of readers in interpreting the rules. Had Professor Greene even taken occasion to read the rules and the reference therein given, he would have seen that the abbreviations of authors' names, journals, etc., to be used in citation have not yet been reported upon by the committee. Criticism of this sort is an expression of querulousness, and degenerates into mere faultfinding, "as any accomplished bibliographer would readily perceive." We may, without offence we hope, remind Mr. Greene that kindliness of word and charitable judgment are vastly more effective than the petulance of this criticism or the rancor of his ungentlemanly attack on Mr. Sheldon in the same number of *Erythea*.

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ON THE INSIDE page of the cover of *Grevillea* the following appears as a standing notice: "Specimens of cryptogamic plants will be named for students. The plants must be carefully packed and numbered and postage enclosed for reply." Then follow the names and addresses of those to whom they are to be sent, and the notice concludes thus: "This applies to students only who show by accompanying notes a desire to work. Wholesale batches, sent merely with the object of forming a 'list', will not be countenanced." While none of our editors in this country is perhaps ready to make such an announcement as a personal matter, this notice really contains a hint for American students. It may be taken for granted that those named in connection with the Systematic Botany of North America (see this journal 20: 177. Ap. 1895) stand ready to receive material under the conditions named above and to determine it for correspondents. It certainly ought not to be necessary to send material abroad for determination, which some collectors seem altogether too ready to do. It is not selfishly that we remonstrate against this. The existence of type specimens of American plants in the public herbaria of the United States ought to be assured by having the new plants sent to American students for study. We hope that our collectors will see to it that they do not increase the number of inaccessible foreign types.

CURRENT LITERATURE.

A text-book for advanced students.[1]

In the second half of Vines' "Student's Text-Book of Botany," recently issued, two-thirds of the space is given to the discussion of phanerogams, which concludes part III of the four grand divisions of the book. The presentation of the phanerogams is not characterized by any novelties in the way of changes in classification, but rather by a conservative retention of the older views. In the present state of our knowledge of relationships perhaps this is the only safe course, but one cannot help wishing that the dicotyledons had not appeared under the old three-fold division. This, however, has been suggestively modified, for the old group *Apetalæ* has been broken up; those in which the flower has become simple by suppression being intercalated among the *Polypetalæ;* and those which are regarded as primitively simple forming the group *Monochlamydeæ.* For example, *Euphorbiaceæ* appear among *Polypetalæ,* while *Chenopodiaceæ* are retained among the *Monochlamydeæ.* Theoretically the distinction is a good one, but the difficulty of determining what groups are primitive and what groups are reduced is a large practical objection.

Aside from the fact that our most recent knowledge of morphology is incorporated, and so the whole presentation enriched, the notable feature is the maintenance throughout of a consistent morphological terminology. Sporophyte and gametophyte are discussed separately, and their structures are so designated as to keep homologies clearly in view. By no means the least important part of the work is the excellent summary given in each great group of the histology and embryology of the sporophyte. Probably the most perplexing morphological problem that remains among angiosperms is that concerning the nature of the structures of the embryo-sac, and one always turns with interest to this subject in a new book. Dr. Vines has adopted the view that the prothallium of angiosperms is developed in two stages, separated from each other by the act of fertilization; that is, that the "endosperm" is simply a later development of the prothallium. It is true that there are other prothallia which continue to develop after the oospheres have been fertilized, but there remains yet to be ex-

[1]VINES, S. H.—A student's text-book of botany (second half). 8vo. pp. 431–821, figs. 280–483. London: Swan Sonnenschein & Co. New York: Macmillan & Co. $2.00. (See for notice of first half, this journal, **19:** 202. 1894.)

plained the significance of the formation of the endosperm nucleus, and the relation of its segmentation to the act of fertilization. The strong development of the antipodal region in certain groups, is a fact coming into such prominence that the old statements concerning it should certainly be modified.

The presentation of phanerogams is certainly a botanical treasure house, full of the latest and best that is known concerning the subject. From the teacher's standpoint the only criticism to be offered is lack of organization. It is difficult for the reader, who is not already a botanist, to grasp the really salient things and separate them from the rest. If the book were a picture one might say that the perspective was bad. With the living teacher such an objection disappears, and in any event is far overbalanced by the fullness and freshness of facts and terminology.

When we turn to part IV, on physiology, we find Dr. Vines at his best, and cannot help regretting that he did not restrict the treatment of phanerogams (which covers nearly 230 pages) to a discussion of the "orders" at least or even to his "cohorts," and thus leave himself room for a fuller discussion of physiological questions. We must however make the best of the 118 pages which he devotes to these topics. No fault can be found with the way in which he has utilized these all too few pages. The matter is logical, clear, well-balanced. The most notable departure from his "Lectures on the Physiology of Plants" is to be found in the parts on the special physiology of the nutritive functions and reproduction. Here Vines distinctly recognizes the manufacture of carbohydrates as a distinct process, to which however he gives no name, designating it merely as "the first step in the process of assimilation." He abandons also the idea that carbohydrates arise in the course of assimilation by a katabolic process, saying "the product of this carbon-assimilation is . . . a non-nitrogenous organic substance having the composition of a carbohydrate."

It need hardly be said that in each of the four chapters, on general physiology, and on special physiology of the nutritive functions, movement and reproduction, the matter has been brought down to date. On the whole the work must be looked upon as one of the best reference books in our language, and, with judicious selection by a good teacher, one of the best texts for advanced readers.

Horticultural botany.

Of all who deal with plants probably the horticulturist and florist come to the most intimate knowledge of certain phases of vegetable life. The success of their daily toil and the year's profits depend upon their recognition of the material needs of the plants under their care, the prevention of disease and injury, and the selection and improvement of varieties and races. Yet the knowledge of the simplest physiological processes and most elementary details of structure of the living objects they daily care for is astonishingly vague and unreliable. This lack of apprehension of the plant nature extends from the boy who washes flower pots to the proprietor of the establishment, with only here and there an exception, and yet no class of cultivators are quicker to comprehend and apply knowledge in their own line. A book giving the physiological meaning of practical operations, if clearly and pleasingly written, must therefore supply a real demand. Such a work, it seems to us, is Dr. Sorauer's Physiology of Plants in its English form.[1]

The field which the author essays to cover is largely unbroken, and so we are inclined to deal leniently with the shortcomings of the work, and more especially as it contains a great amount of most useful information in a form that is likely to prove attractive to the class of persons for whom intended. It can not be overlooked, however, that the title is misleading, as the work is in no proper sense a physiology of plants. It might be termed applied or economic botany based in part upon physiology, and in part upon ecology, whereas most works on applied botany are based upon structural and systematic botany.

The point of view is constantly that of the cultivator, and as such the treatment of the subject is logical and satisfactory. This accounts for the fact that many topics of great physiological interest, like certain portions of metabolism and nearly all of irritability, are not mentioned.

The work opens with an explanation of the true conception of a living plant organism, then passes in succession to consider the functions of root, stem, leaf, flower, and fruit, including, so far as required to understand their activities, some account of the elementary structure. Constant references to practical operations and advice upon the right performance of the same, with the physiological or ecological reasons therefor, give the work a genuine practical value, and rob it of the formality of pure science. Ample attention is given to strictly horticultural matters, *e. g.*, over twenty pages are devoted to pruning and thirty to propagating by cuttings and grafting.

Some fundamental topics are quite inadequately or even misleadingly treated, as the production of organic matter in green leaves, and

[1] Sorauer, Paul: A popular treatise on the physiology of plants for the use of gardeners, or for students of horticulture and of agriculture. Trans. by F. E. Weiss. 8vo. pp. 256, figs. 33. London: Longmans, Green & Co., 1895.

the use of stomata. Much stress is laid upon the need of aerating the roots, but the author fails to explain why it is necessary if gases, as he says, can not pass through imperforate surfaces of plants.

Such defects, however, may be overlooked in view of the fact that the work is to teach a rational horticulture, and not to teach vegetable physiology. This is certainly the spirit of the book, in spite of the unfortunate title; and as such the work is admirable, and to be highly commended.

Minor Notices.

THE NATURALIST'S DIRECTORY[1] for 1895 comes to us with decided improvements. In addition to the alphabetical list, the names are arranged geographically (by states) and also by subjects. In the latter part of the work the editor has been obliged to omit names from some departments when ten or a dozen "specialties" had been given. But we judge that the real specialists will be found correctly listed. These two additional lists will greatly increase the usefulness of the book and we hope will bring a proper reward to the enterprising publisher and compiler.

THE ATTENTION of those who are following Mr. Charles Robertson's papers on "Flowers and insects" in this journal is directed to a paper by him in the Trans. St. Louis Academy of Science **6**: 435-480. 1894, covering plants included in the families Rosaceæ and Compositæ.

TO BOTANISTS who have occasion to use statistical methods we cordially commend a pamphlet entitled "Statistical Methods," by G. W. Moorehouse. It is a reprint from *Mind and Body* and is published by the Freidenker Publishing Co., Milwaukee, Wis., at 25 cents.

THE BULLETIN of the Botanical Society of Geneva[1] covering the years 1892-4, contains eight papers, dealing chiefly with the local flora. Briquet's "Le Mont Vuache: étude floristique" and Paiche's "Observations sur quelques espèces critiques du genre Hieracium" are of most general interest.

THE LAST semi-annual report of Schimmel & Co. (Fritzsche Bros.) of Leipzig and New York contains notes on many essential oils, of equal interest to botanists and chemists.

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[1] CASSINO, S. E.—The naturalist's directory, containing the names, addresses, special departments of study, etc., of professional and amateur naturalists, chemists, physicists, astronomers, etc., of the U. S. and Canada. 12mo. pp. viii + 382. Boston: S. E. Cassino. 1895.

[1] Bulletin des travaux de la société botanique de Genève (section de la société suisse de botanique(no. 7, années 1892-1894. 8vo. pp. 241. 1 map. 2 figs. Genève: H. Georg. 1894.

OPEN LETTERS.

Astragalus lanocarpus and A. bajaensis.

It seems necessary to notice an ill-advised personal attack which Professor E. L. Greene has made upon me in a recent number of *Erythea*. Professor Greene's failure to keep pace with modern Latin scholarship, pardonable indeed in his case, has betrayed him into an uncalled for display of language.

The trouble seems to be that Mr. Greene objects to such a specific name as *lanocarpus* in the combination *Astragalus lanocarpus* lately published by me. I understand him to profess that the name is compounded of words taken from two languages. And because Mr. Greene has not been properly instructed that *carpus* is a good Latin word, he makes his personal attack upon me. In some moment of mental illumination I hope he will be sorry for this. He intimates that I "lack a grammar school education." He writes that I "have assumed that a mere beginner in systematic botany may unblushingly announce himself an authority upon so large and difficult a genus as Astragalus." That I am a mere beginner is true, although I have made systematic botany my principal occupation for about ten years. That I have announced myself as an authority is wholly untrue. I challenge Mr. Greene to produce a published word of mine in which I have made any such announcement. I consider myself but a student of the genus, and I assure Mr. Greene that upon his failure to produce proof of his unfounded statement, I shall expect a full and abject retraction.

So much for Professor Greene's lapse from courtesy. Regarding "carpus," I beg to refer Professor Greene to page 95 of vol. II of Furlanetto's splendid six volume work, "*Totius Latinatis Lexicon, opera et studia Algeidii Forcellini,*" where he will find "*carpus*, genitive *carpi*, m. from Greek *karpos*." He will also learn that this word occurs in Roman inscriptions of the Empire period. He will discover that while earlier and insufficient study had excluded the word from the Latin vocabulary, later research has shown its place to be as unquestionable as *brevis*, for example, which is also from a Greek root. Yet Mr. Greene does not object to *brevifolia* or *breviflora*. Furthermore, he will learn that the Romans themselves used the compound word *omnicarpus*.

Briefly, then, *carpus* is a good Latin word, *cuspidocarpus*, *lanocarpus* and the rest are correctly formed, and in trying to change them, Mr. Greene has given birth to abortive synonyms.

The other mistake of Mr. Greene concerns the specific name *bajaensis*. *Baja*, he objects is a Spanish adjective, meaning *lower*. This is true, but it is also a substantive. *Baja*, for example, is the name of a town in the state of Coahuila, Mexico. Therefore, *bajaensis* is correct, just as *nevadensis* is correct.

I hope that this will show Mr. Greene the insecurity of dogmatism. —EDMUND P. SHELDON, *University of Minnesota.*

NOTES AND NEWS.

Mr. W. J. V. Osterhout is to spend the next college year in study in Germany.

Mr. E. W. D. Holway sailed for Europe on May 18th to be gone for sixty days.

The *Kew Bulletin* for March contains the descriptions of ten new species of ferns (seven of them Polypodiums) from western China, and a long list of African novelties.

The botanical collections made by Miss Mary E. Gilbreth were lately presented in her memory to Radcliffe College (Harvard Annex) by her mother, Mrs. Martha Bunker Gilbreth.

Mr. A. P. Anderson, assistant in the Department of Vegetable Physiology in the University of Minnesota, has gone abroad to study, intending to remain two years, most of the time in Munich.

The University of Colorado dedicated on March 9th the Hale scientific building, of which the third floor is devoted to biology. The arrangements in the laboratory and museum are said to be "admirable in every respect."

Mr. D. T. MacDougal, in charge of vegetable physiology in the University of Minnesota, sailed on the City of Rome, May 25th, for Glasgow, to spend three months abroad. He will be for most of the time in Professor Pfeffer's laboratory at Leipzig where he may be addressed.

The leaflets of *Menyanthes trifoliata* are given as "entire or repand." It has recently been found with distinctly three-lobed leaflets. Again, although it is a constant feature, I have never seen any mention of the marginal glands at the crenatures of the leaflets.—W. W. Bailey.

The fourth annual session of the summer school at the University of Minnesota will begin July 29th and close August 23d, 1895. Two courses in botany will be conducted by Edmund P. Sheldon, instructor in botany in the University of Minnesota, and John M. Holzinger, instructor in botany in the State Normal School, Winona.

At the meeting of the National Academy of Sciences in April, Professor Charles S. Sargent of Harvard University was elected to membership, and Professor Julius von Sachs of Würzburg, Germany, was made foreign associate. This is a good showing for botany, as only four members, and three foreign associates all told were elected at this session.

The first volume of the *Conspectus Floræ Africanæ* (vol. V, Monocotyledones) by Th. Durand has recently been published. Whereas a volume of 500 pages was promised, it really contains 977 pages; nevertheless no increase has been made in the price (20 fr.) The remainder of the work will appear by half volumes. Vol. 1, part 2, will be published before autumn.

Dr. O. Uhlworm (Terrasse Nr. 7, Cassel, Germany) editorially connected with the *Botanisches Centralblatt* and the *Centralblatt für Bacteriologie und Parasitenkunde*, desires the co-operation of American botanists in increasing the value of the bibliographical departments of these journals. He would be pleased to receive from authors copies of their articles on all botanical subjects pure or applied.

The state of New York has set aside $16,000 to be expended under the direction of Prof. L. H. Bailey of Cornell University, for conducting experiments in horticulture, discovering and remedying the diseases of plants, etc. This may reasonably be anticipated to yield much knowledge of value to the botanist as well as to the cultivator. The work is to be confined to the fruit-growing region of western New York, lying north and west of Cayuga Lake.

The eighth season of the Marine Biological Laboratory at Wood's Hole, Mass., will be opened on June 1st. Instruction in botany will be in charge of W. A. Setchell, instructor in botany, Yale University, and W. J. V. Osterhout, instructor in botany, Brown University. Among special lecturers we note the following names of botanists: G. F. Atkinson, J. M. Coulter, J. M. Macfarlane, William Trelease, and W. P. Wilson.

Dr. J. P. Lotsy associate in botany in the Johns Hopkins University, leaves at the end of the academic year to accept the position of assistant to Dr. Treub, the Director of the Botanic Gardens at Buitenzorg, Java. We hope this does not mean that the too slight recognition hitherto accorded to botany at Johns Hopkins is to be discontinued. It is very important that botanical instruction, and that of the best quality, be provided in an institution of such reputation as this. It is greatly to be desired, also, that the botanical side of the biological work be accorded its due prominence.

The next meeting of the American Microscopical Society will be held at Cornell University, August 21–23, 1895, that is the week previous to the meeting of the American Association for the Advancement of Science at Springfield, Mass. Considering the geographical distribution of the members, Ithaca is as central a point as can be found for the meeting. The University buildings will be at the disposal of the Society. A good display of microscopical apparatus is promised. A special feature of the coming meeting will be the setting apart of one or more sessions for the reading of papers on methods and the demonstration of special or new methods. The chairman of the local committee is Prof. W. W. Rowlee.

Some important notes on North American oaks have been published by Dr. C. S. Sargent in *Garden and Forest* (March 6th). A new white oak (*Q. Toumeyi*), from the mountains of southeastern Arizona, is described and figured; an examination of the type of *Q. grisea* Liebm. confirms Engelmann's opinion that it is a form of the polymorphous *Q. undulata;* a white oak of New Mexico and Arizona, heretofore mistaken for Liebmann's *Q. grisea*, is named *Q. Arizonica;* the great leaf variation of *Q. dumosa* is pointed out, including *Q. MacDonaldii* Greene, and Engelmann's var. *bullata* is changed to *revoluta* on account of preoccupation; Buckley's *Q. Durandii* becomes *Q. brevilobata*, Torrey's original varietal name being taken up; *Q. Muehlenbergii* Engelm. becomes *Q. acuminata*, a varietal name given by Michaux; *Q. ilicifolia* is replaced by *Q. nana*, the original varietal name of Marshall; and Chapman's *Q. obtusifolia parvifolia* becomes *Q. Chapmani*, the name *parvifolia* being antedated.

SUMMER COURSES in biology are offered by the University of Pennsylvania, under the direction of Dr. W. P. Wilson, commencing July 1st and closing on the 26th. The botanical instruction will consist of three five-lecture courses by Professor Macfarlane, Professor Halsted and Professor Wilson; lectures on special topics by eminent botanists among whom are: Prof. L. H. Bailey (two lectures on "How Garden Varieties Originate: a Study in Evolution") and Prof. G. L. Goodale (an address before the students on "The Relations of Certain Plants to Political Economy"). Thirty hours of laboratory practice in biology will be given and five lectures by Mrs. Wilson on biology from the standpoint of teachers in the elementary schools.

LAST SUMMER those interested in the Marine Biological Laboratory at Woods Hole, Mass., instituted a movement to raise an adequate and permanent endowment in order to place the laboratory on an independent basis. This country has no marine station to compare with those of other countries and this lack is a serious obstacle to both zoological and botanical advancement in the United States. The botanical work of this station is advancing rapidly. A separate frame building was added last year and Dr. Setchell of Yale is drawing some very prominent workers to the study of marine botany from the large institutions. The attention of all biologists is called to the pressing needs of the institution, the first of which is the construction of a permanent building in order that the laboratory may be kept open the entire year. The erection of even a modest building will require more money than can be raised among workers at the station and the Boston friends, and biologists everywhere are asked to contribute. Money in any sums may be sent to Dr. C. O. Whitman, Woods Hole, Mass.

IN *Science* (March 22d) the paper of Dr. C. S. Minot, read at the recent meeting of the American Society of Morphologists, on "the fundamental difference between plants and animals," is published in full. The formal definitions are as follows: "Animals are organisms which take part of their food in the form of concrete particles, which are lodged in the cell protoplasm by the activity of the protoplasm itself; plants are organisms which obtain all their food in either the liquid or gaseous form by osmosis (diffusion)." The interesting speculation is offered "that the absorption of solid particles of food is to be considered one of the most essential factors in determining the evolution of the animal kingdom." "The plant receives its food passively by absorption, and the evolution of the plant world has been dominated by the tendency to increase the external surfaces, to make leaves and roots. The animal, on the contrary, has to obtain at least the solid part of its food by its own active exertions, and to the effects, through natural selection, of the active struggle to secure food we may safely attribute a large part of the evoluti n of locomotor, nervous and sensory systems of animals." Of course the correctness of the definition depends upon the definition of "food" in the two cases.

BOTANICAL GAZETTE

JULY, 1895.

Undescribed plants from Guatemala and other Central American Republics. XV.

JOHN DONNELL SMITH.

Duguetia leiophylla Donnell Smith.—Folia oblongo-lanceolata acuminata basi obtusata vel acutiuscula glaberrima venulosa aureo-punctula, margine revoluto. Pedunculi uniflori, bractea versus basin sita parvula. Sepala minuta triangulari-ovata; petala ovalia subaequalia subtus lepidota, margine pubescente, ceterum glabra; torus disciformis crassus cum genitalibus glaber; styli concreti basi articulati ovaria aequantes eisque paululum crassiores.

A low, spreading tree (Thieme). Leaves slightly coriaceous shining, $3–4\frac{1}{4} \times 1\frac{1}{2}–1\frac{3}{4}^{in}$, petioles 2^l long. Peduncles terminal or becoming leaf-opposed, articulated above base, glandular-lepidote, $6–8^l$ long, bract ovate (1^l) with pubescent margin. Sepals 3, free, thick, glandular-lepidote, margin pubescent, $1\frac{1}{2}^l$ long. Petals 6, 2-seriate, fleshy, imbricate, erecto-patent, explanate, $14–17 \times 10–12^l$, each end rounded, shortly unguiculate. Torus somewhat obversely hemispherical, 1^l high, ecostate; gynophore plane, 2^l in diam., areolated with facets of carpels. Stamens all fertile, cuneate, $1 \times \frac{1}{2}^l$. Ovaries 50–70, columnar ($\frac{2}{3}^l$), angular; ovule solitary, basal. Fruit not seen.

San Pedro Sula, Depart. S. Bárbara, Honduras, alt. 800^{ft}, Apr. 1890, C. Thieme, no. 5,129.

Serjania punctata Radlk.—Scandens, fruticosa, glabra; rami subaequaliter 6-costati, costis obtusis, 6-sulcati, cortice e viridi pallescente; corpus lignosum compositum e centrali majore et periphericis 2–3 parvis, teretiusculis, centrali impositis; folia biternata; foliola lateralia ovata, obtusiuscula vel subacuta, sessilia, terminalia elliptica, breviter acuminata et mucronulata, basi attenuata, omnia remotiuscule leviter serrata, membranacea, reti venarum tenero nec prominente instructa, glabra, nec nisi glandulis microscopicis adspersa, punctis pellucidis conspicuis iisque prominentibus insignita, epidermide mucigera; petiolus communis nudus, partialium intermedius (in foliis inferioribus certe) superne marginatus; thyrsi solitarii, dense cincinniferi; cincinni stipitati, pedicellis prope basin articulatis; flores minores; sepala exteriora minutim puberula interioribus tomentellis dimidio breviora; fructus ——.

Rami thyrsigeri diametro 3^{mm}. Folia circ. 10^{cm} longa, 8^{cm} lata; foliola terminalia 4.5^{cm} longa, 2.5^{cm} lata, lateralia superiora 4^{cm} longa, 2^{cm} lata, inferiora dimidio minora; petiolus communis circ. 4^{cm} longus, partialium intermedius 2^{cm}, laterales 8^{mm} longi; stipulæ parvæ, ovato-triangulares. Thyrsi folia superantes, rhachi quam pedunculus communis paullo longiore; cincinni circ. 8-flori, stipite 3–4^{mm} longo suffulti, pedicelli 2^{mm} longi. Flores masculi: sepala exteriora 1.5^{mm}, interiora vix 3^{mm} longa. Petala angustiora, ex oblongo attenuata, 3.5^{mm} longa, 1.5^{mm} lata, intus laxe glanduligera; squamæ ciliolatæ, superiores crista bifida (laciniis acutis apice patulis) appendiceque brevi barbata, inferiores crista inaequaliter bicruri instructæ. Tori glandulæ superiores ovatæ, obtusæ, glabræ, laterales minores orbiculares. Stamina basi pilosiuscula. Germinis rudimentum ad angulos pilosiusculum.

Affinis *S. mucronulatæ* (in sect. XI, PHYSOCOCCUS), a qua differt costis ramorum obtusissimis, petiolo intermedio superne marginato, foliolorum punctis pellucidis majoribus.

Cuajiniquilapa, Depart. S. Rosa, Guat., alt. $2,500^{ft}$, Oct. 1894, Heyde & Lux, no. 6,091.

Paullinia hymenobracteata Radlk.—Scandens, fruticosa, hirsuta; rami trigoni vel subteretes, striato-sulcati, pilis patentibus e sufferugineo pallescentibus vestiti; corpus lignosum compositum e centrali majore et periphericis 3 minoribus partim quodammodo complanatis in centrale plus minus immersis; folia 5-foliolato-pinnata; foliola terminalia rhombea, in acumen acutum angustata, supra medium grossiuscule inaequaliter dentata, lateralia superiora ovalia, basi acuta, inferiora ovata, basi inaequilatera rotundata, apice acuta vel obtusata, a basi remotiuscule dentata, breviter petiolulata, membranacea, supra pilis setulosis adpressis laxe adspersa vel praeter nervos glabra, subtus subhirsuta necnon glandulis microscopicis curvatis vel geniculatis obsita, minutim pellucide punctata retique utriculorum lacticiferorum subtus instructa, epidermide parum mucigera; rhachis nuda; stipulæ insignes, semicordato-deltoideæ, subacuminatæ, basi subbilobæ, inter lobos oblique affixæ, lobo interiore (i. e. folii medianam spectante) majore, scariosæ, extus hirsutæ; thyrsi axillares, inferiores folia subduplo superantes breviores paniculatim congesti, subhirsuti; bracteæ bracteolaeque conspicuæ, oblongæ, tenuiter scarioso-membranaceæ, concavæ, apice margineque necnon dorso secus medianam pilis longioribus obsitæ; flores mediocres pedicellique supra articulationes tomentelli.

Rami diametro 2–4^{mm}. Folia superiora 16–18^{cm} longa, 10–12^{cm} lata, inferiora duplo majora; foliola lateralia 5–6^{cm} longa, 2.5–3^{cm} lata, terminalia subduplo majora, sicca subfusca; petiolus communis circ. 4^{cm}, rhachis 3^{cm} longa, subhirsuta, petiolluli 2–3^{mm} longi; stipulæ 7^{mm} longæ, 5–6 latæ. Cincinni stipitati, stipite 5–6^{mm} longo hirsuto; pedicelli 3^{mm} longi, infra medium articulati, infra articulationes hirsuti; bracteæ 5^{mm} longæ, 2^{mm} latæ, bracteolæ (prophylla) vix tertia parte minores. Alabastra obovata, 3–4^{mm} longa. Sepala interiora 4–5^{mm} longa, exteriora breviora. Petala obovata, intus glandulis microscopicis adspersa; squamæ margine villosiusculæ, superiores crista obcordata appendiceque deflexa squamam dimidiam longitudine superante villosa instructæ. Tori glandulæ ovatæ, basi villosiusculæ. Stamina pilosa. Germinis rudimentum puberulum.

Affinis videtur *Paullineæ monogynæ* Radlk. (in sect. XII, CALOPTILON). Ad eandem *P. hymenobracteatam* pertinet Tate no. 59!, ann. 1867 in Nicaragua lecta, in Hb. Kew. servata (*Paullinia sp.* Hemsley in Salvin et Godm. Biol. Centr.-Am., Bot. **1:** 211. 1879–81. [no. 17.]).

Malpais, Depart. S. Rosa, Guat., alt. 4,000^{ft}, Sept. 1894, Heyde & Lux, no. 6,093.

Dalea cinerea Moric. ex sched. Bentham in herb. Kew.; erecta, sublignosa, caule striato, undique fulvo-tomentoso, ramis erectis, foliis imparipinnatis, pubescentibus, foliolis 4–5 jugis, subtus glandulosis, floribus in spicas densas, terminales, congesti, siccitate nigricantibus.

Suffrutex videtur 1.5–2^{ped}. Caules erecti, ramis ascendentibus, dense fulvo-tomentosis. Stipulæ lineari-setaceæ, rigidiusculæ, 1–1.5^{lin} longæ, folia vix pollicem longa, usque ad basim petioli foliolata, petiolo gracili, fulvo-pubescente. Foliola 3–4 juga, sessilia, ovata, obtusa, utrinque pubescentia, ciliata, subtus glandulis nigris irregulariter obsita, 2^{lin} longa.

Spicæ ad apicem ramorum terminales, densifloræ, $1.5–2^{poll}$ longæ, siccitate nigricantes. Bracteæ late cordato-ovatæ, carinatæ, longe acuminatæ, florem amplectentes, 1.5^{lin} longæ, persistentes. Calyx pubescens, coriaceus, 5-dentatus, lacinia carinali longiore, tubo 10-nervio, glanduloso, 1.5^{lin} longo. Vexillum cordato-orbiculare, longe stipitatum, carina brevius, 1.5^{lin} longum. Alæ rectæ, stipitatæ, vexillum vix superantes, lateraliter plicatæ. Carina recta, obtusa, stipitata, glandulis raris notata, vexillum superans 2^{lin} longa. Stamina monadelpha, vagina supra fissa. Antheræ parvæ, nutantes, ad apicem glandulosæ. Ovarium sessile, ovatum, dense tomentosum. Legumen calyce coriaceo inclusum membranaceum, pubescens.

Haec planta ad specimen in herb. Kew. servatum et a cl. Bentham sub nomine *D. cinerea* Moric. labellatum pertinet. Sed nunquam in libris, herbariis, etc. Moricand, hoc nomen occurrit. Verisimiliter hoc nomen errore cl. Bentham hic adest et planta nondum descripta fuit. Nobis species bene delimitata videtur sed genus Dalea revisionem aegre caret. (M. Micheli.)

Santiago, Depart. Zacatepéquez, Guat., alt. $6,500^{ft}$, 1891, Rosalió Gómez, no. 999.—Embaulada, Depart. Zacatepéquez, Guat., alt. $5,500^{ft}$, Dec. 1889, Heyde & Lux, no. 4,465.

GLIRICIDIA MACULATA HBK., var. **multijuga** Micheli. Differt foliolis 7–8- nec 3–5-jugis, minoribus et magis pubescentibus.

S. Rosa, Depart. S. Rosa, Guat., alt. $3,000^{ft}$, Apr. 1892, Heyde & Lux, no. 3,296.

ÆSCHYNOMENE AMERICANA L., var. **longifolia** Micheli. Quam planta typica in omnibus partibus major, magis robusta, folia longiora, foliolis latioribus, magis nervosis, racemi densiores, flores longiores, carina obtusa.

Cassillas, Depart. S. Rosa, Guat., alt. $4,000^{ft}$, Oct. 1892, Heyde & Lux, no. 4,172.—S. Juan Utapa, Depart. S. Rosa, Guat., alt. $4,500^{ft}$, Oct. 1894, Heyde & Lux, no. 6,099.

Desmodium Hondurense Micheli; lignosum vix scandens dense velutino-tomentosum, stipulis linearibus, foliis trifoliolatis, stipellatis, floribus parvis in racemos densos, axillares congestis, legumine dense tomentoso, articulis sibi invicem replicatis.

Frutex ramulis gracilibus, tomentosis. Folia petiolata, pinnatim trifoliolata. Stipulæ lineares, acutæ, tomentosæ.

Petiolus communis dense tomentosus, 4^{lin} longus. Foliola ovata vel anguste ovata, obtusa, terminale stipellatum, distans, $1\frac{1}{2}$–2^{poll} longum, 5–6^{lin} latum, lateralia minora, senilia omnia crassiuscula, superne puberula, subtus dense crispo-tomentosa. Racemi axillares vel terminales, sub anthesi 4–5^{poll} longi, rachi fere a basi florifero. Flores breviter pedicellati, secus rachin ternati vel fasciculati, purpurascentes, parvi, congesti; bracteæ parvæ, lineares, caducæ. Calyx fere bilabiatus, labio superiore tridentato, inferiore bidentato, dense tomentosus, vix lineam longus. Vexillum basi nudum, latum, fere orbiculare, breviter unguiculatum, $2\frac{1}{2}^{lin}$ longum, alæ carinæ leviter adhaerentes, 2^{lin} longæ, carina vix curvata, late obtusa vel truncata. Stamen vexillare e basi liberum. Ovarium 3–4-ovulatum. Legumen (junius) dense tomentosum, articulis 3–4, omnibus fertilibus, e calyce exsertis, sibi invicem replicatis.

Species verisimiliter e sectione Chalarium (nisi stamine vexillari libero); fructus structura ad *D. plectocarpum* Hemsley Diag. Pl. Nov. pars 3, p. 46 pertinet.

San Pedro Sula, Depart. S. Bárbara, Honduras, alt. 600–$1,000^{ft}$, Febr. 1887 and Apr. 1890, C. Thieme, nos. 5,197 & 5,207.

CALLIANDRA PORTORICENSIS Benth., var. **multijuga** Micheli.—Inflorescentia, floribus, legumine omnino *C. Portoricensis* Benth.; differt pinnis 7–8- nec 2–4-jugis.

Casillas, Depart. S. Rosa, Guat., alt. $4,000^{ft}$, Jan. 1893, Heyde & Lux, no. 4,148.—San Juan Utapa, Depart. S. Rosa, alt. $4,500^{ft}$, Oct. 1893, Heyde & Lux, no. 6,098.

Pithecolobium insigne Micheli; puberulum, foliolis bigeminis, amplis, floribus spicatis, magnis, spicis ad apicem ramorum racemosis.

Arbor vel frutex, in partibus junioribus puberulum, caeterum glabrescens, stipulæ ignotæ. Folia bipinnata, pinnis unijugis. Petiolus communis gracilis, 2–$2\frac{1}{2}^{poll}$ longus, glandulis ad apicem et inter pinnas parvis, vix elevatis rachis $1\frac{1}{2}^{poll}$ longus. Foliola unijuga, ampla, 5^{poll} longa, $1\frac{1}{2}$–2^{poll} lata, glabra, penninervia, subcoriacea, oblique ovata, ad apicem sensim attenuata, longiuscule acuminata, acuta. Pedunculi ad apicem ramorum longe laxeque racemosi; spicæ 5–7^{poll} longæ, supra medium floriferæ, rachi velutine puberulo. Flores sessiles, secus rachin haud congesti, bracteis minutis fulti. Calyx dense velutino-puberulus, fere 2^{lin} longus, 5–7-

dentatus. Corolla velutina, 3^{lin} longa, 5–7-fida. Stamina indefinita, filamentorum tubo corollam paullo excedente. Antheræ parvæ, eglandulosæ. Pollen in massas coalitum. Ovarium sessile, puberulum. Legumen ignotum.

Species magnitudine florum et foliorum insignis; fructu absente determinatio incerta. Notis plurimis tamen ad genus Pithecolobium rite pertinere videtur. A sectione Caulanthon imprimis affini differt petiolis glandulosis et pedunculis racemosis.

San Pedro Sula, Depart. S. Bárbara, Honduras, alt. 600^{ft}, Apr. 1890, C. Thieme, no. 5,208.

CENTRADENIA FLORIBUNDA Planch., var. **grandifolia** Cogn.—Planta robustior. Folia magna, glabrata, majora $6–11^{cm}$ longa et $1.5–3^{cm}$ lata.

Palin, Depart. Amatitlan, Guat., alt. $3,560^{ft}$, Febr. 1892, J. D. S., no. 2,645.—Rio Samalá, Depart. Retalhuleu, Guat., alt. $1,700^{ft}$, Apr. 1892, J. D. S., no. 2,651.

Arthrostemma hirtella Cogn.; caule herbaceo; ramis junioribus petiolis pedunculis calycibus foliisque subtus setulis brevissimis adpressis sparse hirtellis; foliis parvis, breviter petiolatis, elliptico-ovatis, obtusis, basi obtusiusculis, margine integerrimis vel obscure crenulatis, sparse adpresseque setoso-ciliatis, trinerviis; floribus solitariis, axillaribus vel ad ramulum brevissimum terminalibus; calycis tubo campanulato, segmentis anguste triangularibus, vix ciliatis, tubo subaequilongis; staminibus valde inaequalibus, majorum connectivo basi profunde bifido, minorum connectivo ultra insertionem filamento vix porrecto basi integro; ovario superne breviter denseque setoso.

Rami satis graciles, acutiuscule tetragoni. Petiolus gracillimus, $2–4^{mm}$ longus. Folia rigidiuscula, supra intense viridia, subtus pallidiora, $12–22^{mm}$ longa, $8–15^{mm}$ lata. Pedicelli graciles, $1–1.5^{cm}$ longi. Calycis tubus 6^{mm} longus, apice 4^{mm} latus; segmenta subreflexa, 5^{mm} longa, basi 3^{mm} lata. Petala purpurea, anguste obovata, brevissime glanduloso-ciliata, 12^{mm} longa. Capsula obovoidea, $7–8^{mm}$ longa.

San Miguel Uspantán, Depart. Quiché, Guat., alt. $6,000^{ft}$, Mch. 1892, Heyde & Lux, no. 3,328.

Conostegia viridis Cogn.; ramis junioribus petiolis pedunculis calycibusque densiuscule furfuraceo-puberulis; foliis membranaceis, ovatis, breviuscule acuminatis, basi rotundatis vel subemarginatis, acute minuteque duplicato-dentatis ciliatis-que, 5-plinerviis fere 5-nerviis, supra tenuissime punctato-furfuraceis et breviter sparseque setosis, subtus ad nervos nervulosque leviter stellato-furfuraceis caeteris glabratis; floribus 5-meris, subsessilibus; alabastris anguste obovoideis, obtusiuscule acuminatis.

Rami robustiusculi, obscure tetragoni. Petiolus 2.5–3.5^{cm} longus. Folia supra intense viridia, subtus laete viridia, 10–13^{cm} longa, 6–7^{cm} lata, nervis nervulisque subtus satis prominentibus. Paniculæ corymbiformes, multifloræ fere 1^{dm} longæ. Alabastra cinerea, 6–7^{mm} longa, 4^{mm} crassa. Petala oblique obovata, 5^{mm} longa. Antheræ oblongæ, subrectæ, fere 2^{mm} longæ. Stylus crassus, 5^{mm} longus, stigmate non dilatato. Fructus nigricans, depresso subglobosus, 5–6^{mm} crassus.—Species *C. subcrustulatæ* Triana (Cogn. in DC. Monogr. Phan. **7**: 709) proxima, sed foliis 5-plinerviis, etc.

San Felipe, Depart. Retalhuleu, Guat., alt. 2,050^{ft}, Apr. 1892, J. D. S., no. 2,650.

Var. **angustifolia** Cogn.—Petiolus 5^{cm} longus. Folia oblonga, distincte 5-plinervia, basi acuta vel subacuta 17^{cm} longa, 6–6.5^{cm} lata.

Primavera, Depart. Sololá, Guat., alt. 760^{ft}, July 1891, Shannon, no. 487.

Miconia Donnell-Smithii Cogn. (§ AMBLYARRHENA); glaberrima; ramis teretiusculis; foliis satis parvis, breviter petiolatis, pergamentaceis, lanceolatis, longuiscule angusteque acuminatis, basi cuneatis, integerrimis, leviter triplinerviis; floribus 5-meris, longuiscule pedicellatis; calycis tubo suburceolato, dentibus anguste triangularibus, tubo triplo brevioribus; stylo apice truncato.

Rami gracillimi, leviter ramulosi. Petiolus gracilis, circiter 1^{cm} longus. Folia 5–7^{cm} longa, 1.5–2^{cm} lata, nervis supra impressis, subtus valde prominentibus, nervulis paulo distinctis. Paniculæ pyramidatæ, laxæ, submultifloræ, 6–9^{cm} longæ; pedicelli 4–7^{mm} longi, sub apice articulati. Calycis tubus 3^{mm} longus, apice leviter constrictus; dentes erecti, vix 1^{mm} longi. Petala subrotundata, 1.5^{mm} longa. Antheræ rectæ, 1.5^{mm} longæ. Stylus crassiusculus, rectus, 4–5^{mm} longus.—Species *M. pergamentaceæ* Cogn. (DC. Monogr. Phan. **7**: 873) proxima.

San Miguel Uspantán, Depart. Quiché, Guat., alt. 6,000^{ft}, Apr. 1892, Heyde & Lux, no. 3,333.

Miconia alpestris Cogn. (§ CREMANIUM); ramis superne obtuse tetragonis et leviter compressis, junioribus petiolis pedunculis calycibusque dense stellato-furfuraceis; foliis majusculis, longiuscule petiolatis, obovato-lanceolatis, longiuscule subabrupteque acuminatis, basi late cuneatis, integerrimis, triplinerviis fere trinerviis, supra primum furfuraceis demum glabris, subtus ad nervos densiuscule stellato-furfuraceis cæteris glabratis; floribus 5-meris, brevissime pedicellatis calyce subhemisphærico, dentibus brevibus, obtusiusculis, carnosulis; antheris biporosis; stylo brevi, apice truncato.

Rami robustiusculi, apice fuscescentes. Petiolus satis gracilis, fuscescens, 2–5^{cm} longus. Folia erecto-patula, rigidiuscula, supra intense viridia, subtus satis pallidiora, 12–17^{cm} longa, 4–7^{cm} lata, nervis subtus satis prominentibus. Paniculæ late pyramidatæ, multifloræ, 5–8^{cm} longæ; pedicelli sæpius vix 1^{mm} longi. Calycis tubus fuscescens, 2^{mm} longus, 2.5^{mm} latus; dentes erecti, 0.5^{mm} longi. Petala obovata, apice leviter emarginata, 2^{mm} longa. Antheræ 1^{mm} longæ. Stylus rectus, 2^{mm} longus.—Species *M. carneæ* Cogn. (DC. Monogr. Phan. **7**: 912) proxima. San Miguel Uspantán, Depart. Quiché, Guat., alt. 7,500^{ft}, Apr. 1892, Heyde & Lux, no. 3,334.

Clidemia radicans Cogn. (§ CALOPHYSOIDES); caule brevi, repente, radicante; ramis junioribus petiolis pedunculisque brevissime denseque stellato-puberulis; foliis valde inæqualibus et dissimilibus, integerrimis, trinerviis, supra primum puberulis demum glabris, subtus ad nervos nervulosque densiuscule stellato-furfuraceis cæteris glabratis majoribus brevissime petiolatis satis obliquis oblongis acutis basi leviter inæqualibus subrotundatis, minoribus sessilibus ovatis vel suborbicularibus; racemis axillaribus vel interdum terminalibus, breviusculis, paucifloris; floribus 5-meris, breviter pedicellatis; calyce urceolato, leviter furfuraceo, brevissime 5-dentato.

Rami graciles, breviusculi, leviter flexuosi, teretiusculi, cinerei, paulo ramulosi. Petiolus satis gracilis, 2–5^{mm} longus. Folia membranacea, supra saturate viridia, subtus viridi-cinerea; majora erecta vel erecto-patula, 10–17^{cm} longa, 3–5.5^{cm} lata; minora patula, 1.5–4^{cm} longa, 14–20^{mm} lata. Racemi erecti, 4–6^{cm} longi; pedicelli 2–3^{cm} longi. Calyx cinereo-fuscus, ultra medium satis constrictus, 2.5^{mm} longus, inferne 2^{mm} latus. Petala patula, suborbicularia, 1.5^{mm} lata. Antheræ lineares, leviter arcuatæ, 1.5^{mm} longæ. Stylus rectus, 3^{mm}

longus, stigmate punctiformi. Bacca depresso-sphærica, distincte 10-costata, intense cyanea, 4–5^{mm} crassa.

Jiménez, Llanos de S. Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 4,789.—Collected also by M. Pittier in the valley of Rio Reventazon, Costa Rica, 1893 (no. 8,123).

Clidemia glandulifera Cogn. (§ SAGRÆA); ramis junioribus pedunculis calycibusque brevissime denseque stellato-tomentosis et pilis patulis brevibus glandulosis densiuscule vestitis; foliis longiuscule petiolatis, satis disparibus, anguste ovatis, acutis vel breviter acuminatis, basi rotundatis, integerrimis, supra pilis simplicibus brevissimis dense hirtellis, subtus brevissime denseque stellato-pilosis, majoribus 7-nerviis, minoribus 5-nerviis; paniculis longiusculis, pyramidatis, multifloris; floribus 4-meris, subsessilibus; calyce campanulato, brevissime dentato.

Rami satis graciles, juniores teretiusculi, sordide fusci. Petiolus brevissime denseque stellato-tomentosus et sparsissime breviterque glandulosa-pilosus, 3–7^{cm} longus. Folia submembranacea, supra intense viridia, subtus cinerea, 12–15^{cm} longa et 7–8^{cm} lata, minora subdimidio breviora et angustiora. Paniculæ patulæ, 7–10^{cm} longæ. Calyx cinereo-fuscus, 3^{mm} longus. Petala obovata, 3^{cm} longa. Antheræ lineares, subrectæ, 2.5–3^{mm} longæ. Stylus capillaris, 5–7^{mm} longus, stigmate punctiformi. Bacca nigricans, subglobosa, 4–5^{mm} crassa.

San Miguel Uspantán, Depart. Quiché, Guat., alt. 6,000^{ft}, Apr. 1892, Heyde & Lux, no. 3,329.

Pittiera trilobata Cogn.; ramis junioribus petiolis cirrhisque breviter sparseque pilosulis; foliis breviuscule petiolatis, rigidiusculis, late ovatis, leviter vel usque ultra medium trilobatis, basi profundiuscule emarginatis, supra scabris, subtus ad nervos densiuscule breviterque asperis caeteris brevissime denseque pubescenti-scabriusculis;calyce brevissime denseque puberulo, tubo breviter campanulato-subcylindrico, segmentis triangulari-lanceolatis, tubo satis longioribus; corollæ segmentis obovato-oblongis, acutis vel breviter acuminatis; staminum filamentis basi pilosulis.

Rami graciles, elongati, paulo ramulosi, leviter sulcati. Petiolus satis gracilis, profunde striatus, 2–5^{cm} longus. Folia supra intense viridia, subtus viridi-cinerea, margine remotiuscule spinuloso-denticulata, 7–10^{cm} longa, 6–9^{cm} lata; nervi subtus paulo prominentes, duo laterales trifurcati imum sinum leviter marginantes. Cirrhi robusti, elongati, sulcati, saepius 5-fidi. Pedunculus masculus satis gracilis, brevissime et densiuscule puberulus, 7–26^{cm} longus. Calycis tubus 10–13^{mm} longus, superne circiter 1^{cm} latus; segmenta erecto-patula, 15–18^{mm} longa, basi 5^{mm} lata. Corolla membranacea, utrinque leviter furfuraceo-puberula, 2.5^{cm} longa. Staminum filamenta filiformia, 11–12^{mm} longa; capitulum antherarum ovoideo-conicum, 1^{cm} longum, 6^{mm} crassum. Fructus oblongus, laevis, 8^{cm} longus, 3^{cm} crassus. Semina ovata, apice obtusa, basi obscure tridentata, margine subalata, 1^{cm} longa, 7^{mm} lata, 1.5^{mm} crassa.

Buena Vista, Depart. S. Rosa, Guat., alt. 5,500^{ft}, Dec. 1892, Heyde & Lux, no. 4,189.

Schizocarpum Guatemalense Cogn.; foliis longiuscule petiolatis, ambitu ovatis, leviter vel usque ad medium trilobatis, supra glabratis, subtus brevissime et densiuscule puberulis, basi leviter emarginatis; nervis lateralibus imum sinum non vel vix marginantibus; calycis tubo brevissimo, late campanulato, segmentis triangulari-linearibus, tubo multo longioribus; corollæ segmentis longe acuminatis; fructu anguste ovoideo, apice longiuscule rostrato.

Rami gracillimi, elongati, sulcati, glabrati vel leviter puberuli. Petiolus gracilis, striatus, brevissime et densiuscule hirtellus, 2–4^{cm} longus. Folia tenuiter membranacea, intense viridia, margine vix denticulata, 6–10^{cm} longa, 4–7^{cm} lata; lobus terminalis triangularis vel oblongus, acutus, laterales multo breviores, obtusi. Cirrhi filiformes, inaequaliter bifidi, sulcati, glabrati. Pedunculus masculus gracilis, densiuscule et brevissime puberulus, 3–4^{cm} longus. Calyx furfuraceus et longiuscule sparseque pilosus, tubo 3^{mm} longo, 4–5^{mm} lato, segmentis erecto-patulis, 8–12^{mm} longis, basi 2^{mm} latis. Corolla pallide flava, anguste campanulata, vix furfuraceo-puberula, fere 3^{cm} longa. Staminum filamenta 6–7^{mm} longa; capitulum antherarum 6^{mm} longum. Pedunculus fructiferus robustiusculus, 7–8^{mm} longus. Fructus sparse pilosus, (maturus ?) 3.5^{cm} longus, 17^{mm} crassus.

Carrizal, Depart. S. Rosa, Guat., alt. 5,000^{ft}, Nov. 1892, Heyde & Lux, no. 4,186.

Cyclanthera Donnell-Smithii Cogn. (§ EUCYCLANTHERA); ramis glaberrimis; foliis breviter petiolatis, trifoliolatis; foliolis breviter petiolulatis, undulato-denticulatis, glabratis, supra sparse punctato-scabriusculis, mediano oblongo-lanceolato, acutissime breviterque acuminato, lateralibus valde asymmetricis, ovato-oblongis, acutis; cirrhis bifidis; racemis masculis petiolo brevioribus, paucifloris; floribus minutis.

Rami graciles, elongati, angulato-sulcati. Petiolus gracilis, striatus, glaber, 2–3^{cm} longus; petioluli leviter puberuli, 3–5^{mm} longi. Foliola tenuiter membranacea, intense viridia; terminale 6–7.5^{cm} longum, 2–2.5^{cm} latum, basi acutum; lateralia 3.5–5^{cm} longa, 1.5–2.5^{cm} lata, basi extrinsecus auriculata. Cirrhi graciles, longissimi, sulcati, glabri. Pedunculus communis masculus filiformis, sulcatus, leviter puberulus, 0.5–1.5^{cm} longus; pedicelli capillares, patuli, 2–3^{mm} longi. Flores ut videtur vix 2^{mm} lati. Calycis dentes subnulli.—Species *C. gracillimæ* Cogn. (DC. Monogr. Phan. **3:** 834) proxima.

San Miguel Uspantán, Depart. Quiché, Guat., alt. 6,000^{ft}, Apr. 1892, Heyde & Lux, no. 3,345.

Burmeistera cyclostigmata Donnell Smith.—Suffrutex orgyalis ramosus. Folia longe petiolata lanceolato-elliptica, termino utroque praecipue superno acuminato, margine glanduloso-punctulo, costis lateralibus utrimque 10–12 supra impressis subtus prominulis, venulis pellucidis. Pedunculi folia superantes. Calycis tubus longiuscule campaniformis lobis oblongis sublongior. Corollæ tubus dorso breviter fissus, lobi valde inaequales recurvi secundi. Antheræ omnes prorsus nudæ. Stigmatis magni lobi suborbiculares.

Leaves $3\frac{1}{2}$–$5 \times 1\frac{1}{2}$–$1\frac{3}{4}^{in}$, paler beneath, lateral nerves forming intramarginal arches, base often unequal, petioles 1–$1\frac{1}{2}^{in}$ long. Peduncles 3–$4\frac{1}{2}^{in}$ long. Tube of calyx $5 \times 2\frac{1}{2}^{l}$, sometimes narrowing at base, lobes 3–4^{l} long and obtuse. Tube of corolla 6^{l} long, narrowed above; limb unequally partite, oblique, inflated on lower side; 2 superior segments 11–13^{l} long, twice exceeding the 3 inferior; all linear, acute, arcuately deflexed to lower side. Staminal tube adnate to base of corolla, pubescent, $1\frac{1}{2}^{in}$ long; anthers lightly recurving, the 3 superior 4^{l} long and twice exceeding the others. Placentas peltate, oval, entire. Lobes of stigma 2–$2\frac{1}{2}^{l}$ in diam., barbate beneath.—Nearest to *B. virescens* Benth. et Hook.

Estrella, Prov. Cartago, Costa Rica, alt. 4,400^{ft}, Apr. 1888, Juan J. Cooper, no. 5,845.

Psammisia symphystemona Donnell Smith.—Tota glabra. Rami teretes. Folia subdisticha coriacea elliptica longe caudato-acuminata basi obtusa 3–5-plinervia minutim reticulata, venis intramarginalibus transversis crebris. Racemi sessiles, rhachi brevissima, pedicellis confertis gracilibus basi bracteatis supra basin bibracteolatis. Stamina aequalia tertiam partem corollæ attingentia, filamentis in tubum connatis, antheris prope basin affixis; omnibus ad apicem connectivi 2-calcaratis.

Epiphytal, 8–10^{ft} long (Cooper). Branches pale, internodes 9–15^{l} long. Leaves 5–7×2–3^{in}, more narrowing above the middle than below, caudate prolongation 9–12^{l} long, interior 2 lateral nerves arising 3–4^{l} above base and like midrib very prominent beneath, the exterior 2 basal and obscure. Petioles 2^{l} long. Rhachis 2–5^{l} long; pedicels articulated at base, 5–8^{l} long; bracts ovate; bracteoles lanceolate, glandular-denticulate, like bracts very minute and colored. Tube of calyx campanulate, 2^{l} high; limb as long, spreading; lobes round, mucronate-acuminate, 1^{l} long. Corolla red, sprinkled toward apex with red glands, cylindrical-tubular, 13–15^{l} long, tapering above stamens, lobes triangular-oblong, 2×1^{l}. Filaments persistently connate, 2^{l} long; anther-cells 2^{l} long, twice exceeding their tubes. Style exsert.

Mariposa, Prov. Alajuela, Costa Rica, alt. 5,500^{ft}, May 1887, Anastasio Alfaro, no. 5,842.

GAULTHERIA ODORATA HBK., var. **Costaricensis** Donnell Smith.—Folia orbiculari-ovata subintegra, costis lateralibus utrimque 3–4 subtus prominentibus usque ad apicem fere adscendentibus. Bracteolæ semipollicares.

Estrella, Prov. Cartago, Costa Rica, alt. 4,400^{ft}, Mch. 1888, Juan J. Cooper, no. 5,841.

Calceolaria Irazuensis Donnell Smith. (§CHEILONCOS Wettst.)—Herbacea adsurgens ferrugineo-glanduloso-pubescens. Folia ovato-lanceolata basi cuneata, uniuscujusque jugi alterum aliquantum minus, grosse dentata supra puberula subtus pallida et praeter nervos glabra petiolata. Pedunculi terminales 2 longissimi foliis ternatis bracteati, cymis corymbiformibus nutantibus, pedicellis filiformibus, floribus inter maximas. Corollæ labium superius semi-globosum calycem subaequans ab inferiori obovato breviter aperto 3-plo superatum. Antherarum loculi confluentes.

Stem stout, sparingly branched, 3–4^{ft} long. Leaves $2\frac{1}{2}$–4×1–$1\frac{1}{2}^{in}$, petioles 3–6^{l} long. Peduncles 3–4^{in} long; bractlets 2, foliaceous, unequal, $\frac{3}{4}$–$1\frac{1}{4}^{in}$, subtending viscid-pubescent corymbs $1\frac{3}{4}$–$2\frac{1}{2}^{in}$ high and 7–12-flowered. Calyx-segments nearly free, ovate-acuminate, 3×2^{l}, 5-nerved, tipped with a gland. Corolla obovate, $10\text{–}12\times5\text{–}6^{l}$, yellow, pluri-nerved, sprinkled with minute dusky glandular hairs, barbate at insertion of stamens. Anthers stout, arcuate; cells $\frac{3}{4}^{l}$ long, divaricate from apex of shorter filament. Stigma incrassate. Capsule glandular-punctate.

Moist, shaded slopes of Volcán Irazú, Prov. Cartago, Costa Rica, alt. 9,000^{ft}, Mch. 1894, J. D. S., no. 4,904.

Spathacanthus Donnell-Smithii Lindau.—This determination of no. 1,030 must be substituted for the erroneous one, *Macfadyena simplicifolia* Botan. Gaz. **16:** 198, the specific name being dropped as inappropriate for an *Acanthacea.*

Pisonia macranthocarpa Donnell Smith. (*P. aculeata* L., var. *macranthocarpa* Donnell Smith in Botan. Gaz. **16:** 198). —Arbusculus inermis. Folia obovata vel oblongo-elliptica apice rotundata vel plus minus obtuse acuminata in petiolum cum costa et cymis pubescentem attenuata ceterum glabra. Cymæ corymboso-fasciculatæ, pedicellis longiusculis (fructiferis valde elongatis), perigonio tubuloso-infundibuliformi, floribus hermaphroditis. Anthocarpia magna oblongo-obovata ad costas glandulis pluriserialibus longe stipitatis muricata.

Erect, 12–18^{ft} high, branchlets occasionally spine-like. Leaves opposite, often fasciculate in axils, $1\frac{1}{2}\text{–}2\frac{1}{2}\times\frac{3}{4}\text{–}1\frac{1}{2}^{in}$, the younger sprinkled beneath with cystoliths; petioles 3–5^{l} long, marginate, at length glabrous. Peduncles axillary and terminal, 8–12^{l} long, in fruit elongated; corymbs subglobose (1^{in}); bracts orbicular-ovate (1^{l}); bractlets near apex of pedicel 3, oblong ($\frac{3}{4}^{l}$). Perigonium puberulous, $2\frac{1}{2}\text{–}3^{l}$ long, twice to thrice exceeding pedicel, lobes 5 and ovate ($\frac{1}{4}^{l}$). Stamens nearly free, 6–7, didynamous, exsert, anthers orbicular. Style included, stigma minutely laciniate. Cymes in fruit 5–6^{in} in diam., pedicels $1\frac{1}{2}\text{–}2^{in}$ long; anthocarps $9\times4\frac{1}{2}^{l}$, flavo-tomentulose, stipes of glands lageniform ($\frac{1}{4}^{l}$).

Escuintla, Depart. Escuintla, Guat., alt. 1,100^{ft}, Apr. 1890 and Feb. 1892, J. D. S., nos. 2,091 and 1,230.—Los Verdes, Depart. Amatitlan, Guat., alt. 3,500^{ft}, Oct. 1893, Heyde & Lux, no. 6,301.

TRIPLARIS MACOMBII Donnell Smith in Botan. Gaz. **19:** 237, var. **rufescens** Donnell Smith.—Folia utrimque praecipue subtus ad nervos pilosiuscula. Calycis rufescentis lobi interiores plerumque plus minus exserti, interdum lineares exteriorum dimidium paene aequantes.

Tree 30–50^{ft} high; flowers brick-red.

Mazatenango, Depart. Suchitepéquez, Guat., alt. 1,200^{ft}, Jan. 1894, Heyde & Lux, no. 6,375.

Pseudolmedia oxyphyllaria Donnell Smith.—Primo sericea, cito aetate provectiore glabrata. Folia semipedalia et ultra ter quaterve longiora quam latiora oblongo-lanceolata in acumen longiusculum obtusum angustata ad basin acuta subinaequilatera falcata, costis subtus prominentibus in utroque latere circa 20. Capitula mascula singula vel 2–5-glomerata; involucri bracteæ externæ deltoideæ, internæ ovatæ, cunctæ autem acutæ; receptaculi concavi magni bracteolæ rhomboideo- vel lanceolato-spatulatæ. Stamina numerosissima, antheris nudis ad basin breviter auriculatis.

Tree 20–30^{ft} high. Branchlets terete. Leaves $6–8 \times 1\frac{1}{2}$–$2\frac{1}{4}^{in}$, glabrous; petioles pubescent, 3^{l} long. Heads about 5^{l} in diam.; bracts cano-sericeous with scarious margins, the interior 3^{l} long; bractlets cano-sericeous, lacerate, exceeding stamens. Anthers 1^{l} long. Female heads not seen.

Slopes of Volcán Tecuamburro, Depart. S. Rosa, Guat., alt. 6,000^{ft}, Febr. 1893, Heyde & Lux, no. 4,429.

Pilea Costaricensis Donnell Smith.—Dioica glabra. Folia in eodem jugo maxime inaequimagna admodum autem conformia, alterum nempe majus oblongo-ellipticum longiuscule cuspidato-acuminatum basi aliquantulum inaequilaterum et plerumque obtusum longe petiolatum, alterum quadruplo minus breviusque petiolatum oblongo-lanceolatum a medio utrimque sensim angustatum, ambo 3-nervia subtus pallida et evenia supra basin integram incurvo-crenulata, nervis lateralibus apicem fere attingentibus. Cymæ brevissime pedunculatæ, masculæ a petiolo folii majoris feminæ a petiolo folii minoris superatæ.

Herbaceous, ascending 1–2^{ft} from a rooting base, branching. Leaves, especially beneath, occupied by linear cystoliths; the larger in the pair $3\frac{1}{2}$–$5\frac{1}{2} \times 1\frac{1}{2}$–$1\frac{3}{4}^{in}$, more narrowing above the middle than below, cuspidate tip 4–6^{l} long, petioles 1–2^{in} long. Masculine cymes 6–8^{l} high, perianth 2^{l} in diam. with oblong segments exceeded by anthers; feminine cymes less evolute, exterior segments of perianth scarious-tipped and twice exceeded by obliquely oval ($\frac{3}{4}^{l}$) achenium.

Estrella, Prov. Cartago, Costa Rica, alt. 4,400^{ft}, Apr. 1888, Juan J. Cooper, no. 5,952.

Dioscorea calyculata Donnell Smith. (§ EPISTEMON Griseb. in Fl. Brasil.)—Omnibus in partibus glaber. Folia tenuiter membranacea inter minora subcordata vel subcordato-ovata acutissime acuminata et mucrunculata, basi ima cuneata cum nervis basalibus 3–5 in petiolum marginatum decurrente. Racemi filiformes elongati, pedunculis furcatis, pedicellis solitariis basi bracteolatis subflore bibracteolatis. Perianthii masculini minimi infundibulari-rotati segmenta exteriora orbicularia, interiora oblongo-obovata.

Herbaceous, twining. Leaves alternate, $1\frac{3}{4}$–$2\frac{1}{2} \times 1\frac{1}{4}$–$2^{in}$, the younger ovate-lanceolate with a filiform mucro, petioles 6–14^{l} long. Racemes 6–10^{in} long, axillary or composing an elongated terminal panicle; peduncles 2–3-furcate, 2–3^{in} long; pedicels 1^{l} long; basal bracteole filiform, exceeding pedicel; apical bracteoles opposite, ovate ($\frac{1}{3}^{l}$), persistent. Tube of male perianth very short, segments $\frac{2}{3}^{l}$ long; stamens 6, all perfect, inserted at base of segments; filaments flat, attenuate upwards, incurved at apex, exceeding perianth; anthers many times shorter than filament, oblong, arcuate, affixed at middle. Rudimentary ovary globose, exceeding tube of perianth, styles united and at apex 3-lobed. Pistillate flowers and fruit not seen.

Alajuela, Prov. Alajuela, Costa Rica, alt. $2{,}700^{ft}$, Nov. 1887, Anastasio Alfaro, no. 5,959.—Guachipilin, Depart. S. Rosa, Guat., alt. $2{,}500^{ft}$, Nov. 1893, Heyde & Lux, no. 6,260.

Baltimore, Md.

Contributions to the embryology of the Ranunculaceæ.

WITH PLATES XVII–XX.

DAVID M. MOTTIER.

(Concluded from page 248.)

Of the three species of Ranunculus examined, *R. abortivus* is most abundant in this vicinity thriving well in the dry soil of open woods and meadows, while the other two, *R. recurvatus* and *R. septentrionalis*, seem to prefer the moist soil of more dense and shady woods and along water courses. We shall direct our attention first to

Ranunculus abortivus.—The carpophyll may be said to consist of a short stalk or petiole and a broader portion, the lamina. The ovule arises as a small protuberance at the junction of petiole and lamina, but, of course, before any differentiation into these two parts is perceptible. The lamina soon broadens, the edges bending upward to form a crescent shaped cup or cavity into whose opening the rudimentary ovule projects. A longitudinal radial section of a carpel thus far developed, presents a picture closely resembling a partly closed hand with the thumb pointing downward toward the palm, the thumb representing the rudiment of the ovule (fig. 41*a*). At this stage of development the edges of the lamina have not quite organically united, a fact made clear by fig. 41*b* which is a transverse section cut in the plane *x*—*x* of fig. 41*a*.

The initial cell of the embryo-sac is hypodermal. The surrounding hypodermal cells by their behavior seem to be suggestive of a sort of archesporium (figs. 31, 32).

Before the first division it elongates a good deal, and sometimes becomes very broad (fig. 33). In the majority of cases observed only the lower of the two cells resulting from the first division divided again (fig. 38). Sometimes, however, both cells divide as in the preceding genera (fig. 39) though this is less frequent in the genus Ranunculus. In a number of instances the nucleus in the upper cell divided without being followed by the formation of a cell wall (fig. 35), and in others a longitudinal division of this cell took place. From fig. 34 it seems probable that two cells have begun to develop into embryo-sacs. Here only two cells were formed from each initial cell, the upper being already partly disorganized. The development of the embryo-sac from the mother-cell is perfectly normal. In this species the egg-apparatus is larger at first than the antipodal cells (fig. 40) two of which only are shown in the figure. The latter increase in size, however, with the subsequent growth of the embryo-sac, but as far as observation went, they do not reach the enormous size that obtains in the genera previously mentioned.

Ranunculus recurvatus.—The most striking difference between R. abortivus and R. recurvatus from an histological point of view, is the larger meristematic cells of the latter. In this respect R. recurvatus resembles Delphinium and Caltha. The development of the embryo-sac from the initial cell requires but few additional remarks. Figs. 42 and 43 will make the process clear. Fig. 44 presents a phenomenon probably indicating the tendency of more than one cell to develop into an embryo-sac.

The antipodal cells are large, and increase considerably in size during the subsequent growth of the sac. In one case their position differed from their usual orientation (fig. 45). In one embryo-sac a cleft or cavity seemed to extend some distance downward into the chalaza beneath the antipodal cells, in which could be recognized only a slight trace of a protoplasmic substance (fig. 46). Here the large antipodal cells, rich in protoplasm, and with large nuclei, rest upon the disorganized remains of cells. Another exceptional phenomenon was observed in the presence of a small tracheary and a small tracheid element beneath the antipodal cells (fig. 60). In this figure are shown two antipodal cells of unequal size, one behind the other, with an endosperm nucleus on the right and left, and the above named elements below. As these two phenomena were observed in one case only, I am not inclined to attach any special significance to them at present.

R. septentrionalis.—This species resembles the preceding very closely, especially in regard to the size of its embryonic cells and the behavior of the initial cell, which gives rise sometimes to four cells (fig. 47). Fig. 48 illustrates what frequently takes place in the cells which immediately surround the embryo-sac mother cell and its disorganizing sister cells. The mother-cell in the figure is partly concealed by those on either side.

The mature embryo-sac is perfectly normal; the antipodal cells are large, and increase in volume with the subsequent growth of the embryo-sac.

Anemonella thalictroides.—In an early stage of the ovule of this species there was observed in several instances a number of hypodermal cells well marked off from the cells below, suggesting a primitive archesporium (figs. 49, 50). It is very probable that there is here but one initial cell, as only one was found to proceed in its development, and that the sharp definition of these cells is due to regularity in growth; yet the possibility is not excluded that there is present a tendency of more than one ceil to become reproductive. As to the origin of the inner integument at *i—i*, fig. 49, there can be no question. In all ovules examined the number of cells produced by the initial cell was three (fig. 52). The nucellus is rather long and narrow impressing this character upon its cells.

The antipodal end of the gradually enlarging embryo-sac is more or less pointed, and the large antipodal cells adapt themselves to this space. Extending backward through the nucellus from the antipodal end of the newly formed embryo-sac is a strand of long narrow cells resembling the rudiment of a vascular bundle. This strand is gradually absorbed by the encroaching embryo-sac which makes its way wedge-like to the base of the nucellus. The nuclei of the antipodal cells are large and undergo division.

Thalictrum dioicum.—In this genus the development of the embryo-sac agrees closely with that of Anemonella. It is evident (fig. 54) that the great bulk of the nucellus owes its origin to the hypodermal layer of cells. This statement will apply generally to all the preceding genera.

As far as observation extended, the initial cell gives rise to three cells only, but in all probability four occasionally result from two successive divisions, as in the other genera.

The nucellus is less elongated than in Anemonella; the embryo-sac more oval in form and it reaches maturity sooner with reference to the corresponding growth of the integuments. The antipodal cells are large, but not so pronounced as in Anemonella.

Hepatica acutiloba.—The earlier stages in the development of the embryo-sac of Hepatica were not observed, as my material, collected about the middle of November, was too far advanced for that purpose. The youngest stage observed showed three cells derived from the initial cell, the lower one becoming the mother cell.

The mature embryo-sac of Hepatica is especially interesting. Before fertilization both egg-apparatus and antipodal cells, as well as the cavity of the sac itself, become unusually large. At the upper ends of the synergidæ there appears a number of protoplasmic strands converging to a point and thus forming a star-shaped cap (fig. 55). The egg-cell is broader at its upper end and rather deeply inserted. All three cells of the egg-apparatus are surrounded by very delicate membranes. The antipodal cells increase greatly in size during the subsequent growth of the embryo-sac, and at the time of fertilization each cell may contain as many as ten or a dozen nuclei (fig. 56), due to fragmentation. The process of fragmentation may be readily observed here (fig. 57). Each nucleus contains two or more nuclei situated in spherical or oval vacuoles.

Soon after fertilization, or when the embryo has reached the stage of development shown in fig. 58, the antipodal cells bear evidence of dissolution, the fusion of all the nuclei into a common mass being the preparatory step.

On account of the large nuclei, the cells of the developing embryo and endosperm of Hepatica afford favorable objects for the study of karyokinesis.

I may add here that by staining on the slide with aniline safranine and picric nigrosine I was able to see the centrospheres or what seemed to be centrospheres (fig. 69). The centrosomes appeared as extremely small dark points surrounded by a colorless court, and the radiating kinoplasmic zone was also darker but difficult to see.

In some instances I have observed what were taken to be centrospheres at the poles of nuclear spindles (fig. 4, upper end of spindle) in preparations that were not subjected to the special process said to be necessary to demonstrate these structures.

Summary.—This work has been interesting especially as a study in variation. That which first of all attracts our attention is found in the presence of more than one initial cell and their development into normal embryo-sacs. In the genera under consideration the number of initial cells reaches its culmination in Caltha where five or more may be present in the ovule, suggesting a sporangium which indeed it is, for the ovule certainly stands for a macrosporangium with its integumentary covering or indusium. Although the presence of more than one embryo-sac in an ovule has been observed by several investigators in widely separated families, yet further research will undoubtedly show the phenomenon to be still more prevalent and widely distributed. Just how far this fact will throw light upon the origin of the angiosperms remains yet to be seen, but it certainly contributes materially to the phylogeny of the seed plants.

The production of a series of four cells by two successive divisions of the initial cell of the embryo-sac, occurs more frequently in this family than had hitherto been supposed; and it seems probable that a more extended search in those genera in which this phenomenon was not observed by myself would reveal its occasional presence.

In connection with the foregoing facts several questions naturally arise upon which it is not my purpose to speculate at present. What is the significance of the fact that in the same species the initial cell gives rise sometimes to only three cells and sometimes to four? Is the behavior of the initial cell due to inherent tendencies alone, or is it determined partly by external forces? Which is the more primitive condition, that represented by the series of three or of four cells?

If the small cell cut off occasionally from the initial cell in Aquilegia be regarded as a tapetum, we certainly have here an isolated phenomenon occurring where it would not be generally expected. Guignard[10] has observed the presence of a tapetum in certain genera of a family while in other genera of the same family a tapetum was absent; but no other instance is now known to me in which a tapetum was only of occasional occurrence in the same species.

The rule so general in its application among angiosperms, that the lower cell of the series derived from the initial cell develops directly into the embryo-sac, seems to have a probable exception in Caltha (fig. 16). Guignard speaks also of a probable exception in *Acacia albida*, and in the same place refers to a case reported by Mellink in one of the monocotyledons (Agraphis), together with the analogous case described by Strasburger for *Rosa livida.*[11]

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[10] Embryogénie des Legumineuses. Ann. des Sc. Nat. Bot. VI. **12:** ——.

[11] l. c., p. 137.

In regard to the large cells of the ovule in such species as Caltha palustris, Ranunculus septentrionalis and Delphinium tricorne and the comparatively small cells of Aquilegia, it seems that we have a phenomenon which may be correlated with the habitat of the plant. In the marsh dwelling Caltha we find the largest cells, followed in order by Ranunculus septentrionalis, R. recurvatus which thrive better in moist soil; then come Delphinium, Hepatica and R. abortivus which flourish in a drier soil. On the other hand Anemonella, Thalictrum, and especially Aquilegia, whose cells are very small, are particularly dry soil plants. This is not given as a theory or explanation, but merely as a suggestion, for I do not know how far the facts in different genera and species of other families contribute to the support of such a view or whether they contradict it.

Besides the Ranunculaceæ, unusually large antipodal cells have been observed in *Delphinium villosum*,[12] *Ornithogalum nutans*, *Gladiolus communis* and *Crocus*. I have also observed large antipodal cells in *Jeffersonia diphylla*.

As to the large antipodal cells, which with their numerous nuclei become so rich in protoplasm, it may be said in harmony with known facts, that they have passed from a formative into a nutritive condition which we find paralleled in the internodal cells of Chara and Nitella.[13]

Bloomington, Ind.

Explanation of Plates XVII–XX.

Figs. 1–10, Delphinium.

Figs. 1 and 2. Median longitudinal sections of very young ovule. × 335. In fig. 1 two initial cells can be seen; in fig. 2, only one, which is larger than the other hypodermal cells.—Fig. 3. Similar section of an older ovule with two large initial cells. × 335. The anatropy of the ovule is more pronounced.

Figs. 4–8. Median longitudinal sections of the nucellus. Fig. 4. The nucleus of the large initial cell of the embryo-sac is in the spindle stage of division; at the upper pole are centrospheres. × 335.—Fig. 5. The initial cell has divided transversely, the lower cell being larger. × 335.—Fig. 6. The lower cell has already divided; the upper is in process of division. × 335.—Fig. 7. Two initial cells in process of development. In the cell on the right, the nucleus is dividing; the one on the left shows the lower cell in process of division. × 335.—Fig. 8. The lower cell of the series, the embryo-sac-mother-cell, has en-

[12] Strasburger, Ueber Befruchtung und Zelltheilung. 38. 41. 1878.

[13] Strasburger, Histologische Beiträge. 5: 99. 100, etc. 1893.

larged considerably; the three cells of the series above are disorganized. × 335.

Fig. 9. Two mature embryo-sacs lying side by side in the same ovule. × 260.—Fig. 10, *a* and *b*. The egg-apparatus and antipodal cells respectively drawn from the same embryo-sac. Only one synergida is shown, the other lies beneath. Above the antipodal cells, of which two are drawn, lies the large endosperm nucleus. × 335.

Figs. 11–19, Caltha.

Figs. 11 to 18. Median longitudinal sections of young ovules.

Fig. 11. Three large initial cells stand side by side in the plane of the section. Some of the epidermal cells above them have divided by periclinal walls. × 335.—Fig. 12. Probably a group of four or five initial cells; a space is seen between the two on the left. × 335.—Fig. 13. The initial cell has divided, and the nucleus of the lower cell is in the skein stage preparatory to division. × 335.—Fig. 14. Three cells have been derived from the initial cell. The mother-cell already slightly enlarged is separated above by a swollen wall. ×335.—Fig. 15. Two cells have been formed from the initial cell; the two nuclei in the lower are separated by two large vacuoles. × 335.—Fig. 16. Of the three cells derived from the initial cell the two upper are larger; the lower cell seems partly crowded out; the inner integument has just appeared. × 335.—Fig. 17. The mother-cell has apparently displaced the two cells above it. The epidermis of the nucellus has formed a layer three or four cells thick. × 335.—Fig. 18. Embryo-sac with two nuclei in each end. × 335.

Fig. 19. In the upper cell formed by the first division of the initial cell two nuclei are shown in outline. × 335.

Figs. 20–30. Aquilegia.

Figs. 20–28. Median logitudinal sections of the nucellus.

Fig. 20. A small cell has been cut off from the initial cell. ×465.—Fig. 21. Similar to Fig. 20; the nucleus of the larger cell is in division. × 465.—Fig. 22. One step beyond fig. 21; in the two cells below the small tapetal (?) cell, the nuclei are in division. ×465.—Fig. 23. Only the usual four cells have been produced by the initial cell. ×465.—Fig. 24. Same as fig. 23, the mother cell having enlarged. × 465.—Fig. 25. The initial cell has given rise to five cells. × 465.—Fig. 26. The terminal cell of the series has divided almost at right angles to the usual plane of division. × 465.—Fig. 27. The enlarging mother cell with the remains of the sister cells above; a large vacuole occupies the upper half of the mother-cell. × 465.—Fig. 28. Similar to fig. 27, but the nucellus is narrower; the vacuole occupies the lower half of the cell. × 465.

Fig. 29. An embryo-sac shortly after maturity. The nucellar cap is only two cells thick. × 335.

Fig. 30, *a* and *b*. A young embryo with the remains of one of the synergidæ and two enormous antipodal cells drawn from the same embryo-sac. Two nuclei are present in the cell on the left; vacuoles are indicated by dotted lines. × 260.

Figs. 31–41. Ranunculus abortivus.

Figs. 31–38. Median longitudinal sections of the ovule.

Fig. 31. The initial cell is distinguishable by its larger size. × 335.—Fig. 32. The initial has increased greatly in length; the cell of the axial row of the nucellus, just below it failed to divide, and as a result is larger than its neighbors. × 335.—Fig. 33. The nucleus of the unusually broad initial cell is in division. × 335.—Fig. 34. Two initial cells that have each given rise to two cells which are apparently mother-cells. One mother-cell is partly hidden by the other. × 335.—Fig. 35. Three cells have resulted from the initial cell, the nucleus in the upper one has divided. × 335.—Figs. 36 and 37. Similar to fig. 35. In fig. 36, the uppermost cell has divided longitudinally. In 37, the two nuclei in this cell lie side by side in a vertical plane. × 335.—Fig. 38. The mother-cell has begun to encroach upon the cells above. × 335.

Fig. 39. Four cells have evidently been produced from the initial cell. The disorganizing cells above the large mother cell have greatly swollen walls. × 335.

Fig. 40. Mature embryo-sac, together with the surrounding tissue of the nucellus. Only two antipodals and two cells of the egg-apparatus are drawn. × 260.

Fig. 41, *a* and *b*. *a*, *a* longitudinal radial section through an immature carpophyll; *b*, a transverse section made in the line *x—x*. × 85.

Figs. 42–46, 60, Ranunculus recurvatus.

Fig. 42. Median radial longitudinal section of a rudimentary ovule. The nucleus of the initial cell is drawn in outline. × 335.

Figs. 43 and 44. Median longitudinal sections of the nucellus. In fig. 43, four cells would have resulted from the initial cell, the division of the upper cell is almost complete, when the wall would have been oblique. In fig. 44, three cells have resulted from the initial cell (on the right), and if two initials were present here, four cells (on the left) would have been the descendants of the same. × 335.

Fig. 45. Three antipodal cells, with an unusual orientation.

Fig. 46. A vertical section through a portion of the chalaza. Two antipodal cells rest upon fragments of disorganized cells, and below them a narrow cavity extends a short distance downward into the chalaza. This figure was taken from an embryo-sac that had increased greatly in size after having been laid down. × 335.

Fig. 60. Two antipodal cells, below which are two small tracheary elements: on the right and left may be seen a nucleus of the endosperm. × 335.

Figs. 47, 48, Ranunculus septentrionalis.

Fig. 47. Longitudinal section of nucellus. Four cells have been formed from the initial cell; the upper one has divided obliquely. × 335.

Fig. 48. The enlarging mother cell is partly hidden by the lateral, turgid cells. × 335.

Figs. 49–52. Anemonella.

Figs. 49, 50. Longitudinal section of the ovular rudiment. Several hypodermal cells with nuclei indicated are very sharply defined from the cells beneath. The origin of the inner integument is shown at *i, i.* In Fig. 50 the hypodermal cells are equally well defined; the initial cell is probably the middle one of those in which the nuclei are outlined. × 335.

Figs. 51, 52. Longitudinal sections of the nucellus.

Fig. 51. The nucleus of the initial cell is in process of division. × 335.—Fig. 52. Three cells have been derived from the initial cell; the mother-cell has somewhat enlarged. The nucellus is long and narrow. × 335.

Figs. 53–54. Thalictrum.

Fig. 53. Longitudinal section of young ovule. The initial cell is very large, reaching almost the entire length of the nucellus. This figure plainly shows that the bulk of the nucellus, aside from the epidermis, owes its origin to the hypodermal layer of cells. × 335.

Fig. 54. Three cells owe their origin to the initial cell. × 335.

Figs. 55–59. Hepatica.

Fig. 55. Egg-apparatus with the nucellar cap above. At the upper ends of the synergidæ is a star-shaped protoplasmic mass. × 260.

Fig. 56. An antipodal cell with eleven nuclei due to fragmentation. × 260.

Fig. 57. Two nuclei from an antipodal cell in process of fragmentation. × 335.

Fig. 58. A four-celled embryo. The wall separating the lower end cells lies almost in the plane of the paper. The nucleus indicated by dotted line could be seen by focusing down. × 335.

Fig. 59. Nucleus with two centrospheres at the right. × 675.

ATKINSON on COLLETOTRICHUM.

Some observations on the development of Colletotrichum lindemuthianum in artificial cultures.

GEO. F. ATKINSON.

WITH PLATE XXII.

Several times during the summer of 1893 I attempted to obtain a pure culture of the bean anthracnose for the purpose of noting its behavior in artificial media. Dilution cultures were attempted in the ordinary agar-agar peptone broth, from material recently collected but which had dried. None of the spores germinated. Thinking that the nutrient agar might be an unfavorable medium for their growth, cell cultures were started in water to test the vitality of the spores. The spores here likewise failed to germinate for me. This seemed surprising, for related forms of *Gloeosporium* and *Colletotrichum* of quite a number of species have never failed to germinate promptly even after several months drying.

Some of the material from which the attempts were first made was used in the dilutions within three days after picking the fresh pods of the bean, which contained the spores of the fungus in great numbers, and they had not been dry for more than twenty-four hours. Still they failed to germinate for me. Several other attempts were made during the autumn of the same year with like failures.

During February of the following year, 1894, preparations were made for another attempt at obtaining a pure culture of the fungus. Since the fungus is perennial in matured beans which are affected, it was planned to obtain diseased but mature and dry beans, and then grow them in order to obtain in the laboratory freshly developed spores. Accordingly requests were made from several leading seedsmen for badly anthracnosed beans for the purpose of obtaining material for cultures. Some very fine specimens were received of what is known as Wardwell's kidney wax. The beans presented an unsightly appearance, being stained various shades of yellow and fuliginous, some of them also possessing depressed spots where the fungus was more deeply seated. In one specimen which presented nearly one entire side in a badly diseased condition, there were also several pustules which appeared as if spores were present in a dormant condition. This bean was placed in a moist chamber to induce the fresh development of spores. March 7, 1894 (a few days later), the pustules were considerably larger and the material was examined. Fresh spores were present in great numbers and dilution cultures for the separation of the fungus were started on the same day. The room temperature was rather low, and on the following day none of the spores had germinated though some which were seen had swollen to some extent and refringent granules were appearing. Culture number one was then left in a warmer room and on the following day the spores were germinating and their study in this condition was then made. The germ tubes are very large, equalling or even in some cases exceeding the diameter of the spore. The first tubes usually arise near the ends of the spore and are generally directed at a greater or less angle from the axial line of the spore. The refringent granules are quite numerous and large so that the protoplasm presents a very coarsely granular appearance. In the homogeneous protoplasm vacuoles also soon appear but they are at first quite indistinct. The threads for a short distance from the spore describe a sinuous course and branch in an irregularly monopodial fashion, at the same time other threads arise from the spore so that a small radiating colony is soon developed. Quite soon however on the margin of the small colony the threads frequently present a dichotomous appearance. This in some cases is brought about by a perfect dichotomy of the thread but very frequently and perhaps in a majority of cases there arises a branch just behind the growing end of the thread which very soon overtakes the primary thread, and the influence of its origin so close to the end of the thread causes the growing end of the same to be diverted so that the appearance of dichotomy is the result. On the very young colony only a few of the threads on the margin present this appearance, but soon all of the threads partake in this dichotomous branching and very frequently it occurs successively in rapid sequence on the same thread, so that a plumose or brush shaped tuft is produced. The various branches of this tuft lie nearly parallel and quite close together. At this time and indeed very soon after germination the vacuoles in the protoplasm become quite large and prominent. Also at the ends on the plumose branches very short lateral branches now arise, several on one side, and the end of the thread is frequently curved to the same side. Upon these short branches are developed the dark bodies which appear in certain of the anthracnoses sometimes called secondary spores.

On March 10th from dilution culture no. 2 small colonies of the fungus were transplanted to vetch stems in culture tubes for pure cultures. In two days a very minute growth appeared at the points of the transplantings as fine radiating white threads. In a few days more the spots of the central point of growth became black by the darkening of the threads while the advancing margin of the weft continued white. On the 14th spores were found to be developing in considerable numbers. By the 16th areas varying from 1 to 2^{cm} in length on the stems were occupied by the very black and thin stroma of the fungus. Except where the threads had reached the liquid in the bottom of the culture tube there was no considerable development of white fungus threads. In the liquid however quite a profuse growth took place. From the surface of the dark stroma in some cases a scanty growth of whitish threads arose for a few millimeters from the surface. The dark stroma itself was roughened by the development of irregular tuberculate prominences.

April 20th pure dilution cultures were started to obtain the spores in different stages for the study of germination and the following development stages, more especially that these might be recorded in photomicrographs while the organisms were *in situ*.

The dilutions were made in Petri dishes. On the following day, the 21st, the cultures were examined and no spores were found germinating, though they were present in numbers and there was no difficulty experienced in finding them in the cultures.

The cultures were examined again on the 22nd, and while the spores did not appear as if they were dead there were none germinating. On the 23d a few of the spores were found to be germinating.

On the 24th at 5 P. M. additional cultures were made in Van Tieghem cells in the following way. The cells were prepared and the cover glasses sterilized by passing several times through the flame and then placed under a bell jar to protect them from gravitating germs while the culture material was being placed on them. In order to have a large number of spores in a small space about one-half cc. of liquid agar was prepared in culture tubes and these inoculated by transplanting a considerable quantity of the mycelium and attached spores from the culture on vetch stems. This would probably assure a large number of spores in the liquid. With a looped sterilized platinum needle a small quantity of the inoculated liquid was lifted from the tube and allowed to spread upon the center of the cover glass, only one transfer being made, and the liquid thus was held in a thin layer until solidification took place. Many of the spores were thus in close contact with the glass, and in germination would be nearly in the same plane.

During the afternoon of the following day the spores began germinating in the cell culture and one of the spores with four germ tubes was photographed (fig. 1). This same spore was photographed on the following day, twenty hours later, and is shown in fig. 2. In all cases unless the spore is very short and nearly oval a septum appears at the time of germination, forming two cells, and at the point of the septum the spore becomes constricted even soon after germinating. The cell culture now became contaminated with bacteria and further growth was impossible. Even at the time of photographing no. 2 the bacteria at this place were quite numerous, and the flocculent matter which clouds one portion of a thread and the margins of others is a mass of bacteria (fig. 2).

The cultures in the Petri dishes were now examined again, dilution no. 1 first. A few colonies were visible to the unaided eye as irregular stellate patches. This examination showed that the spores after germination had continued to increase in size for some time so that they became several times larger than when germination first takes place. One of these was photographed with a magnification of about 500 diameters (fig. 4). With this magnification only the central portion of the colony could be shown. The threads radiating from the spore turn in various directions so that it is not possible to bring them all in the same focal plane. The spore was the point which was focussed upon and a few of the threads are in the same focal plane and show the proportionate diameter, the septation and size of the cells. At this time the highly refringent granules which appear at the time of the germination of the spore and are then comparatively small, are now much larger and quite strongly differentiated from the hyaline contents. They are quite numerous in the enlarged spore and are also present to a less degree in the threads.

At the same time it was observed that the very large majority of spores in the same culture, which had failed to germinate at the time the first ones germinated, had continued to increase in size, were once septate, strongly constricted at the point of the septum and were richly charged with large highly refringent granules. It fact but for the germination of the first spores there could not be determined any difference. One of these is shown at fig. 6. The margin was a trifle out of the focal plane so that the wall presents a heavier line than should be the case. In culture dilution no. 1 none of these spores germinated, but in culture dilution no. 2 nearly all of them began germinating on the 25th and on the 26th several of these were photographed to show the different results which follow. Fig. 7 shows one with only the ordinary germ tubes, fig. 8 is developing basidia directly from the spore and bearing several spores, others had but few germ tubes terminated by the oval, dark bodies. It thus seems that these spores which do not readily at first germinate become for a short time places for the storage of reserve material, and later germinate. Whether they would under conditions giving an abundance of room produce colonies like the first ones has not been determined, for in the present culture they were too close together for this result.

In plate culture no. 2 the older and stellate colonies developed a compact stroma at the center which bore numerous spores with a slight roseate or flesh colored tinge. On April 28th four cultures on sterilized bean stems were made of this dilution culture in order to study the behavior of these normally developed spores in comparison with those which were late in germinating and did not develop in this culture many spores. Two of these cultures on bean stems were made by transplanting spores from the normally developed colonies, and two were made by transplanting some of the agar containing the second type of spores which were late in germinating.

May 7th a culture, using numerous spores, was made in a Petri dish during the afternoon. This culture was made by pouring a small quantity of agar containing numerous spores over the surface of previously solidified agar in the plate, thus securing numbers of spores in a thin plane at the surface of the medium. On the following morning eighteen hours after sowing, the culture was examined and many of the spores were found to be germinating, the temperature being quite favorable to quick germination for this species. One group of spores was selected for a photomicrograph (fig. 11), containing three spores with young germ tubes and two spores not yet germinated. One of the spores germinating shows plainly the division of the spore into two cells at the time. Twenty-four hours later considerable growth had taken place. The preceding day when the first photomicrograph was taken, a cover glass was placed over a portion of the culture in order to prevent the moisture from the surface of the agar from condensing on the objective when the strong reflected rays of the sun should be mirrored through the culture during the exposure.

From former experiences it was found that very little growth was made after having once shut out the access of oxygen by placing a cover glass over a number of the spores. In this case the growth was surprising for it was quite considerable, though not so much as that of spores not thus covered. Perhaps this considerable growth compared with the very little or none in other experiences was due to the peculiar way in which this culture was made. A photomicrograph of the growth of one spore was made at this time (forty-two hours after sowing) and is shown in fig. 12. The spore itself at the center of the colony can be seen from its greater diameter than that of any of the threads. It is also quite strongly constricted at the center which is brought about by the rapid enlargement or swelling of the spore. In order to bring certain of the threads into strong focus which it was desired to reproduce with their characteristic features in detail the spore was thrown slightly out of focal plane, and the septum in the spore is not well seen and the vacuoles not distinct. In certain of the threads however the vacuoles and septa are distinctly shown. The peculiar dichotomous branching of the hypha which frequently occurs in this species is shown in two of the threads. A photograph taken three hours later of this same colony is represented in fig. 13. In one of the dichotomous divisions one fork has considerably outgrown the other. The growth of the spores which were not covered by the cover glass was by this time considerably in advance of that of the ones used to illustrate these features. In this culture as well as in those previously studied, many of the spores did not germinate at first, but manifested their activity by absorbing nutrient material and assimilating it from the medium, thus increasing in size and in the richness of the granules. This is also accompanied by the formation of the cross wall making two cells in most cases and also in a greater or lesser constriction of the spore at the middle. These spores begin to germinate at varying intervals so that the process of germination is going on for several days or even for a week. Forty-eight hours after sowing the spores, two of them having recently germinated were photographed (fig. 14). One spore possesses two very short germ tubes, one at each end; the other spore which was slightly out of the focal plane has not only a germ tube from each end but some from the side as well, and all but one of the threads are quite long and flexuous. Sixty-six hours after sowing two other spores were photographed (fig. 15). Here the spores are of considerable size, a result of the continuous swelling, and the septum at the strongly constricted central portion can easily be seen.

Cornell University.

Explanation of Plate XXII.

Figures 1 to 15 are photomicrographs of the living organism in the nutrient agar where it was growing. The objects were therefore unstained.

In figures 16 and 17 are represented, natural size, the form of the mature colonies of two plate cultures.

On the validity of some fossil species of Liriodendron.

THEO. HOLM.

WITH PLATE XXIII.

The making of species of fossil plants has been increasing rapidly during the last few years, and many new species have been recorded from this country. It seems, however, when we study the various articles that have been published upon the subject, as though there were a rivalry to see who could establish the largest possible number of species. Whether or not this is true, American paleobotanists are certainly going too far in giving incomplete and insignificant leaf-fragments specific names. Any botanist who studies our existing flora can not avoid observing the great variation that exists in the foliage of our trees and herbs; and must admit that it would be very difficult to refer all these leaf-forms to their respective species if they had been detached from their branches. Another fact that makes the study of paleobotany still more difficult is the usual absence of flowers and fruits. The identification of even the most completely preserved leaf must, therefore, be more or less uncertain, and when we consider fragments of such leaves, which do not show anything but a few veins and no very pronounced outline, we can only say that the identification becomes a mere guess, not only wholly worthless for scientific purposes, but often very misleading.

A careful study of the recent flora is, therefore, absolutely necessary, when it is desired to identify fossil leaves with even an approximate degree of correctness. The plant must be studied as it stands amidst the surroundings to which it has adapted itself, and which its leaves reflect, as we have learned from the excellent illustrations by Sachs[1], Wiesner[2], and Stahl[3].

But it would really seem as if our paleobotanists ignore these facts, and consider their fossil leaves only as dead matter

[1] Sachs, Julius: Die Anisotropie der Pflanzenorgane. Vorlesungen über Pflanzen-Physiologie 855. 1882.

[2] Wiesner, Jul.: Untersuchungen über den Einfluss der Lage auf die Gestalt der Pflanzenorgane. Sitzungsber. d. kais. Akad. d. Wiss., math.-naturw. Classe **101**: 657–705. 1892.

[3] Stahl, E.: Regenfall und Blattgestalt, ein Beitrag zur Pflanzenbiologie. Ann. du Jardin Botan. de Buitenzorg **11**: 98–182. 1893.

HOLM on LIRIODENDRON.

without signs of ever having lived. Some peculiar species have been made in this way, and it is our intention to give a few illustrations of supposed relationships existing between some fossil forms and the living species of our tulip-tree.

One of the most striking characters of the Liriodendron leaf is of course the notched apex in connection with the broad, more or less deeply lobed blade. We have already shown[4] that leaves of seedlings and those at the base and apex of branches of mature trees are often oblong or obcordate without any lobation, and yet they still possess the characteristic notch at the apex. This last form, the approximately obcordate, reminds one very much of the leaflets of certain Leguminosæ, and such leaves, when found in a fossil state, are generally referred to *Leguminosites* or to *Liriodendron.* With very few exceptions we believe that such forms do not belong to Liriodendron, at least if we compare the illustrations given of the fossils with the leaves of our recent species. Mr. Arthur Hollick in a recent paper[5] figures and describes several oblong leaves with notched apices as representing *Liriodendron simplex* Newb. Some of these leaves are very well preserved and show the outline and venation very distinctly, so distinctly in fact, that it may easily be seen that they are very different from leaves of Liriodendron as we understand the genus from the living species. We have copied one of Mr. Hollick's figures on the accompanying plate XXIII, fig. 3, and we have added two forms of similar small leaves of our living species for comparison (figs. 1 and 2.). Considering the mere outline of the leaves here brought together, we notice at once the disproportionate length of the fossil species, and the open sinus or notch at the apex of the recent form in connection with its long and slender petiole. It is not known whether the fossil leaves had any petiole; they appear rather to have been nearly sessile. The venation also is different, the living showing but few secondary veins, the fossil on the contrary numerous ones which together with the tertiary veins form a reticulate venation. So far therefore these fossil leaves show no evidence whatever of any relationship to the genus Liriodendron.

[4]Holm, Theodor: Notes on the leaves of Liriodendron. Proceedings U. S. National Museum **13:** 15–35. *pl. 4–9.* 1890.

[5]Hollick, Arthur: Preliminary contribution to our knowledge of the Cretaceous formation on Long Island and eastward. Transact. New York Acad. Sci. **12:** 222–237. *pl. 5–7.* 1893.

We have stated above that such unlobed, notched leaves in many cases remind us of the leaflets of several Leguminosæ, and if we compare Mr. Hollick's figure 2 on his plate V (l. c.) where three leaves of the same size, shape and venation as our fig. 3, which is one of them, are figured, might we then not assume that they have been situated close together as they were found in the rock? They seem indeed to have formed a *trifoliate leaf*, not unlike Desmodium, Phaseolus, and others. Their venation is much more like that of the Leguminosæ than of any known Liriodendron. Moreover we must not forget that notched leaves are not only common among the Leguminosæ, but exist in many genera of various families, e. g., Zygophyllum, Passiflora, Akebia, etc., which might also be taken into consideration.

We see from this comparison that it is very unsafe to refer such leaves to Liriodendron, when such essential points as the petiole and the venation are imperfect or wanting. It is furthermore difficult to understand how Mr. Hollick could find any probable relationship between the small fragments figured on his plate 179[6], and the genus Liriodendron. These fragments might just as well have been referred to genera of entirely different families and if not, we do not see why his leaf of Colutea (l. c.) figured on our plate as no. 5, has not been identified as a Liriodendron or Liriophyllum, in accordance with the other species mentioned above.

There is now another point to which we should like to call attention, viz., what Mr. Hollick calls the wing-like appendages on the petioles of *Liriodendron "alatum."*[7] It seems to be taken for granted that this fossil form is also a representative of our tulip tree. Mr. Hollick's drawings are so large that we have only had space enough to figure one of these fragments, fig. 4, on our plate XXIII. He figures one nearly complete leaf with a wide notch at the apex and a winged petiole. Also the base of a blade with a similarly winged petiole (figured on our plate) and finally the upper part of a blade with a very narrow notch, unlike that of a typical leaf of Liriodendron. The winged petiole appears to have been no obstruction to Mr. Hollick's identification, the notched

[6] Hollick, Arthur: Additions to the paleobotany of the Cretaceous formation on Long Island. Bull. Torrey Bot. Club **21**: 49–65. *pl. 174–180*. 1894.

[7] Hollick, Arthur: Wing-like appendages on the petioles of *Liriophyllum populoides* Lesq., and *Liriodendron alatum* Newb., with description of the latter. Bull. Torrey Bot. Club **21**: 467–471. *pl. 220–221*. 1894.

apex eliminating all doubt of kinship in spite of the fact that the venation does not agree with that of our type. This species, *L. alatum*, was described by Dr. Newberry, but not published. Mr. Hollick in accepting the identification considers it from the point of view of a modern evolutionist. He sees nothing wrong in attributing adnate stipules to this genus; on the contrary he claims it to be a leaf-form "exceedingly interesting and significant." Taking "the standpoint of the evolutionist" he compares the leaf with *Platanus basilobata*, figured and named by Professor Lester F. Ward.[8]

The fact that Liriodendron and Platanus are genera with entirely different biological peculiarities is overlooked. Mr. Hollick even goes so far as to state that "it is reasonable to attribute similar origin to the conspicuous but fugacious stipules on the young saplings and shoots of Liriodendron." It would appear that Mr. Hollick does not know that the stipules are free in all the leaves of our tulip-tree, not only on the saplings but on all the branches from seedlings to mature trees. And this view, says Mr. Hollick, is "of course greatly strengthened by the discovery of the fossil species now under consideration." Professor Ward has figured some leaf-fragments of a supposed Platanus, and he compares these with our recent species, *P. occidentalis*, in which a basal lobation of the blade may sometimes be observed. But we have no proof whatever that these fragments of *Platanus basilobata* really belonged to any true Platanus, and Nathorst,[9] one of the ablest of European paleobotanists, considers their identification as incorrect. The French botanist Godron[10] and later Sir John Lubbock[11] have described the stipules of Liriodendron and explained how the leaf becomes notched. Godron figures the shape of the leaf while still enclosed in the bud, the bud scales being the stipules themselves. The entire leaf bends over when it is in bud, and the notch is the result of the fact that the apex of the blade rests in a furrow formed by the axis and one of the stipules.

Any one who has studied vernation in its various forms will

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[8] Ward, Lester F.: The paleontologic history of the genus *Platanus*. Proceed. U. S. National Museum **11:** 39–42. *pl. 17–22.* 1888.

[9] Nathorst, A. G.: Review of "Types of the Laramie Flora by Lester F. Ward." Neues Jahrbuch für Mineralogie **2:** 219–222. 1893.

[10] Godron, A.: Observations sur les bourgeons et sur les feuilles du Liriodendron Tulipifera. Bull. de la Soc. Bot. de France **8:** —. 1861.

[11] Lubbock, Sir John: Phytobiological observations. Journ. Linn. Soc. **22** and **24:** —. 1887.

appreciate the fact that the Liriodendron leaf could not possibly assume the position it does in the bud if the stipules were not free. If we now consider Mr. Hollick's figure of *L. alatum*, it is easily understood that this leaf could not show such vernation as our tulip-tree. The winged petiole would not allow any considerable curvature and the leaf-blade would meet no obstacle to the development of its apex. The notch of this leaf, *L. alatum*, if it is natural and not due to accidental injury or defective preservation, must depend on entirely different causes. It may be for the same reason that so many leaves have a more or less emarginate apex. Why this is we can not explain. One thing is evident, however, that Mr. Hollick's explanation is altogether too superficial to convince one that the ancestors of the tulip-tree had adnate stipules. If we consider his leaves as belonging to Liriodendron, we must suppose the apex to have been acute, that the notch was not natural to the leaf, and finally that the venation was entirely different from our recent type. We must express the same opinion as to Mr. Hollick's comparison of *Liriodendron alatum* with *Liriophyllum populoides*, viz.: that they were closely related on account of their adnate stipules and notched apex. It may be so, but to say the least the chances are quite as strong the other way, and in all probability none of these leaves have ever had anything to do with ancestral forms of Liriodendron.

Washington, D. C.

Explanation of Plate XXIII.

Figs. 1 and 2. Leaves of *Liriodendron Tulipifera* drawn from nature, natural size. — Fig. 3. *Liriodendron simplex* Newb. (copied).— Fig. 4. *Liriodendron alatum* Newb. (copied).—Fig. 5. *Colutea primordialis* Heer (copied).

The nomenclature question.

Botanical nomenclature and non-systematists.

In the discussions on nomenclature, an important phase which receives scant consideration is the attitude of the non-systematists towards it. This is natural enough in this country since nearly all American botanists are systematists, a condition which is due of course to the influence of Dr. Gray. Although he left few or, as some would say, no pupils, he nevertheless, by his pre-eminence and authority at home and abroad, by his attractive personality, and by his splendid works, set systematic botany as the ideal to the students of this country. No teacher or investigator of any thing like equal prominence has arisen among us in any other department of botany, the morphology of cryptogams alone excepted, so that his influence in this particular has hardly yet been weakened.

But the day of systematic botany of the old fashioned based-upon-anatomy sort is passing away. It is exhausting its own field; the law of diminishing return applies to it; and most important of all, the science is outgrowing it. A few of our younger systematists are interested equally in biology; young men, influenced it is true from Europe, are arising among us ambitious to become biologists in the same true sense as zoologists are; and they will change the complexion of botanical work for the next generation.

Now what will be the attitude of the biologists, of the new systematists, of the interested public, in nomenclature? In other words, upon what principle will future users of plant names use them? Now for my own part from what I know of human nature, and from what I have seen and heard among those to whom what a living plant is and does is of more interest than what it resembles or what is said about it in books, I am convinced that the future users of plant names utterly regardless of systems will use them exactly on the same principle as they use other names, simply as conveniences. What then makes a name convenient? Undoubtedly its first quality is ready intelligibility, which depends upon its use by the most people, and as Dr. Robinson has said, this is more important than stability or consistency. This is simply the law which governs the persistence of all other names. By what divine or other right is botanical different from other language? We must admit that in the long run, where there is no personal or philological reason for keeping to a special system, the principles controlling the use of other names will control the use of botanical names also. But all other names, those of things, places, people, battles, institutions, are, except to philologists, mere symbols or handles. Nobody except the philologists ever trouble to enquire whether they are appropriate, or historically correct or give due honor to their first users or fit a system of orthography or grammar. There are principles governing their giving and use, it is true, but these are never statutory, they are unwritten, unconscious, psychological. Nearly all attempts to legislate on names fail, as witness efforts at orthographical reform of English, of grammarians to control certain features of language, of rulers to replace native names of rivers, etc., by introduced ones. Regulations unaccompanied by a power to enforce them, always fail. In language, names however given, after they have once come into use, are upon the principle of least resistance, used still more because they are the most intelligible. Men use those most convenient at the moment without regard to reasons. Botanical names differ from others only in that they are given with more deliberation and some attempt at system; I am unable to see any principle in their use which will in the long run make them different from other names. I believe, therefore, that all efforts to reform nomenclature which involve changes of well known and well established names, will ultimately fail, for the very good reason that the make-up of men's minds is against the success of such changes.

Another feature of language which the reformers forget is the immense value of authority upon hero-worshiping mankind. It is in all language the use of words by great men which makes these words good form; considerations of consistency and stability are as nothing in comparison. This is very illogical and inconsiderate of humanity, but it is true. The personal nomenclature system of Dr. Gray is to most people made as authoritative by his very use of it, as is the use of English words by a recognized master of English. And why not? Who is better competent to judge of what constitutes a good name? The only man who can attempt with any hope of success to reform Dr. Gray's nomenclature is one who is greater than he and can overcome the weight of his authority by a yet greater, and none such has yet attempted it. If the American botanists would but recognize this principle, and get over their soreness on the point of Dr. Gray's personal system, there would soon be sufficient stability in nomenclature.

In other affairs of life a reform to have hope of success must proceed by building upon whatever already exists that is fixed and good. A reformer who wishes to reform by upsetting everything, good and bad, and beginning all over again upon a plan of his own, is called an anarchist, and the sentiment of the community is against him. A system of reform of nomenclature which would abandon the most fixed names if they do not fit its rules, savors of this spirit. We are told, however, that the proposed system has been tried by other sciences and is a success. But I am inclined to suspect either that the blessed peace which we are assured broods over the camp of the ornithologists, ichthyologists, herpetologists, *et al.*, is not so perfect as it seems, or else that the conditions there are somewhat different from ours.

The solution of the difficulty seems to me to lie primarily in treating nomenclature on the known principles of persistence of language as far as these go, accepting what is fixed as final, endeavoring to settle doubtful cases by following the best usage, and by trying through congresses, etc., to frame uniform rules for the future. This would give us a system which, if not consistent or at first stable, would be convenient and certain to be successful.

The real trouble, I believe, lies in the virtual exhaustion of the field of North American botany. The plants have been nearly all described and well described, so there is nothing left to do except to describe them over again in new ways, or under new titles. If one will persist in threshing over and over old straw, and finds only an occasional kernel of grain as a reward, it is not unnatural that he should find amusement and even see importance in piling the heaps of straw in new and striking patterns. The subject seems to share with millstones and the human heart the necessity for grinding itself when it has nothing else to grind. Systematic botany is too conservative in its methods, especially among us. It refuses to use new lines of research offered by embryology and comparative morphology, and except in the accumulation of more material and some refinement in details it is hardly less but rather more of a book and skeleton study than it was fifty years ago, or even to Linnaeus himself. The earnest worker in other fields, and indeed present popular opinion can hardly be blamed for considering a good deal of it, and especially wrangling over nomenclature, as of a very amateurish sort, employing the faculties of the postage stamp collector rather than those of the naturalist.

To sum up: I do not believe in and do not teach the nomenclature of the Madison Congress, because I do not believe it can possibly prevail. It violates the psychological principles of the use of language, it is not sanctioned by the leading authority of the systematic world, past nor present, and its advocates give us no guarantee that they can produce works on North American botany of greater authority than those already in existence; it is impossible to secure the cooperation of the foreign botanists; it overturns much that was sufficiently stable, to replace it by a new system which has not the element of stability, since it will not be able to induce future botanists to use it.—W. F. GANONG.

Dr. Robinson and homonyms.

In the preceding number of the GAZETTE Dr. B. L. Robinson has presented another of his fatal objections to the principles of nomenclature adopted by the Botanical Club of the American Association—namely, the principle of the rejection of homonyms as applied to binominals. In support of this objection he cites not a case known to science, but a wholly suppositious one, the occurrence of which is a matter of almost ridiculous improbability. It should be answer enough that this is a purely hypothetical objection, especially if we are to be guided by Dr. Robinson's previous utterance[1] that principles of nomenclature should not be laid on theoretical grounds. There probably will never occur a more glaring case of unscientific "lumping" of genera than that indulged in by Dr. Otto Kuntze when he united Bigelovia, Solidago, and Aplopappus with Aster, and yet even this lamentable piece of patchwork has not produced the chaotic results por-

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[1] Recommendations regarding the nomenclature of systematic botany, p. 1. (May, 1895).

trayed by Dr. Robinson. The Botanical Club principles are explicit in this matter of homonyms, and the disposal of real cases, if any occur, presents no uncertainty and no difficulty to one who first reads the rule and then practices accordingly. Before discussing the practical validity of this objection we may at least ask that some actual cases be cited, and that the objection be not based solely on the alleged possibility of a preposterous publication on the part of some irresponsible botanist.

To illustrate the object and working of the rejection of homonyms as applied to binomials the following example will suffice. There is in the western United States a species of rush, closely related to *Juncus nodosus* and by some authors considered only a variety of it, but undoubtedly a good species and first treated as such in the year 1861 under the name *Juncus megacephalus* Wood. Now according to the Botanical Club rules this name is not tenable because Mr. M. A. Curtis as early as 1834 described under the same name, *Juncus megacephalus*, another rush which has been commonly known as *Juncus scirpoides echinatus*. According to Dr. Robinson's ideas, however, the name *Juncus megacephalus* Wood is entirely tenable, since *Juncus megacephalus* of Curtis was long since relegated to synonymy. This disposition appears at first sight to be satisfactory, but we may go a little further. A careful study of the group has shown that the variety *echinatus* is a valid species distinct from *J. scirpoides* and that it must stand under the name *Juncus megacephalus* Curtis. This would necessitate a change also in the name *Juncus megacephalus* Wood, since two species could not have the same name. According to Dr. Robinson, therefore, future critical work on this group, would entail a change not only in the name of the plant under examination but also in that of still another species having no relationship whatever with the first. According to the Association rules the name *Juncus megacephalus* Wood being untenable from the start would at once be changed and could in no way be affected subsequently by critical work on *Juncus scirpoides* and its varieties. The answer to the question which of these practices contributes to stability is evident.

In the last paragraph of his remarks Dr. Robinson introduces a depreciatory allusion to the botanists who attended the Madison meeting of the American Association, both as to their number and their standing. This is a dangerous position, to say the least,—to challenge a public discussion of the relative scientific merits of prominent botanists. Consideration of such a question is in my opinion better left to each botanist for his personal and individual judgment. I must decline, therefore, to accept this tempting invitation, and content myself by giving a list, from memory, of some of the botanists present at the Madison meeting:

J. C. Arthur,	J. M. Coulter,	W. A. Kellerman,
Charles R. Barnes,	Frederick V. Coville,	Conway MacMillan,
Charles E. Bessey,	E. L. Greene,	B. L Robinson,
N. L. Britton,	Byron D. Halsted,	W. T. Swingle,
Mrs. E. G. Britton,	A. S. Hitchcock,	Edwin B. Uline,
Douglas H. Campbell,	Arthur Hollick,	L. M. Underwood.

To these should be added the names of Henry H. Rusby, William Trelease, and Lester F. Ward, who although not present, voiced their approval as members of the nomenclature committee. Other professional botanists, whose names I do not at the moment recall, making the number of at least thirty, were present, besides the amateur botanists who customarily attend the meetings—altogether probably a larger and more broadly representative group of professional botanists than has ever attended a meeting of the American Association.

In his closing sentence Dr. Robinson gives vent to a statement as unfair in its implication as it is unwarranted in its assumption, to the effect that I have sought to decry any adverse criticism of the Association principles. What I did call attention to, and what I wish to point out again more plainly than before is that Dr. Robinson ignored the Association principles as long as possible, declined to discuss them at the times set for their discussion, and then after their final adoption conducted a "confidential" correspondence directed secretly against the reform. I doubt whether any committee could have given to nomenclatural principles more careful, deliberate, and judicial consideration than did the committee which prepared this code, and I repeat that Dr. Robinson's course, to say the least, seems to me wholly unjustifiable, assuming that he is working for the progress of systematic botany.—FREDERICK V. COVILLE.

BRIEFER ARTICLES.

A red-seeded dandelion in New England.—In June, 1892, my attention was called, by Mr. Chas. G. Atkins of East Orland, Maine, to a red-seeded dandelion, which grows abundantly in northwestern Hancock county. Mr. Atkins noted that the red seed were invariably associated with sparse foliage, and deeply cut leaves, and that the outer involucral bracts were not reflexed as in the ordinary Taraxacum. The color of the flowers, too, is a striking character as evidenced by Mr. Atkins's note, "where the two sorts were intermingled in a field I could (at a distance of several rods) detect the red-seeded sort by the brighter yellow of the flowers."

In May, 1894, Mr. N. T. Kidder, and others interested in the Flora of the Boston Metropolitan Parks, found the same form growing about the waterfall on Beaver Brook, at Waverly, Mass., and later the author detected it in some quantity with Cinna pendula, Eatonia Pennsylvanica, and Woodsia Ilvensis, in rocky woods near Pease Pond in Wilton, Maine.

During the present season it has been found in great abundance about Cambridge, Mass. Messrs. Emile F. Williams, Alfred S. Higgins and the author have found it plentiful in dry fields about Winchester, Mass., and in great abundance on the west ledges and cliffs in "Shaker Glen," East Lexington. In "Shaker Glen" the plant is associated with Anemonella thalictroides, Aquilegia Canadensis, Cardamine rhomboidea, Oryzopsis asperifolia, Adiantum pedatum, Cystopteris fragilis, and other species which point to the possibility that the Taraxacum is indigenous. In a recent visit to Kennebunkport, Maine, Mr. Warren H. Manning and the author found the plant everywhere on the ledges, both on the main land and on the islands off Cape Porpoise.

In all these stations no forms have been detected which show any intergradation with Taraxacum officinale, and until such forms may be found it seems desirable to follow DeCandolle, Liebmann and others in considering this a distinct species, rather than to give it varietal rank as has been done by Koch, Hooker, and Karsten. The following description and notes will summarise the points of distinction already suggested.

TARAXACUM ERYTHROSPERMUM Andrz. in Bess. Fl. Podal. cont. Il. n. 1586. (*T. officinale* Weber, var. *glaucescens* Koch). Leaves dull green, glabrous, deeply runcinate-pinnatifid or even pinnately divided, with narrowly triangular or lanceolate segments: scapes glabrous or very sparingly pubescent above, bearing small heads scarcely an inch across: involucral bracts glaucous, the outer lanceolate, 3–5 lines long, horizontally spreading or sub-erect, one or two with a corniculate appendage below the tip; the inner bracts linear, 6–9 lines long, nearly all with a corniculate appendage ½ line or so below the whitish tip: flowers 70–80, sulphur-yellow, the outer ligules conspicuously purplish without: achenes spindle shaped, bright red or reddish brown, the body 1½ lines long, sharply muricate above, gradually contracted to a narrowly-conical apex ¾ line long; the filiform beak barely twice the length of the achene, and with the pappus dirty white: fruiting receptacle rarely more than ¼ inch broad.—In dry or rocky places, Hartford, Maine, 1886 (J. C. Parlin); northwestern Hancock county, Maine, June, 1892 (C. G. Atkins); Waverly, Mass., May, 1894 (N. T. Kidder and others); Wilton, Maine, August, 1894 (M. L. Fernald); Lexington and Winchester, Mass., May, 1895 (E. F. Williams, A. S. Higgins and M. L. Fernald); Kennebunkport, Maine, May, 1895 (W. H. Manning and M. L. Fernald); and Cambridge, Mass.

The species seems well distinguished from *T. officinale*, which has larger and less cut leaves; larger, orange-yellow heads, with many more flowers (the specimens examined show from 170–190 in a head); involucral bracts larger, not glaucous, the outer conspicuously reflexed, and rarely with corniculate appendages; receptacle broader; achenes broader, less tapering above, olive green or greenish brown; the beak two or three times as long as the achene, and the pappus a purer white.—MERRITT LYNDON FERNALD, *Cambridge, Mass.*

Gilbreth Botanical Collection.—One of the most valuable and interesting gifts which have recently been presented to Radcliffe College is that of Mrs. Martha Bunker Gilbreth of Brookline, consisting of the botanical collections made by her daughter, Miss Mary E. Gilbreth, who died not long since. On the occasion of the formal presentation of the gift to the college—an occasion which drew together a large number of instructors, and representatives of the College Club, Idler Club, Home and Field Club, and other societies of which Miss Gilbreth was a member when she was a student in the college—Professor George L. Goodale, who made the presentation address, described the extent and value of Miss Gilbreth's collection and the relation which part of it bears to the great scientific problems of the time, and the light it throws upon them, prefacing his statement with a brief account of her life.

The part of her collection specially referred to by Professor Goodale is that illustrating the dissemination of plants by means of their seeds. . . .

The materials of the collection, which were gathered during the last ten or twelve years of Miss Gilbreth's life, for her own use as a student and teacher, are of three kinds: 1. Pressed specimens for an herbarium; 2. Material preserved in alcohol for microscopic study; 3. Dried specimens of fruits and seeds preserved in boxes to illustrate the dissemination of plants. . . .

The collection to illustrate the dissemination of plants is of special importance and, in fact, is thought to be unique in its design and extent among American botanical collections. The specimens of this collection have been placed in boxes of multiple sizes, arranged in trays of standard herbarium size and have been classified with reference to the agencies of dissemination as devised for: 1. Dissemination by gravitation; 2. Dissemination by water; 3. Dissemination by wind; 4. Dissemination by animals; and 5. Mechanical expulsion. Under each of these heads specimens are classified with reference to the device employed—as edible berry, hooked appendage, wing-like expansion, etc. Under each of these headings the special morphology of the part which serves the purpose is briefly stated, explaining what part of the plant is modified and in what way, to form the wing, hook or whatever the device may be.—Condensed from Boston *Transcript*, May 22, 1895.

Poisoning by shepherd's purse.—A case was reported to me recently by a competent and reliable physician, of severe poisoning of two children by eating the tops of shepherd's purse (*Bursa bursapastoris*). The effects were noticeable within half an hour and were so severe that the physician was called within two hours. He found the patients pale and exhausted; vomiting was frequent, the pulse very rapid and too feeble to be counted, breathing difficult; blood was vomited and one of the patients passed bloody urine.

Calcined magnesia and olive oil were administered, also whisky and digitalis. The symptoms continued severe for fifteen hours. Recovery followed. The children had been strong and healthy, and took nothing apparently that could have produced these symptoms except the shepherd's purse which they ate while going across the field to the place where their father was plowing.

I visited the locality on learning of the case and searched in the vicinity and over the immediate neighborhood for other plants that might have been taken by the children but could find nothing suspicious except very small quantities of Rhus radicans. I think it highly improbable that the children partook of this and besides they aver that they ate only the shepherd's purse.

A very few plants were found affected with albugose but the fungus

(*Albugo candidus*) causing this disease is not, I think, supposed to be poisonous. Even if so, it is doubtful whether the children ate any plant affected with this disease.

Are there cases on record, or known to any one, of poisoning by this plant?—W. A. KELLERMAN, *Columbus, Ohio.*

Viola sagittata Hicksii, var. nov.—Somewhat cespitose, from a thick ligneous rootstock; leaves hirsute pubescent, the earliest cordate, the later deltoid ovate, decurrent on the petiole, obtuse, remotely denticulate and nearly entire; flower nearly as in the type; fruiting peduncles more or less recurved; capsules pubescent; sides heavily marked or pitted.

Collected by Mr. Gilbert H. Hicks, of the U. S. Department of Agriculture, May 26, 1895, on a hillside in Rock Creek Park, D. C. Plants of the normal *V. sagittata* also occur at this locality, but are not plentiful, being outnumbered ten to one by the new variety. No other species grows there in sufficient quantity to warrant the supposition that this is a hybrid; its affinities are altogether with V. sagittata. The distinction lies in the habit of the plant: in the hirsute leaves, which never exhibit any sign of lobation: in the recurved fruiting capsules: and in the seeds, which are conspicuously, instead of obscurely, spotted.

There is a specimen of this variety in the National Herbarium, collected many years ago by Professor Ward, apparently at the same locality, with characters in every way identical with those of the rediscovered specimens. It will be interesting to note whether future observations will indicate a more extended range and the possibility of specific rank for the plant.—CHARLES LOUIS POLLARD, *Washington, D. C.*

An interesting Equisetum.—Through the kindness of Dr. J. M. Coulter, I have received a curious *lusus naturæ* in the form of an Equisetum, presumably *E. hiemale*, collected near Joliet, Illinois, by Miss Jessie E. Davison. A sketch of the plant is appended. It will be seen that in place of the ordinary growth into joints there has been a lateral growth of the stem and sheath so that there has resulted a spiral extension reminding one of the helicoid growth of *Riella helicophylla* as frequently figured (*Cf.* Goebel: Outlines, etc. 145). The plant is evidently distorted in this manner from some injury received early in its growth, but nevertheless forms a remarkable sport.—LUCIEN M. UNDERWOOD, *Greencastle, Ind.*

FIG. 1—ABNORMAL EQUISETUM. (Nat. size.)

CURRENT LITERATURE.

The natural history of plants.[1]

When we recently welcomed the announcement that Kerner's Pflanzenleben was to be translated into English and published by A. & C. Black, we did not even hope that an edition would be prepared for this country. The issue of such an edition by Messrs. Henry Holt & Co. is therefore a most agreeable surprise. The first volume, in two parts, dealing with forms and growth, is now before us, and the second volume is in press.

Professor Oliver has done English speaking botanists a favor in translating this work. But he has done more, for it is hardly necessary to say to botanists that the appearance of Kerner's work in English will do much towards bringing modern botany before the intelligent public. We need more of this kind of teaching that will bring those not professionally interested in botany to some realization of its scope and great interest. The fascinating style of the author, and his freedom from pedantry in the use of terms, have been admirably retained by the translator. In fact, nothing in the style reveals that the book is a translation, which can be said of very few of the scientific books that have come to us from Germany.

This lucidity, and the excellent illustrations, not only will introduce the non-botanical reader to the science of botany, but should serve as a lesson to the professional botanist in the art of presentation. As a source of material and illustration for lectures no book has been the equal of Kerner's Pflanzenleben; and its usefulness will be multiplied many fold now that students and amateurs can be referred to it.

The general subjects treated are: the living principle in plants; absorption of nutriment; conduction of food; formation of organic matter from the absorbed inorganic food; metabolism and transport of materials; growth and construction of plants; plant-forms as completed structures.

It will be seen that physiology and ecology are the dominant thoughts, and the latter is far too much neglected in these days of morphology and physiology. But the subjects listed do not do justice to the inter-

[1] KERNER, ANTON, von MARILAUN. The natural history of plants, their forms, growth, reproduction, and distribution. Translated from the German by F. W. Oliver, with the assistance of Marian Busk and Mary F. Ewart. Half-volumes I and II. Large 8vo. pp. 777, figs. 188, colored plates 8. New York: Henry Holt & Co. 1895. $7.50.

esting discussion and the lucid style. For instance, under "the living principle in plants," in addition to the ordinary treatment of protoplasm such a chapter as "communication of protoplasts with one another and with the outer world" gives new zest to the subject; and under "absorption of nutriment" the subjects of parasitism and symbiosis are discussed. More than all is to be commended that summary view of plants which considers them in relation to their environment, as organisms showing a resultant structure. It is time to suggest that the laboratory student should also become a student of nature, and that the purpose of our analysis is not fulfilled until it leads to synthesis.

A good word also needs to be said for the excellence of the volumes from the book-maker's point of view. When we say that the quality of the original edition is really surpassed we say what can rarely be said of such works. Typography, printing, colored plates, and binding leave nothing to be desired—except a lower price.

A new hand book of systematic botany.

The wonderful botanical activity of the last decade is bearing fruit in a sudden gush of text-books, and in no department are they more numerous than in taxonomy. Research has been so multiplied that results can be applied to the general subject, and schemes of classification are appearing with bewildering frequency. It is well to have Dr. Warming's book[1] introduced among English texts, for the Danish original and Knoblauch's German edition have long been recognized as important contributions to systematic botany. Professor Potter has given us much more than a faithful translation, for he has called in the aid of specialists in the revision of certain parts. He has also done excellent service in presenting in an appendix a comparative view of the different prominent schemes of classification. Aside from the fact that the matter is as fresh as the nature of the subject permits, certain peculiarities of presentation characterize the book. Five grand divisions are recognized, phanerogams being broken up into gymnosperms and angiosperms; a view which certainly commends itself in so far as it emphasizes the fact that gymnosperms are no more related to angiosperms than to pteridophytes. Perhaps, however, the group archegoniates is a better expression of the real relationships. The thallophytes are presented in three groups, the myxomycetes sharing rank with algæ and fungi. The classification of the fungi is by Dr.

[1] Warming, Dr. E. A hand book of systematic botany; translated and edited by M. C. Potter. 8vo. pp. 620, illustrated. New York: Macmillan & Co., 1895. $3.75.

Knoblauch, following the most recent researches of Brefeld. Among the angiosperms the sequence of orders is based upon opinions as to morphological simplicity and complexity. For instance, epigyny and perigyny are less simple than hypogyny; zygomorphy is younger than actinomorphy; forms with united leaves indicate younger types than those with free leaves; acyclic flowers are older than cyclic; and so on. Such a sequence is largely like many that precede it, differing only in minor details. In our opinion the most useful chapter of the book is that entitled "the transition from the cryptogams to the phanerogams," not that its facts are new, but because it is a compact presentation of what is often scattered. This particular "transition" may be no more important than several others, but the "gap" at that point has such a wide reputation that it is worth while to make a special effort to fill it. The Warming-Potter book is a very welcome one to American botanists.

Elements of botany.[1]

This little book is one of the series of Cambridge Natural Science Manuals, and is quite a commentary on the status of botany at that ancient university. It is rather startling to us that our trans-atlantic friends are compelled to put such primers in the hands of university students. It is too meager even for our secondary schools. We have been cursed with "fourteen weeks of botany," but fourteen days of botany is something appalling. Taking for granted that English botanists are not to blame for this state of affairs, but rather the mediaeval spirit of the universities, it becomes a matter of interest to see how our unfortunate brethren have accomplished this marvel of condensation. We believe that Mr. Darwin has done all that could be expected in the time at his command. How much better this is than nothing is another matter. He presents morphology, physiology, classification, anatomy, does not neglect the cryptogams, and does what is styled "practical work." The subjects of the fourteen practical exercises suggest the general range of the accompanying lectures. They are (1) the cell, (2) the seed and seedling, tubers, bulbs, (3) the root, (4) the herbaceous stem, (5) the arboreal stem, (6) phloem and cork, (7) the leaf, (8) reproduction, (9) the fern, (10) the reproduction of the fern, (11) the flower, (12) the flower, dichogamy, (13) the seed, (14) the fruit. Several examples are used under each study, so that a comparative view may be had. Well as the work has been done, our one thought is that of pity that it had to be done.

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[1] Darwin, Francis; The elements of botany. Small 8vo. pp. 235; figs. 94. Cambridge (England) University Press. New York: Macmillan & Co. 1895.

Minor Notices.

A MOST COMMENDABLE undertaking has been begun by Mr. C. G. Lloyd of Cincinnati, Ohio. He is photographing the larger fungi, natural size, upon plates 6 by 8 inches. These are distributed to friends, and so great an acquisition are they that any one interested in fungi will consider himself exceedingly fortunate to be counted upon the list of recipients. The first distribution consisted of the three species: Morchella conica, Peziza badia, and Lycoperdon separans. The selection of specimens is excellent, and the photographic work is beyond all criticism. This distribution was so warmly received that Mr. Lloyd decided to change his original plan and use the photogravure process of reproduction. The second distribution, just made, includes Gyromitra brunnea and Polyporus squamosus. These are not so clear and striking as the photographic prints of the first distribution, but are still very handsome plates. Mr. Lloyd proposes to reissue the first three numbers by the photogravure process, provide descriptive text, and thus enable those who choose to bind the series in a uniform volume. Mr. A. P. Morgan is sponsor for the accuracy of the determinations. Although the issue is at present a complimentary distribution, the work is of so much value that we trust Mr. Lloyd will place some copies on sale for the benefit of the less fortunate part of the botanical public.

THE *Pflanzenphysiologische Versuche* of Oels, which was translated by D. T. MacDougal last year,[1] has been recast, and now appears from the publishing house of Henry Holt & Co. as a new work.[2] The book has been made more convenient and more satisfactory for general use than its predecessor, by a better arrangement of the subject matter, a clearer separation into chapters and paragraphs and the addition of titles to both paragraphs and experiments. Some substitutions and changes have been made in the illustrations, and also in minor features. The work as it now stands well meets the needs of high schools and colleges for a laboratory manual for elementary classes in vegetable physiology. It is, however, essentially the same work as Oels', and it seems to us that the compiler has scarcely given his chief source due credit by the scant acknowledgment in the preface that "the general form of Oels' manual has been retained . . . and a few paragraphs of the text have been repeated here without indication of their origin." Scientific men cannot be too scrupulous in this matter.

[1] See review in this journal **19**: 341.

[2] MACDOUGAL, D. T.—Experimental plant physiology. 8vo. pp. vi+88, illust. New York, Henry Holt & Co. 1895.

THE FACT THAT the first edition of "*The horticulturist's rule-book*"[1] was issued late in 1889, and that a third edition is now called for, is sufficient evidence that the book is appreciated by those for whom it is chiefly intended, viz., fruit growers, market gardeners, and florists. Yet there is information, compact and well-arranged, not only for them, but much that will be useful to any person who has a garden of any sort, or even a lawn to look after. In short, it is one of those handy reference books that ought to be found in every library. The name of the author—a guarantee of its reliability—the dainty and appropriate dress given it by its publishers, and the low price commend it at once to the intellect, the eye, and the pocket.

MANY STUDENTS of plants must also be entomologists enough to recognize insects at least in a general way. Flowers and insects are so closely related that insect manuals as well as phanerogam manuals must find a place upon the botanist's shelves. Professor Comstock has just published a work[2] which botanists should have. It is handsomely printed, profusely illustrated. and still so cheap that it should find ready sale. Numerous analytical keys direct the student to the larger groups, and the abundant figures still further simplify his determinations. We are also glad to note an attempt on uniform terminology based upon the study of homologies.

A WEED BULLETIN by L. H. Dewey has been issued by the U. S. Department of Agriculture as one of the Farmers' series (No. 28). It describes, with aid of cuts, ten of the weeds which have received most notice during the year, excluding the Russian thistle. These are Lactuca Scariola, Plantago aristata, Solanum Carolinense, S. rostratum, Amaranthus spinosus, Xanthium spinosum, Chondrilla juncea, Daucus Carota, Avena fatua, and Camelina sativa. Much practical information is given. Characteristics of one hundred weeds are briefly stated in form of a table.

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[1] BAILEY, L. H.—The horticulturist's rule-book, a compendium of useful information for fruit-growers, truck-gardeners, florists, and others. 3d ed., revised and extended. Small 8vo. pp. X + 302. New York: Macmillan & Co., 1895. 75 cents.

[2] COMSTOCK, JOHN HENRY AND ANNA BOTSFORD: A manual for the study of insects. Comstock Pub. Co., Ithaca, N. Y. 1895. 8vo. pp. 700, illustr., *net* $ 3.00.

OPEN LETTERS.

Identification of fossil leaves.

After reading the article "On the validity of some fossil species of Liriodendron," which I was kindly permitted to see in manuscript, I at first concluded that the personal nature of the contribution would render it impossible of comment by me. I have never yet entered into a personal controversy and do not care to begin now.

The author, has, however, given evidence of such remarkable failure to understand or appreciate the principles upon which paleobotany is founded that I shall say a few words on behalf of paleobotanists in general.

In the first place the mission of the paleobotanist is to describe and depict the fragments of vegetation with which he has to deal, in order that these fragments—a leaf, a fruit, a seed, a portion of a stem, etc.—may be recognized in the event of a similar fragment being found elsewhere at any future time. The naming of the fragment is an incident only, but it is a purely gratuitous assumption that earnest and conscientious thought and investigation are not given to this part of the work. The fragments are constantly coming to light, clamoring for recognition, and they cannot be ignored. It would be worse than folly to wait until perfect material should be found, before describing, merely because the exact affinities of a fossil fragment with our living flora could not be satisfactorily determined.

I am criticised for accepting the opinion of competent authorities in regard to the affinities of certain emarginate leaves from the cretaceous formation, with our living genus *Liriodendron*. While I am quite satisfied that the facts adduced warranted the inferences regarding this and other affinities, I am free to add that new material, recently collected on Long Island and Martha's Vineyard, will demonstrate the relationship even more clearly and, when described and published, will render any reference or reply to the foregoing paper unnecessary.

One other matter of principle needs to be touched upon. The possible relationship of the above mentioned leaves with the Leguminosæ is well taken, but this idea did not originate with the author. Unless however such relationship can be absolutely demonstrated, and the leaves referred without question to some living or extinct genus, a mere multiplication of synonymy would be inexcusable. So I shall continue to call the leaf found on Eaton's Neck, Long Island, *Colutea primordialis* Heer, not necessarily because I believe it to be placed in its correct genus or order, according to modern systematic botany, but because it is clearly the same species as the leaf described by Heer under that name from Greenland.—ARTHUR HOLLICK, *Columbia College, New York.*

NOTES AND NEWS.

Julien Deby, well known for his study of diatoms, died recently in London after a long illness.

Dr. Emil Knoblauch has become an assistant in the botanical institute of the University of Tübingen.

Mr. E. Fischer refers *Æcidium penicillatum* Müll. (Roestelia penicillata) to *Gymnosporangium tremelloides* A. Br.[1]

A herbarium of five thousand sheets has been presented by Dr. J. P. Lotsy to the Women's College of Baltimore.

Dr. Gunther Ritter Beck von Mannagetta has been called to the a.-o. professorship of systematic botany in the University of Vienna.

Mr. M. B. Waite announces in *Science* that he has discovered a remedy for pear blight. He has been investigating the disease for several years.

The field meeting of the Ohio Academy of Sciences was held at Sandusky, July 2nd and 3d, with an attractive series of short excursions to collecting localities in the vicinity.

The sum of $250,000 has been subscribed by citizens of New York city for a botanic garden, and the city is under obligation to contribute $500,000 more. The garden is now assured. It will be located in Bronx Park, and occupy 250 acres.

A new journal, *Allgemeine botanische Zeitschrift*, devoted to systematic botany, appeared with the year, under the editorship of A. Kneucker of Karlsruhe. It costs six marks per year, consists of at least sixteen pages per number, and appears on the 15th of each month.

Mr. Frank H. Lamb of Leland Stanford Jr. University has collected about Mazatlan, Santiago, San Blas and other points in western Mexico during the winter past. The collection has been determined at the Gray herbarium and sets of 200–250 species will be ready for distribution about October first.

Wild parsnips, that is feral plants of Pastinaca sativa, which are popularly supposed to be poisonous, are considered by Prof. L. H. Pammel (Gard. & For. 8: 228) to be quite harmless. He adduces evidence to uphold his opinion, and explains the popular belief by supposing that Cicuta maculata has been mistaken for parsnip.

By order of the Secretary of Agriculture, the work of the Division of Microscopy, in the United States Department of Agriculture, ceased on July 1st. The Division of Chemistry, the Division of Vegetable Physiology and Pathology, and the Office of Fiber Investigations re-

[1] Hedwigia **34**: 1. 1895.

ceived the apparatus, specimens, books, etc., held by the Microscopist. This will be good news to those who have known the inefficiency of this ridiculously illogical division.

THE COLORADO SUMMER SCHOOL of science, philosophy and languages holds its fourth annual session from July 15th to August 16th. The situation of Colorado Springs is famous for its beauty and healthfulness, as it includes some of the most attractive Rocky Mountain scenery. The schedule of instruction embraces many subjects by distinguished educators. Botany is in charge of Professor Charles E. Bessey of the University of Nebraska.

THE Division of Vegetable Physiology and Pathology in the U. S. Department of Agriculture, has had under cultivation the past year something over one thousand varieties of wheat and oats. The grains have been collected from nearly all parts of the world, and have been grown chiefly for the purpose of obtaining information upon their rust-resisting qualities. Numerous crosses have been made, and material and facts obtained which will be used in further work.

THE AMERICAN NATURALIST has seemingly erected a new department, that of "vegetable physiology," under the editorship of Dr. Erwin F. Smith. As the editor takes a considerable part of the space in his initial number to attack the nomenclature movement, which can not be construed as having anything to do with physiology, it is not apparent why the items should not have appeared under the heading of "Botany," the department still edited by Dr. Charles E. Bessey.

A NEW DIRECTORY of botanists is in course of compilation by J. Dörfler, of the I. R. Court Museum and long at the head of the botanical exchange society of Vienna. It is intended to be a complete list of botanists, botanical gardens, institutes, societies and publications, both periodical and official, of all countries. Botanists will confer a favor by sending their full names, addresses and specialties; and directors of gardens or institutes are particularly requested to send lists of all employees whose names ought to appear in such a directory. Mr. Dörfler's address is Wien I, Burgring 7, Austria.

GŒBEL'S sixth contribution, under the title Archegoniatenstudien (Flora 80: 1. 1895), is on the function and formation of elaters. He finds their biological significance to be double; (1) they function, particularly when young, as conductors of nutriment to the sporogenous cells; and, (2) when mature, as distributors of the spores. The latter object (not by any means the subordinate one Leclerc du Sablon suggests it to be), is accomplished in two ways; (1) either by acting as slings, energetically hurling away the spores at the moment of drying, as in the greater number of forms; or (2) by their slight elastic movements loosening up the tangle of spores and elaters so that it may be readily carried away by gentle air currents.

POLYEMBRYONY is not an uncommon phenomenon and arises from various causes. One of the most interesting cases was described a few years ago by Dodel in *Iris Sibirica*, and by Overton in *Lilium Martagon*, who showed that one embryo arose from the egg and another from one of the synergidæ. Now S. Tretjakow announces the formation of one or even three embryos from the antipodal cells of *Allium odorum.* Fertilization is micropylar, and a normal embryo arises from the egg and sometimes another from a synerg. The antipodal embryos are not the result of fertilization, he thinks, but offer an instance of apogamy in the development of prothallial tissue into a sporophyte. (Cf. Ber. d. deutsch. bot. Gesells 13: 13. 1895.)

DR. J. GRUESS has adapted the reaction between diastase, guaiacum, and hydrogen peroxide to the microchemical recognition of diastase. Objects to be tested are to be laid, for a time sufficient to be permeated by it, in a dark brown solution of gum guaiacum in absolute alcohol. The alcohol is then allowed to evaporate and the object brought into a more or less dilute solution of H_2O_2, which colors the precipitated diastase of the cells a beautiful blue. By the use of this test, controlled by others, Grüss claims to have established the theory of Haberlandt which ascribes the secretion of diastase to the aleurone layer of grass seeds. He also finds that diastase is produced by the endosperm and cotyledonary tissues, and refutes the statements of Brown and Morris. (Cf. Ber. d. deutsch bot. Gesells. 13: 1. 1895.)

RECENT STATION BULLETINS comprise one upon local flora, two upon weeds and five upon diseases and their treatment. "The early flora of the Truckee valley" by Fred H. Hillman (Nev. no. 24) is an excellent manual of the spring flowers of the region. "The Russian thistle" is treated by Charles H. Shinn (Cal. no. 107) and by G. P. Clinton (Ill. no. 39), with illustrations. "Treatment of common diseases and insects injurious to fruits and vegetables," presumably by S. A. Beach (N. Y. no. 86) is a concise practical manual with index (56 pages). This station adopts the objectionable method of suppressing the names of those who write its bulletins. "Some special orchard treatment of the apple, pear and quince" by L. F. Kinney (R. I. no. 31); "Spraying of orchards: apples, quinces, plums," by E. G. Lodeman (Cornell no. 86); and "Prevention of potato blight" by H. H. Lamson (N. H. no. 22); all three have in view the use of Bordeaux mixture. "Damping off," by Geo. F. Atkinson (Cornell no. 94), is chiefly devoted to *Artotrogus* (Pythium) *Debaryanus* (Hesse), *A. intermedius* (De Bary), *Completoria complens* Lohde and *Volutella leucotricha* n. sp. (40 pages).

A CIRCULAR has been issued by Dr. Wm. Trelease, director of the Missouri Botanical Garden, calling the attention of botanists to the facilities afforded for research at the garden. In establishing and endowing the garden, its founder, Henry Shaw, desired among other things to provide facilities for advanced research in botany and cognate sciences. For this purpose, additions are being made constantly to the number of species cultivated in the grounds and plant houses, and to the library and herbarium, and, as rapidly as it can be utilized, it is proposed to secure apparatus for work in vegetable physiology, etc., the policy being to secure a good general equipment in all lines of pure and applied botany, and to make this equipment as complete as possible for any special subject on which original work is undertaken by competent students. All the facilities of the garden will be freely placed at the disposal of persons competent to carry on research work of value in botany or horticulture, subject only to such simple restrictions as are necessary to protect the property of the garden from injury or loss. Persons who wish to make use of them are invited to correspond with the director, outlining with as much detail as possible the work they desire to do, and giving timely notice so that provision may be made for the study of special subjects. Those who have not published the results of original work should state their preparation for any investigation they propose to undertake.

TWO MOST IMPORTANT papers on physiological topics have recently been published in the Philosophical Transactions of the Royal Society of London, by Mr. F. Frost Blackman of St. John's College, the senior demonstrator in botany in the University of Cambridge. The first of these[1] describes a new method of investigating the carbonic acid exchanges of plants, by means of a most ingenious combination of respiratory (*resp.* assimilatory) absorption and titration chambers with aspirators and pressure bulbs. The apparatus is in duplicate to allow continuous observations, and while very complicated in connection is very simple to manipulate, requiring only the turning of stop-cocks. The aim is to absorb by baryta water the CO_2 in the air which has been drawn over the plant, to titrate the whole of the baryta water with HCl, using phenol-phthalein as an indicator, and then to empty the absorption tube without ever permitting the access of atmospheric air to the interior of the apparatus or interrupting the observations.

Working with this apparatus, Mr. Blackman reaches in his second paper[2] the following results, which set some matters in a new light, and demand careful consideration:

1. Under normal conditions, practically the sole pathway for CO_2 into or out of the leaf is by the stomata.

2. In young leaves the cuticle seems to be no more permeable to CO_2 than in mature leaves.

3. If the stomata be mechanically blocked an appreciable osmosis of CO_2 may take place through the cuticle provided that the tension of the CO_2 be great enough.

4. The normal amount of CO_2 in the atmosphere is not sufficient to produce any appreciable osmosis into a leaf with its stomata blocked; assimilation therefore cannot continue under these conditions.

5. The experimental optimum of CO_2 for assimilation depends on the structural porosity of the leaf, so that if this be reduced by blocking the stomata even pure CO_2 may not quite effect optimal assimilation.

6. To this, and not to the stomata being inoperative in gaseous exchange (which was Boussingault's view), is due the fact that in concentrated CO_2 a leaf with its stomata open assimilates less than one with the stomata blocked.

7. In bright light a fully green leaf assimilates all the CO_2 that it is forming by respiration, and none escapes from it. Garreau's demonstration to the contrary is only an expression of the imperfection of the conditions under which it was performed.

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[1] l. c. **186 B:** 485–502. 1895.
[2] l. c. **186 B:** 503–562. 1895.

BOTANICAL GAZETTE

AUGUST, 1895.

Synopsis of North American Amaranthaceæ. III.

EDWIN B. ULINE AND WILLIAM L. BRAY.

FRŒLICHIA Moench. Meth. **1:** 50. 1794.

Annual or perennial cinereous-pubescent herbs with opposite leaves and opposite or whorled spikes, flowers subtended by three scarious bracts (the laterals strongly imbricated), the densely woolly calyx tubular, cleft into five scarious lanceolate lobes, two of them becoming prominently winged or toothed below, the remaining three more or less tuberculate or smooth, all indurated in maturity and enclosing the thin indehiscent utricle, the filaments united into a tube bearing the five oblong anthers in the sinuses of the strap-shaped lobes, style capitate or lobed.

The original generic name *Frœlichia* of Moench was restored by Moquin-Tandon in 1849, replacing *Oplotheca* Nutt. (*Hoplotheca* Spreng.), which, though not the only name since assigned to the group was most generally adopted at that time.

Moquin's primary sections HOPLOTHECA and DILOPHA, with stigmas capitate in the one case and penicillately lobed in the other, suggests a distinction so deep-seated as to seem at first more than specific in comparison with the very trivial distinctions of the species coordinated under these respective sections. Such an opinion is expressed in Bentham & Hooker Gen. Pl. **3:** 41. But further study has shown that here, as is so often true of the older botanists, the breaking-up process has been carried too far. For example, Moquin presents five species under the section HOPLOTHECA, though the one set of characters alone which may with any degree of facility be laid hold of in this polymorphous group is, on the one hand, the unfailing presence of prominent, distinct, dorsal teeth on the sepals of the fruiting calyx, designated by Holzinger as the *gracilis* group (Contr. Nat. Herb. **1:** 213), and, on the other, a coalescence of the teeth in such a way as to form a broad wing, leaving only a serrate or crenulate margin to mark their origin. On this basis, then, we venture to act upon Holzinger's suggestion and reduce our five native forms of the section HOPLOTHECA to two species.

The section DILOPHA as we have seen it, though considerably divergent in its stigma character, is in most respects so intimately related to the HOPLOTHECA species as to preserve its specific relation to them. Since its habitat is restricted to tropical South America, we may limit its discussion in this paper to the suggestion that here, as in HOPLOTHECA, further study may likewise result ultimately in reduction of the number of species.

1. F. FLORIDANA (Nutt.) Moq. DC. Prodr. **13²:** 420. 1849.

Oplotheca Floridana Nutt. Gen. Am. **2:** 79. 1818.
O. gracilis Hook. Ic. Pl. sub *pl. 256.* 1837–1854.
F. gracilis Moq. l. c.
O. Texana A. Br. Ann. Sci. Nat. III. **13:** —. 1849.

Stem slender, leafless above, varying in height from a few centimeters to 9^{dm}: leaves very variable in size, linear-lanceolate to ovate acute, mostly attenuate at base: bracts often becoming black in age: fruiting calyx ovate; dorsal crests dissected into distinct rigid irregular teeth.—From Georgia, Florida and the Gulf states throughout Texas, where it is most abundant, westward to Chihuahua, reaching its northern limits in Colorado, Nebraska, Wisconsin and Illinois. It does not appear to be found east of Illinois in the northern states.

While there is one unbroken transition series from certain minute specimens from southwestern Texas of Bigelow's collection, some of which are less than 3^{cm} high, to the leafier taller forms of the original *F. Floridana*, making it impossible to draw definite boundary lines at any point in this ascending scale, it yet appears that the proportion of intermediate forms is small, so that two groups, based almost solely on the size of the plant would seem to present themselves; though in our opinion this is not sufficiently justifiable ground for permitting them to remain separate. Mr. Holzinger arrives at a similar conclusion, but in preserving the name *gracilis* he has overlooked the priority of *Floridana*. See also Torrey in Pac. R. R. Rep. **4:** 131, where the same conclusion is reached. A specimen in the Gray herbarium, cultivated in 1848 from Texas seed, is peculiar in its glabrate habit, with very long narrow leaves, some of which are over 17^{cm} long. It has not the appearance of *F. Floridana*, but its crest characters show very close affinities for this species, in view of which we have tentatively classified it here.

Type in Nat. herb. (?). The uncertainty here lies in the fact that the label on this specimen is not identical with Nuttall's familiar little square labels, and the words "garden specimen" are added, though "Banks of the Altamaha, *Nuttall*," would indicate that the specimen is of no slight importance.

✓F. FLORIDANA DRUMMONDII (Moq.).

F. Drummondii Moq. l. c. 421.

Plant taller and stouter, tawny-sericeous, with larger oblong-elliptical leaves: teeth of the sepal crests unequally united, in this regard passing into the next species.—Southwestern Texas and northern Mexico. Types in herb. Gray (*Berlandier*, 2001) and herb. Columbia College (*Drummond*, 326 ?). The latter was published in Torr. & Gray's Fl. N. Am. as *Oplotheca Floridana*. It is probable that it is one of Drummond's types, though Moquin makes no mention of the collection number.

2. F. INTERRUPTA (L.) Moq. l. c. 421.

Gomphrena interrupta L. Sp. Pl. 2: 224. 1753.
Celosia procumbens Jacq. Misc. 2: 344. 1781.
Gomphrena spicata Lam. Encycl. 1: 120. 1791.
Frœlichia lanata Moench Meth. 1: 50. 1794.
Lophocarpus interrupta Link Diss. Bot. Suerin. 52. 1795.
Oplotheca interrupta Nutt. Gen. Am. 1818.
Ninanga interrupta Raf. Fl. Tellur. 3: 76. 1836.
Frœlichia alata Wats. Proc. Am. Acad. 21: 437. 1886.

Plant variable as in *F. Floridana* and not essentially distinct in habit from it: fruiting calyx ovate; teeth of the crest coalescent into a thin continuous broad wing which is usually erose-denticulate.—Arizona, Chihuahua, Sonora and Lower California, rare. *Palmer* and *Pringle* specimens in herbaria labelled *F. interrupta* prove to be *F. Floridana*. Type unknown.

If the absence of secondary crests which are invariably seen to appear on the mature fruiting calyx in the form of horny tubercles or nascent wings were to be accounted for on any grounds other than immaturity, it would be possible to recognize Watson's *F. alata.* But we have been forced to abandon this as an unreliable character. Hence, it develops that the affinities of Watson's plant are here and not, as he supposed, with *F. tomentosa.*

√F. INTERRUPTA **cordata,** var. nov.

Frœlichia Texana Coult. & Fisher, Bot. Gaz. **17**: 350. 1892.

Fruiting calyx fuscous, broad (broader than long), cordate, with broad crenate wings.—Western Texas. Types in herb. Coulter and J. D. Smith (Pena, *Nealley*, 421, referred to *F. Floridana* Moq. in Contr. Nat. Herb. **1**: 48), and herb. Gray (*Wright*, 591, from western Texas). The name *Texana* is abandoned because of its preemption as a specific name under *Oplotheca* (see synonymy of *F. Floridana*).

GOSSYPIANTHUS Hook. Icon. **2**: 251. 1840.

Procumbent and diffusely branching woolly herbs from a perennial root-stock, with thick, more or less silky-woolly leaves, the radical ones varying from linear-spatulate to obovate-spatulate or ovate-oblong, small axillary heads of perfect flowers, three delicate scarious bracts, five equal acute three-nerved very pilose sepals, five stamens united into a cup at base, short style and emarginate two-lobed stigma.

This genus is frequently confused with *Guilleminia*, which it closely resembles in aspect. It may be distinguished at a glance by the invariable presence of the rosette of radical leaves and the more conspicuously pilose flowers.

1. G. LANUGINOSUS (Poir.) Moq. DC. Prodr. **13**^{2}: 337. 1849.

Paronychia lanuginosus Poir. Encycl. Suppl. 4: 303. 1816?
G. rigidiflorus Hook. l. c. 1840.
G. tenuiflorus Hook. l. c. 1840.

Branching from the short thick root-stock: leaves generally pilose above and silky-canescent beneath, but often both surfaces becoming glabrate; the radical ones numerous in a flat rosette, varying in length from 2 to 7^{cm}, persistent, sub-coriaceous; the cauline ones smaller (4 to 10^{mm} long) spatulate-orbicular, obovate, ovate or lanceolate, opposite: bracts ovate-lanceolate: flowers densely covered with jointed hairs: sepals usually narrowly lanceolate, acuminate, with three prominent green nerves, scarious on the margin: filaments usually dilate: pistil equalling or surpassing the stamens.—Indian Territory, southward throughout central and western Texas, westward to Chihuahua, and reported as extending southward into Mexico (Hemsley Biol. Centr. Am.) and from the West Indies (Moq. l. c.). The only specimen in our possession found west of El Paso, Tex., was collected by Pringle near Chihuahua, Mex. While it may occur in the intervening regions, it is probably quite rare west of Texas. Type unknown.

G. LANUGINOSUS **Sheldoni,** n. var.

Plant more robust throughout: cauline leaves larger: flowers rigid, flat on the ventral side: bracts short orbicular: sepals destitute of chlorophyll, not scarious margined.—Collected in July, 1891, near Cash Creek, Indian Territory, by C. S. Sheldon (no. 170). Types in Nat. herb. and herb. Gray.

In merging *G. rigidiflorus* with *G. tenuiflorus* we have simply confirmed the suggestions of Dr. Watson (Proc. Am. Acad. **18:** 144) and of Dr. Torrey (Bot. Bound. 180). Furthermore, there is no doubt that Moquin's *G. lanuginosus* must also be included here. Hooker f. in Benth. & Hook. Gen. Pl. **3:** 37, 39 referred *Gossypianthus lanuginosus* Moq. to *Guilleminia*, briefly characterizing it by the narrower lobes of its perianth. Even if the transfer were correct, this difference would scarcely be counted of specific importance in a group of so keen susceptibility to variation as is everywhere prevalent in the *Amaranthaceæ.* But a critical study of Moquin's description of *Gossypianthus lanuginosus* discloses the fact that it is quite distinct from *Guilleminia densa* Moq. in the presence of a rosette of radical leaves and of distinctly 3-nerved acute sepals, both of which are characteristic of *Gossypianthus.* It is not probable, moreover, that so critical an observer as Moquin-Tandon should have committed the error of confusing two genera so distinct in floral character. Still more conclusive is the fact that no *Guilleminia* with 3-nerved sepals has been found in any of our larger herbaria, though definite statements are made about its range in Coulter's Botany of Western Texas, and in Hemsley's Biol. Centr. Am. Since the name *Gossypianthus lanuginosus* does not appear in our herbaria, the only reasonable explanation is that the facts of range were taken from the original *Paronychia lanuginosa. Guilleminia lanuginosa* Hook. f., then, so far as it pertains to our own boundary region is fictitious; and the plants in question that have been referred to under the name must be looked for in the herbaria among the material labelled *Gossypianthus rigidiflorus* and *G. tenuiflorus.*

Specific lines had been drawn chiefly on relative length of bracts, relative length of stamens to the pistil, and on slight differences in the shape of the filaments. The first two prove to be dependent upon age of specimen, while the last point seems in most cases to be wholly without foundation.

GUILLEMINIA HBK. Nov. Gen. et Sp. **6:** 40. *pl. 518.* 1823, non Neck. Elem. **2:** 132. 1790.

Habit very similar to *Gossypianthus* with opposite cauline leaves connate at base, the radical ones few, long spatulate, not persistent, dense leafy axillary flower clusters, minute scarious woolly flowers, three oblong delicate bracts, campanulate 5-lobed calyx with obconic tube, five stamens inserted at the mouth of the tube opposite the calyx lobes, short style with emarginately 2-lobed stigma and translucent seed.

The presence of radical leaves in mature specimens is very rare, having been observed only once among fifty specimens. They differ from those of *Gossypianthus* in their delicate texture, and so withering and disappearing before the flowering period.

Necker's *Guilleminia* is a synonym of *Votomita* Aubl. (1775), an ill-defined genus of the *Cornaceæ*. The present acceptance of the law of synonyms would suggest that the name might be justifiably abandoned; and this course would now be taken if the retroactive force of this law were not still an open question. But in view of its continued agitation and the probable final rejection of the "retroactive" principle, we have adopted the more conservative plan of retaining the present name.

1. G. DENSA (Willd.) Moq. DC. Prodr. **13^2:** 338. 1849.

Illecebrum densum Willd. Roem et Schult. Syst. **5**: 517. 1819.
G. illecebroides HBK. l. c. 1823.
G. densa alsinefolia Moq. l. c. 1849.
Achyranthes piloselloides Poit. ex Moq. l. c.

Leaves spatulate to ovate or lanceolate, minute, punctate, mostly bright green and glabrous above, pilose-pubescent below: bracts sub-equal: calyx lobes oblong, obtuse, 1-nerved. —Western Texas, Southern Arizona and New Mexico, extending southward into tropical America. It has been found as far south as Bolivia. Type unknown.

G. DENSA **aggregata,** n. var.

Plant larger with flowers and leaves densely aggregated on the long stout branches. Southern Mexico.

Types: Near Mexico, "Bustamenta y Rocha," in herb. Columbia College; Jalisco, Guadalajara, (*Palmer* 47 in 1886) in herb. J. D. Smith, Columbia College and Nat. herb.

CLADOTHRIX Nutt. ex Moq. DC. Prodr. **13**[2]**:** 359. 1849.

Low herbaceous annuals or suffruticose perennials with opposite small (often very minute) rounded or oblong leaves, which, together with the branches, are more or less encased in a felt-like tomentum of verticillately branched hairs, slightly or deeply imbedding the small scattered axillary perfect flowers, three concave hyaline bracts, five equal, oblong sepals, filaments coalescent at base into a short cup with small staminodia present (or none), large oblong 1-celled anthers and deeply 2-cleft subsessile stigma.

The genus presents very close affinities with *Alternanthera*, section "*simple staminodia*," but when it is considered that the prevailing and typical representatives of the genus are mostly destitute of staminodia, that these staminodia when present are relatively much smaller than those of *Alternanthera*, and that the general plant habit with its stellate tomentum has no equivalent in that section of *Alternanthera*, (*A. stellata* (Wats.) having laciniate staminodia), it at once becomes apparent that the genus *Cladothrix* stands on safe ground apart from *Alternanthera.*

* *Herbaceous, annual, mostly prostrate.*

1. C. LANUGINOSA Nutt. ex Moq. l. c. 1849.

Achyranthes lanuginosa Nutt. Trans. Amer. Phil. Soc. N. S. **5**: 166. 1820.

Alternanthera lanuginosa Torr. in Emory's Rep. 150. 1848. Moq. in DC. Prodr. **13**[2]: 359. 1849.

Very various as to habit and foliage, mostly prostrate, but sometimes ascending, densely or sparingly tomentose (becoming glabrate): branches loosely spreading (or often densely diffuse): leaves round, tapering into a petiole, or minute elliptical when crowded: flowers mostly exposed with the scarious yellow sepals longer than in the other species: stamens either very unequal with no staminodia or equal with very short obtuse lobes between the filaments.—The most widely distributed species of *Cladothrix*, apparently abundant from

Kansas and Arkansas through Texas to Arizona and throughout northern Mexico. Type in herb. Columbia College.

***Mostly suffruticose, perennial, ascending or erect.*

+ *Staminodia (alternating lobes) very short and broad, sometimes slightly emarginate.*

2. C. SUFFRUTICOSA (Torr.) Wats. Bot. Calif. **2**: 43. 1880.
Alternanthera suffruticosa Torr. Bot. Bound. 181. 1859.

This species has a thick shrubby base and specimens show branches of the preceding year among the flowering shoots.—Reported only from western Texas (*Wright* 1757 and 592; *Harvard* 110 in 1883). Wright's specimens are in herb. Gray, Columbia College and Nat. herb.

+ + *Staminodia longer, acute (nearly one-half the length of the filament).*

3. C. OBLONGIFOLIA Wats. Proc. Amer. Acad. **17**: 376. 1882.
C. cryptantha Wats. l. c. **26**: 125. 1891.

Stems procumbent, often 6^{dm} long, suffruticose or shrubby ("sometimes showing several years' growth at the base," Coville: Bot. Death Valley 179), the whole plant covered with a very dense persistent white stellate pubescence: branches short, ascending or erect, much crowded: leaves ovate-oblong or oblanceolate to round spatulate, or sometimes minute, elliptical, densely aggregated: flowers in small axillary clusters, deeply imbedded in tomentum, the reduced upper leaves of the flowering branches often forming a sort of involucre: sepals hyaline, white: staminodia present in the form of acute lobes between the filaments, and scarcely less than half their length.—Confined to south-eastern Arizona and the adjoining regions of California. Types of the Newberry collection in herb. Gray, and Nat. herb.; of Pringle in herb. Gray, Coulter, J. D. Smith, and Nat. herb.; of Parish brothers in the same herbaria.

It will be noticed that the forms merged under this species fall together very naturally by virtue of their limited range, suffruticose habit and somewhat prominent intermediate lobes of the stamineal tube (staminodia), though *C. oblongifolia* thereby loses its character of exclusively oblong leaves.

Herbarium Lake Forest University.

Notes from my herbarium. III.

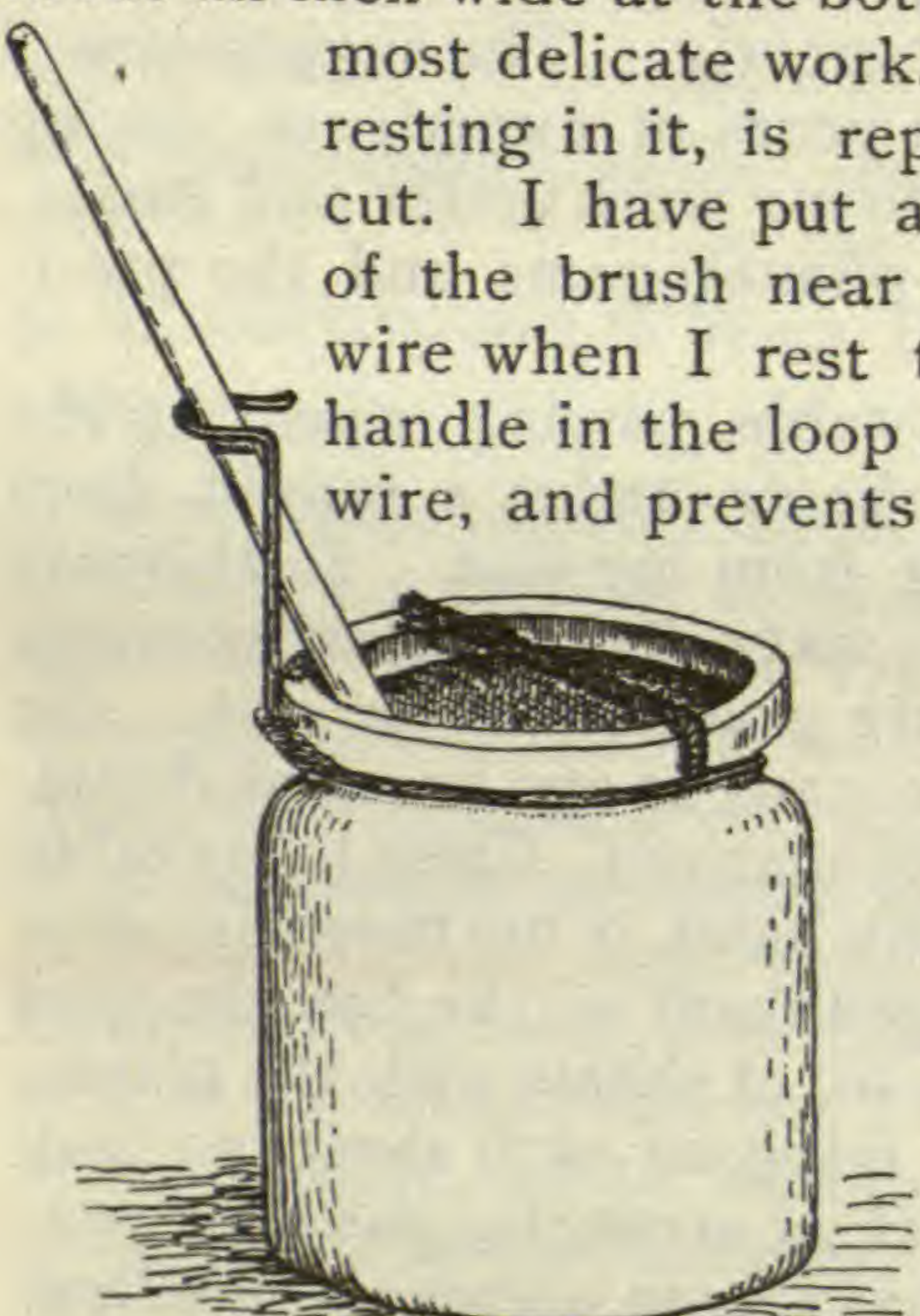
WALTER DEANE.

How I mount plants.

Plants should be mounted for the herbarium with as much care as they are collected and pressed. The æsthetic side should keep pace with the practical side of utility, and this can be done just as easily as not. It takes no more time to mount a plant well than to do it poorly. The suggestions I offer are the result of fourteen years of experience, during which I have constantly tried to do my work better and easier. They apply to the mounting of phanerogams and the pteridophytes.

I do all my work sitting at my table, pasting, mounting the plants and labels, putting the sheets under a weight from time to time, etc., without rising from my seat. In this way I frequently mount from fifty to sixty sheets in an evening, many of the plants being delicate grasses and the like. On a few occasions I have mounted as many as one hundred sheets. Everything must be carefully systematized. Close to my table on the left, within easy reach of my hand, is my mounting-box resting on a chair, with the hinged front of the box dropped down. This box is full, or partly so, of sheets with the plants, labels, paper-pockets and so on, lying on each sheet, as they are to be mounted. All this work of arranging has been previously done, after the plants have been poisoned, labelled, etc. The inner dimensions of a mounting-box should be a little larger than those of a mounting sheet, in order that the sheets may be easily put in and withdrawn from the box.

Directly in front of me, on the left hand side of the table, is a board on which my mounting is done. On this I lay a couple of driers such as I use to press plants. The space directly to the right of this is devoted to the pasting of the plant. For this purpose I use sheets of a rather thin blotting paper, no smaller than a mounting sheet in size. I lay one of these sheets on the table, and I generally lay under it two or three sheets of the white paper I use in drying plants. To the right of this is my glue-pot and brush, a pair of forceps with which to pick up the smaller plants for pasting, and a bit of stiff cardboard a foot in length and one-half an inch or so in width. I also have close by a small paper box divided into compartments and filled with slips of gummed paper of various sizes. My glue-pot, for suggestions in regard to which I am indebted to Mr. M. S. Bebb, is a marmalade jar, about which I have twisted a piece of stiff wire, raising the end some two inches above the edge, and making a loop at the end against which to lean the brush when it is not in use. I have also stretched a bit of wire across the top to take off some of the glue when there is too much on the brush. The brush is a common pasting-brush, about an inch wide at the bottom, and thin. This will do the most delicate work. The glue-pot, with the brush resting in it, is represented in the accompanying cut. I have put a tack half way in, on the handle of the brush near the top. This catches on the wire when I rest the brush on the pot, with the handle in the loop and the bristles on the cross-wire, and prevents the brush from slipping. As I rest the brush in this way every few seconds when mounting, this is of great service.



To the right of my chair on a small rest is a good pile of driers. To the left of my chair, out of the way of the mounting-box, is a rest on which is a board to receive the mounted plants, as will be explained hereafter. I also have ready on the table a piece of rather stiff white paper, some five by three inches, to use when putting on the labels. From my bottle or jar of fish-glue I pour half an inch or less into the glue-pot, and then add water, stirring it up with my brush, till it is of the right consistency. I want the glue to drip off the brush when I lift it up, but not too freely. Experience is the best guide. Now I don my apron, so that I can wipe my fingers on it at any moment, draw my chair up to the table, and I am ready for work.

I lift the top sheet from the box, and lay it on the driers before me. We will imagine the plant a stiff one which can be readily lifted up. First, I take up the label and lay it face down on the blotting-paper. I put one finger on the middle of it, and paste the four edges of the label, making as thin a margin of glue as I can conveniently do. Then I lay the brush back on the glue-pot, take up the label, and lay it on the corner of the sheet in position. I press it gently down, take the bit of white paper in hand, lay it over the label, and rub hard. The whole operation takes a comparatively few seconds, the label is in position, it is not soiled by rubbing the fingers over it, while the small amount of glue on ths edges of the label keeps the corner of the sheet from curling in the slightest degree. When the label is glued all over, the sheet curls. This method I learned some years ago from Mr. M. S. Bebb, and I most heartily endorse it.

Then I lift up the plant, reverse it, lay it on the blotting-paper, and paste it over, not too thickly, getting as little glue as possible on the blotting paper. Then I lay the plant back in position on the mounting sheet, lay over it a couple of driers from my pile on the right, and rub the hand over it a little to press the plant down. I paste on the pockets either before or after doing the plant. If the plant has a thick stem or large fruit, I lay on more than two driers, enough to make a smooth surface for the next sheet. Then I take out another sheet from the mounting box and repeat the operation. When the plant is laid on the blotting paper to be pasted, it will be found that what glue may have got on to it in pasting the previous plant has been absorbed into the sheet, so that one lays the plant on a dry sheet, instead of on a gluey one, thereby getting glue on the upper surface of the plant. Almost all herbaria show dried glue on the plants and sheets. The plants have doubtless been pasted on pieces of newspaper, or some other kind of paper which is non-absorbent, and so the glue which remains on the paper soils the plants, unless the paper is changed for almost every plant. With a little care I can easily make a single sheet of blotting paper last for at least one hundred mounts, before throwing it away, for of course in time the sheet will become filled with the absorbed glue. If a drop of glue stands on the sheet without being absorbed, as sometimes happens, I take it up with my finger, rub my finger on my apron, and go on. I reverse the sheet of blotting paper every few minutes.

Now we come to a plant too flimsy to be lifted. Such we constantly meet with. It takes but a few seconds longer to mount it. After pasting the labels, and pockets if there are any, on the mounting sheet, I take up the blotting paper and reverse it on the sheet, making one corner and edge of the two sheets match exactly, and then on this I lay a couple of driers. I take up the sheet with one drier under it and the two on top, and holding these in my left hand, I put my right hand on the middle of the pile and reverse it, laying the whole down again. I lift up carefully the single drier and mounting sheet, and I have the plant on the blotting paper, undisturbed, and ready to be pasted. In putting the glue on a flimsy plant, and often on a stiff one of any size, I take my strip of cardboard previously mentioned, lay it across the plant near the top, and then, with one hand on it, paste the part of the plant above it. This holds the plant well in position while I am pasting. Then I either paste the part below, or move the cardboard lower down to suit my convenience. After pasting the plant, I lay the mounting sheet on it, matching the same edges and corners as before, put the drier on top and reverse the whole. I carefully lift up the two driers and the blotting paper from the mounting sheet, and the plant is mounted in exactly the original position. This takes far less time to do than to describe. I then put the two driers on the sheet and proceed as usual.

When I have mounted a dozen sheets, more or less, according to the time taken, I take the whole pile from the board and transfer it to the board on the left, laying on the pile, as a mark, a piece of paper projecting over the edge, and then on this I lay a pile of driers, six inches or more in thickness as a weight. This is very necessary. It ensures a smooth plant and sheet when the glue is dry. There is no danger of the drier sticking to the sheet if the work is properly done. Should this happen, it is a sign of careless work, and the appearance of the sheet is injured. Every time I put a fresh pile of mounted sheets in the press, I take off the driers used for a weight, lay them in my lap till I have laid the pile on, and then replace them. If I am mounting in the evening I can take the sheets out of the press the next morning. I use the gummed strips on those parts of plants which the glue does not hold. I generally put them on after the sheets are removed from the press. For an herbarium that is to be used very much, I do not believe in putting the plants on the sheets with gummed strips alone, as the plants break much more easily when handled.

Long experience convinces me that the methods described above are the best. The object is to mount plants neatly and as rapidly as possible, and I cannot but feel that this method produces both results.

Cambridge, Mass.

Some Euphorbiaceæ from Guatemala.

JOHN P. LOTSY.

WITH PLATES XXIV AND XXV.

At the request of Capt. John Donnell Smith I undertook the determination of his last acquired Euphorbiaceæ. After classification the specimens were compared by me with those in the Ryksherbarium[1] of the University of Leiden, Holland, and in the National Herbarium at Washington, D. C.

Euphorbia rubrosperma, n. sp. (§ ANISOPHYLLI, Chamysyceæ Leiospermæ DC. Prod. **15**^{2}**:** 27.)—Tota crispule hirta, caulibus filiformibus carnulosis ad articulationes incrassatis e basi ramulosis. Folia basi valde inaequalia ovata orbiculata irregulariter dentata acuta vel obtusa, stipulis interpetiolaribus lanceolatis ciliatis basi minutissime bidentatis. Cyathia in axillis supremis cymulosa, involucris minutis campanulatis extus hirsutis intus glabris, lobis angustis extus ad margines ciliolatis. Glandulæ 4 exappendiculatæ cyathiformes longiter stipitatæ. Ovarium hirtum, stilis 3 bipartitis non incrassatis sub lente punctulatis trigonis rubellis.

Santa Rosa, Depart. Santa Rosa, alt. 3,000$^{\text{ft}}$, Dec. 1892, Heyde & Lux, no. 4,271.

A small creeping plant with a firm primary root. The plant when dry has small green leaves, here and there becoming red, as do also the involucres of the inflorescences. Length of one of the creeping branches, 5–6$^{\text{cm}}$. Length of leaves 0.5$^{\text{cm}}$. Length of seed 0.06$^{\text{cm}}$.

EUPHORBIA XALAPENSIS HBK. (§ CYTTAROSPERMI DC. Prod. **15**^{2}**:** 53).

San Raphael, Depart. Zacatepéquez, alt. 6,500$^{\text{ft}}$, Febr. 1892, John Donnell Smith, no. 2,617.—San Miguel, Dept. Quiché, alt. 6,000$^{\text{ft}}$, April 1892, Heyde & Lux, no. 3,479.—Laguna di Ayarza, Dept. Jalapa, alt. 8,000$^{\text{ft}}$, Sept. 1892, Heyde & Lux, no. 3,849.—Volcan Jumaytepeque, Dept. Santa Rosa, 6,000$^{\text{ft}}$, Dec. 1892, Heyde & Lux, no. 4,269.

Euphorbia microappendiculata, n. sp. (§ CYTTAROSPERMI.) —Caulis cum ramis oppositis glabris sed ad articulationes

[1]To the subdirector of this herbarium, Dr. J. G. Boerlage, I am indebted for much valuable aid and advice.

pauciter pubescentibus fistulosus ad folia adpresse pubescens. Folia integra, inferiora sparsa, superiora opposita vel ternata; inferiora petiolata ovata acutiuscula, superiora lanceolata, glandulis stipularibus obsoletis. Cymæ terminales vel axillares longiter pedunculatæ 3-cephalæ, involucris longiuscule pedicellatis campanulatis hemisphaericis adpresse pubescentibus, lobis triangularibus pauciter fimbriatis. Glandulæ 4 ovatæ valvatæ, appendicibus rotundatis apice obscure cordatis concaviter inclusis. Stili bipartiti. Capsula ignota. Semen ignotum.

A plant two to three feet high. Leaves pinnately veined with seven to ten pair of secondary veins, covered with scattered hairs on upper side, densely covered on lower side with a grey felt, glabrous on the veins. Bracts of inflorescence spatulate, about one-half longer than the cyathia. Length of blade 5^{cm}. Width of blade at broadest place 2.5^{cm}. Length of petiole $1-1.3^{cm}$.

Laguna de Ayarza, Depart. Jalapa, alt. $8,000^{ft}$, Sept. 1892, Heyde & Lux, no. 3,850.

EUPHORBIA OCYMOIDEA L. (§ CYTTAROSPERMI.)

Rinconcito, Depart. Santa Rosa, alt. $4,000^{ft}$, Nov. 1892, Heyde & Lux, no. 4,263.

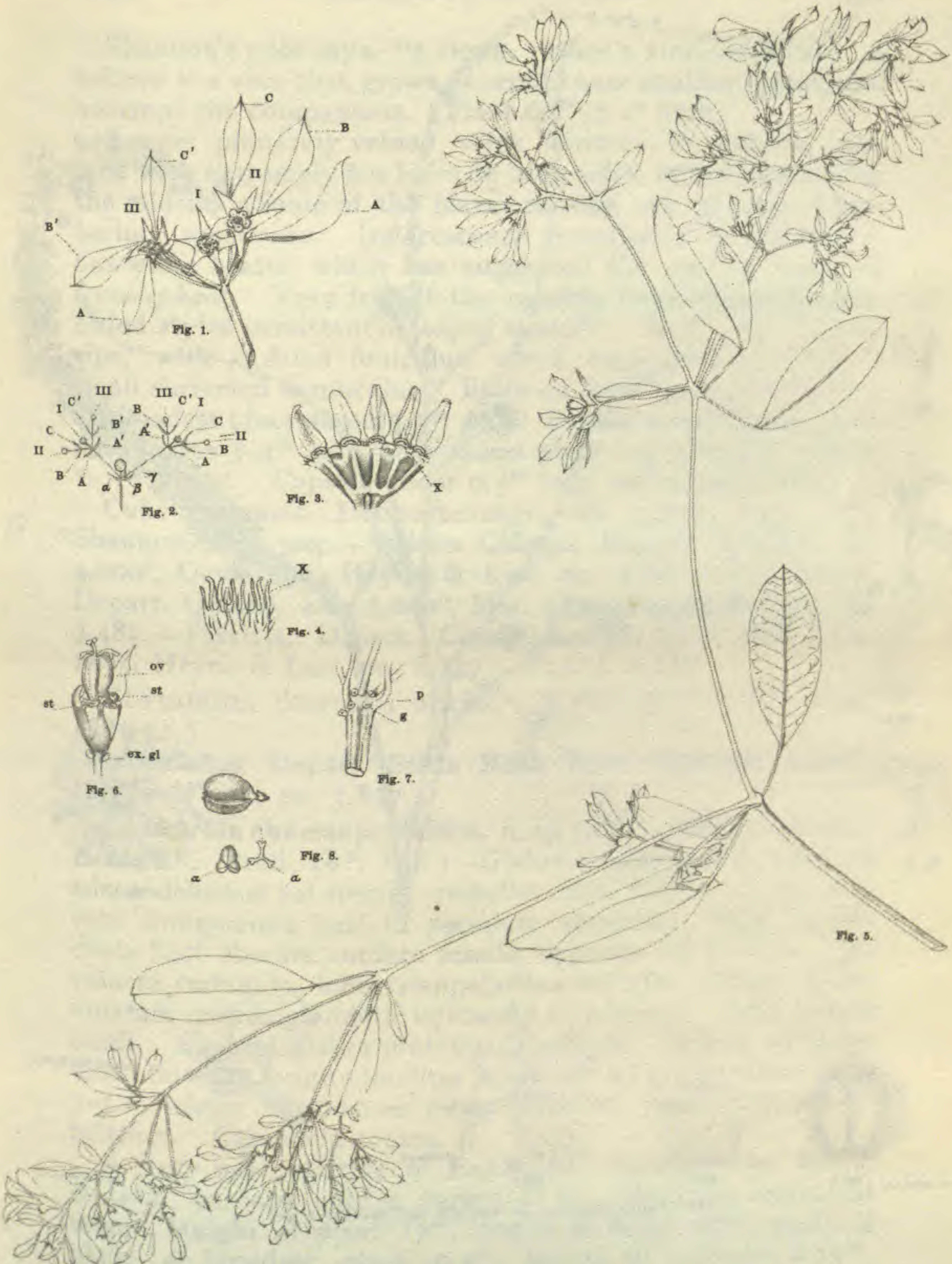
EUPHORBIA ARENARIA HBK. (§ CYTTAROSPERMI.)

Ojo de Agua, Depart. Santa Rosa, alt. $3,500^{ft}$, Dec. 1892, Heyde & Lux, no. 4,262.

EUPHORBIA LANCIFOLIA Schlecht. (§ DICHILII DC. Prod. **15**²: 59.)

Rinconcito, Depart. Santa Rosa, alt. $4,000^{ft}$, Nov. 1892, Heyde & Lux, no. 4,264.—Naranjo, Depart. Santa Rosa, alt. $3,500^{ft}$, May 1892, Heyde & Lux, no. 4,581.

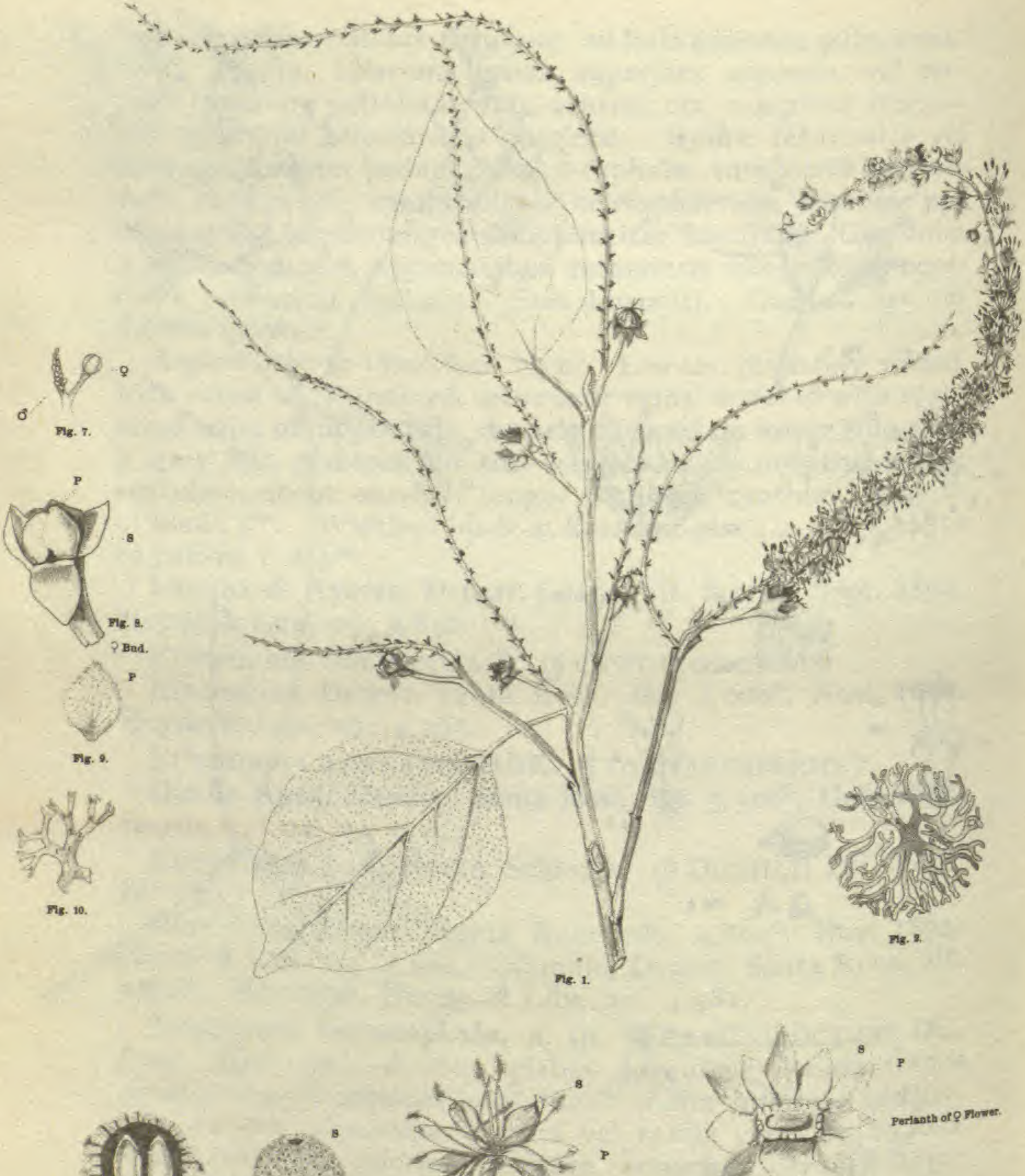
Euphorbia leucocephala, n. sp. (§ ALECTOROCTONI DC. Prod. **15**²: 59.)—Frutex glabra juventute lanosa, ramis striatis ad articulationes incrassatis. Folia inferiora verticillata, caetera plerumque ternata vel rarius verticillata; folia longe petiolata, inferiora obovata, superiora oblonga apice mucronata. Dichasia terminalia polycephala. Bractea alba spathulata mucronata involucris triplo vel quadruplo longiora. Cyathia basi externe biglandulata, involucris breve pedicillatis campanulatis hirtis, lobis transverse oblongis ciliatis. Glandulæ quinæ transverse oblongæ, appendicibus integerrimis eis 6-plo longioribus. Stili bipartiti. Capsula glabra profunde trisulcata. Semen ecarunculatum.



J. P. LOTSY, DEL.

EUPHORBIA LEUCOCEPHALA. nov. spec.

A. Hoen & Co. Lith. Baltimore



CROTON ELUTERIOIDES nov. spec. et CROTON GUATEMALENSIS nov. spec.

Shannon's note says, "a shrub, rather a vinelike shrub. I believe is a vine that grows generally near another (plant) and overtops the companions. Plant 60^{cm}–2.1^{m} high."

Leaves pinnately veined, veins fourteen to sixteen, covered with extremely few hairs on both sides, rather more along the midrib. Some of the leaves turning red, at least in herbarium specimens. Inflorescence remarkable for its numerous white bracts, which has suggested the specific name of *leucocephala*. Very few of the cyathia have female flowers. Dried styles persistent on top of capsule. Seeds, not entirely ripe, with a dried funiculus, which suggests sometimes a small shriveled caruncculus. Blade of lower leaves 6–8^{cm} long, at broadest place about 3.5^{cm} wide. Petiole 2–2.5^{cm} long. Ternate leaves 3–4^{cm} long, at broadest place 1.5–2^{cm} wide. Bracts 1–1.5^{cm} long. Capsule about 0.5^{cm} long and equally broad.

Cuilco, Depart. Huehuetenango, alt. $3,800^{ft}$, Dec. 1891, Shannon, No. 305.—Volcan Chingo, Depart. Jutiapa, alt. $4,000^{ft}$, Oct. 1892, Heyde & Lux, no. 3,661.—Rio Negro, Depart. Quiché, alt. $3,600^{ft}$, Mar. 1892, Heyde & Lux, no. 3,482.—Patzicia, Depart. Chimaltenango, alt. $6,500^{ft}$, Febr. 1893, Heyde & Lux, no. 6,377.—PLATE XXIV.

EUPHORBIA DENTATA Michx. (§ POINSETTIÆ DC. Prod. **15**^{2}: 71.)

Las Cañas, Depart. Santa Rosa, Nov. 1892, alt. $3,000^{ft}$, Heyde & Lux, no. 3,837.

Euphorbia chamaepeploides, n. sp. (§ TITHYMALI sub-sect. *Esulæ* DC. Prod. **15**^{2}: 138.)—Glabra a collo ramosa, caulibus adscendentibus vel erectis, umbellæ radiis tribus. Folia obovata integerrima basi in petiolum attenuata; folia floralia ovata basi obscure cordata sessilia opposita vel ternata. Involucra turbinata, lobis triangularibus margine ciliatis. Glandularum cornua glandulæ latitudini aequilonga. Stili breves bifidi. Capsula glabra profunde trisulcata. Semen ad facies binas internas longitudinaliter sulcatum ad 4 exteriores linea 3–5 fovearum rotundarum exsculptum sub lente totum punctulatum. Caruncula conica.

A very near relative of *Euphorbia chamaepeplus* Boiss. & Gail., perhaps only a variety of it. Only one individual seen. Height of plant 17^{cm}, length of blade 0.6^{cm}, width of blade at broadest place 0.5^{cm}, length of peduncle 0.15^{cm}, length of upper sessile leaves 0.8^{cm}, length of capsule 0.15^{cm}, length of seed 0.1^{cm}.

San Martín, Jilotepeque, Depart. Chimaltenango, alt. 6,000ft, Mar. 1892, Heyde & Lux, no. 3,481.

EUPHORBIA CAMPESTRIS Cham. & Schlecht. (§ POINSETTIÆ.)

Cunén, Depart. Quiché, alt. 6,000ft, April 1892, Heyde & Lux, no. 3,467.

PHYLLANTHUS NIRURI L. (§ EUPHYLLANTHI DC. Prod. **15**²: 374.)

Volcan Jumaytepeque, Depart. Santa Rosa, 6,000ft, Dec. 1892, Heyde & Lux, no. 4,270.

CROTON ELUTERIA Benn. (§ ELUTERIÆ DC. Prod. **15**²: 514.)

Palin, Depart. Amatitlan, alt. 3,560ft, Feb. 1892, John Donnell Smith, no. 2,616.

Croton eluterioides, n. sp. (§ ELUTERIÆ).—Planta in tota parte juvenili lepidota. Folia penninervia utraque pagina lepidota, limbo ovato integerrimo apice breviter acuminato basi rotundato eglanduloso, petiolo quam limbus 2–14-plo breviori, stipulis triangularibus lepidotis. Racemi axillares foliis multobreviores densiflori basi feminini apice masculini. Calycis lacinia utriusque sexus ovata acuta lepidota. Petala utriusque sexus late ovata non lepidota pilosa. Stamina circa 15, filamentis sparse barbatis. Ovarium 2-merum lepidotum. Stili 3 bipartiti, laciniis repetite bifidis.

Differs from *Croton Eluteria* in the number of stamens, the more repeatedly branched style, the much broader and larger leaves which are shortly in place of longly acuminated.

A bush about 12ft high. Leaves when young covered on both sides with silvery scales; these gradually disappear from the upper surface almost entirely, while the lower surface contains on old leaves so few scales that in herbarium specimens, owing to the brown color of the leaf, these appear at first sight rusty-lepidote instead of silvery-lepidote. As far as the specimens at hand go, the number of female flowers seems to vary between one and two at the base. The number of male flowers also is limited. Ripe capsule unknown. Length of blade 10cm, width of blade at broadest place 0.45cm, length of petiole 0.5cm, length of largest capsule found 0.21cm, width of largest capsule found 0.15cm.

Santa Rosa, Depart. Santa Rosa, alt. 3,000ft, June 1892, Heyde & Lux, no. 3,470. —PLATE XXV.

Croton Guatemalensis, n. sp. (§ ELUTERIÆ).—Planta in tota parte juvenili lepidota. Folia penninervia utraque pagina lepidota, limbo ovato integerrimo apice breviter acuminato basi rotundato eglanduloso, petiolo quam limbus 3–4 plo breviori, stipulis obsoletis. Racemi graciliter spicaeformes foliis multo longiores densiflori basi feminini apice masculini. Calycis lacinia utriusque sexus ovata acuta lepidota. Petala utriusque sexus ovato-lanceolata non lepidota margine barbata. Stamina circa 15, filamentis glabris. Ovarium 2–3-merum lepidotum. Stili 3-partiti, laciniis repetite bifidis.

Tree 20–25ft high. Flowering branches of very graceful aspect. Leaves when young covered on both sides with silvery scales; these gradually disappear from upper side so that the older leaves of herbarium specimens appear brown above and silvery beneath, a considerable number of scales remaining however on upper surface. As far as the specimens at hand go, every inflorescence seems to have a solitary female flower with a long peduncle at its base. As is seen from the plate, the male flowers drop pretty early and long before the capsule is ripe, but this may be partly due to the drying. In the female flower a ring-wall can be seen with five episepal bifid glands. The male flower is densely clothed with hairs on the receptacle. Ripe capsule unknown. Seeds (not entirely ripe) smooth.

Santa Rosa, Depart. Santa Rosa, alt. 4,000ft, May 1892, Heyde & Lux, no. 3,035.—PLATE XXV.

JULOCROTON TRIQUETER Baill.

Cerro Gordo, Depart. Santa Rosa, alt. 3,500ft, August 1892, Heyde & Lux, no. 3,838.

ACALYPHA SCHLECTENDAHLIANA Müll. Arg. (§ EUACALYPHÆ DC. Prod. **15²:** 803.)

Barranca de Eminenzia, Depart. Amatitlan, alt. 1,400ft, Feb. 1892, John Donnell Smith, no. 2,618.

ACALYPHA CANCANA Müll. Arg. (§ EUACALYPHÆ.)

Rio de Los Esclavos, Depart. Santa Rosa, alt. 2,500ft, Feb. 1893, Heyde & Lux, no. 4,580.

ACALYPHA MACROSTACHYA Jacq., var. SIDÆFOLIA Müll. Arg. (§ EUACALYPHÆ.)

Pansamalá, Alta Vera Paz, alt. 3,800ft, Oct. 1888, von Türckheim, no. 1,417.

TRAGIA VOLUBILIS Müll. Arg. (§ EUTRAGIÆ DC. Prod. **15**[2]: 932.)

Estanzuela, Depart. Santa Rosa, alt. 2,500ft, Aug. 1892, Heyde & Lux, no. 3,846.

Tragia Guatemalensis n. sp. (§ EUTRAGIÆ.)—Frutex scandens pube brevi et pilis urentibus dense obsita. Petiolus limbo foliorum 2–4-plo brevior, limbo basi palmatinervio et cordato apice breviter acuminato. Racemi longe pedunculati non bipartiti basi flores duos femininos apice flores plures masculinos gerentes. Bractea feminina aequaliter tripartita; bractea masculina tripartita, lobo medio longiore. Pedicellum masculinum articulatum, parte persistente bractea longiore.

Calycis femininæ lacinia 6 lanceolata, calycis masculinæ lacinia 3. Stamina 3.

Leaf palmatinerved at the base with about five veins, the middle one strongest forming the midrib of the leaf. Secondary veins pinnate, three to four pairs. Inflorescence about the length of the petiole. The two female flowers have such long peduncles that they reach about as high as the top of the male part of the inflorescence. Fruit densely covered with bristly hairs. Seeds globular, pale yellow with brown irregular dots. Length of limb of leaf 0.73cm. Width of limb of leaf at broadest place 0.3cm. Length of petiole 0.18cm. Diameter of fruit 0.1cm. Diameter of seed 0.4cm.

Chicacao, Depart. Alta Verapaz, alt. 3,500ft, April 1889, J. Donnell Smith, no. 1,763.

JATROPHA CURCAS L. (§ CURCAS DC. Prod. **15**[2]: 1,076.)

Santa Rosa, Depart. Santa Rosa, alt. 3,000ft, May 1893, Heyde & Lux, no. 4,582.

HURA CREPITANS Müll. Arg.

Sacapulas, Depart. Quiché, alt. 3,800ft, April 1892, Heyde & Lux, no. 2,901.

Johns Hopkins University.

EXPLANATION OF PLATES XXIV AND XXV.

PLATE XXIV. *Euphorbia leucocephala.*

Fig. 1. Dichasium, the length of the lateral cyathia exaggerated to make relations plainer.—Fig. 2. Diagram of dichasium.—Fig. 3. Involucre from inside, showing lobes, *x*, and appendiculate glands.—

Fig. 4. Enlarged fimbriated lobe of involucre.—Fig. 5. Flowering branch, natural size.—Fig. 6. Cyathium with one female, *ov*, and several male flowers, *st*, showing extracyathial glands, *ex. gl.*—Fig. 7. Node; only the petioles of the leaves drawn, showing stipulate glands.—Fig. 8. Capsule showing position of styles.

PLATE XXV.

Figs. 1–6, *Croton Guatemalensis.*

Fig. 1. Flowering branch, natural size.—Fig. 2. Styles, enlarged.—Fig. 3. Ovary in longitudinal section, enlarged.—Fig. 4. Ovary enlarged; *s*, indicates the place where the styles were inserted.—Fig. 5. Male flower, enlarged; *S*, sepals, *P*, petals.—Fig. 6. Female flower after removal of ovary, enlarged; *S*, sepals; *P*, petals..

Figs. 7–10, *Croton eleuterioides.*

Fig. 7. Young inflorescence natural size.—Fig. 8. Female flower in bud enlarged; *P*, petal, *S*, sepal.—Fig. 9. Petal from female bud.—Fig. 10. One style, the two others cut off.

Vegetal dissemination in the genus Opuntia.

J. W. TOUMEY.

The discussion here presented is based upon observations made during the past four years on the various species of Opuntia indigenous to Arizona. All of these plants, more especially the younger growth, are soft and fleshy, with large quantities of sap stored in the cortex and pith. No other plants so persistently retain their moisture when once secured. A thick epidermis with small sunken stomata and the evaporating surface brought down to a minimum, by the condensed form characteristic of the entire genus, enable them to remain green for months, even when continually exposed to the dry and scorching heat of our southwestern plains. They are alike at home on the plains and among the rocks of our mountains and foot-hills. Although of recent origin, compared with other large families of plants, they have lived for ages subjected to an environment which has placed them among the greatest economizers of water to be found in the entire vegetable kingdom. Not only are they economizers of water, but their tissues are, under ordinary circumstances, well provided with water, even after months of exposure to an average maximum temperature of 100° F. and untouched by dews or rains.

Much of the tissue entering into their composition, consists of large thin-walled parenchyma cells, which serve as store-houses of water. These cells have the power of taking up water with great avidity after and during a rain, or when the ground is moist, and as a result the young branches become plump, smooth, thicker, and the tubercles less prominent. As the days become warmer and the rains less frequent these cells gradually give up their contained moisture and the joints become withered and wrinkled. This process is, however, very slow, as many species remain green a year or even longer, after every source of outside moisture has been withdrawn.

The first of July, 1892, half of one of the flat joints of *Opuntia basilaris* was brought to my room and placed, without soil or moisture, in a small open box. The specimen was three inches long, two inches wide and from one-half to two-thirds of an inch in thickness. On the tenth of the same month I observed a branch developing at one of the upper tubercles.

The specimen began to attract my attention and on weighing it I found it weighed 11.78^{gm}. The ten days intervening from the time the specimen was procured until it was weighed it undoubtedly lost considerable by evaporation. In the meantime, however, the large wound, caused by cutting the joint lengthwise had become practically impervious to evaporation by the exuding of the mucilaginous substance of the adjacent cells forming a thick scab-like crust over the wound.

The branch continued to grow rapidly while the old stem began to wither at the point farthest away from the branch. This process continued much in the same manner, month after month, during the entire summer. Not a single drop of moisture came in contact with it after it was placed in the box.

On the twentieth of January of the following year the specimen weighed 10.016^{gm}, losing in six months a little over fifteen per cent. of its total weight. At this time the branch had grown to be five and one-fourth inches long, or nearly twice the length of the old joint. It was, however, very slender and thin.

About seven-eighths of the old stem was dry and hard, but the portion immediately surrounding the base of the growing stem was as fresh and green as ever.

The next observation was on April fourth. At this time the specimen weighed 9.259^{gm}. The old stem was now entirely dry; the branch was nearly six inches long and as fresh as ever. By the middle of May the branch began to wither, but a new one had begun to develop about an inch from the apex of the other. By June twentieth, the new branch had grown to be two inches in length but was even now more slender than the first. In the six months from January to June, inclusive, the specimen had lost a little less than eight per cent. of its weight at the time of the first weighing. No further observations were made for a period of four months. On my return from the east in September the entire plant was dry.

The persistency with which cylindropuntias retain their moisture is as marked as it is in the flat-stemmed forms. In October, 1893, a number of one-year-old stems of *Opuntia Bigelovii* were placed in an open box to dry. Eleven months later these specimens were somewhat shrivelled but on being cut open were found to contain considerable moisture. Of the twenty or more joints placed in the box, none developed branches, but each grew a number of roots, usually one from each of a score or more of tubercles at the base of the joint. Many of these roots were four inches long and remained green throughout the summer.

In December, 1893, a number of nearly mature fruits of *Opuntia fulgida* were collected and similarly placed in an open box. At the end of ten months they had all developed long roots from the small tubercles at the base of the fruit but were practically nearly as green as ever.

The persistency with which these plants retain their moisture makes vegetal dissemination possible. With many species it is not necessary that the detached joints be disseminated during the rainy season. If they chance to fall to the ground during the driest portion of the year their contained moisture is sufficient to enable them to put forth roots which soon firmly anchor them to the ground, and a new plant is the result.

The opuntias of Arizona belong to the two sub-genera, Platopuntia and Cylindropuntia. With few exceptions the former are, in habit of growth, prostrate or at most only semi-erect, while the latter are nearly all erect. Both agree in having bristles and usually spines, which in many species are numerous and highly developed. The bristles are always barbed and are usually more numerous and more highly developed in Platopuntia. The spines in the two sub-genera differ in that in Platopuntia they are but slightly barbed, while in Cylindropuntia the barbed character of the spines is very pronounced. Morphologically the bristles and spines are the same; little is known, however, in regard to their functions.

As pointed out by Dr. W. F. Ganong,[1] it has been frequently asserted that the function of the spines is largely for protection and that the readily detached and irritable bristles serve the same purpose. There is no question but

[1]Present problems in anatomy, morphology and biology of the Cactaceæ. Botanical Gazette **20:** 129. 1895.

the spines do serve largely to protect these succulent plants from the ravages of animals. If they were not so protected, in a few years they would entirely disappear from our western plains. Another important function, more especially in Cylindropuntia, is their great aid in dissemination.

It is not sufficient that the joints grow when detached from the parent plant. They must find a means of transportation from one place to another. In cylindropuntias this is largely effected by means of the barbed spines which adhere closely to all objects which come in contact with them.

As previously stated the spines of Platopuntia are nearly smooth or but slightly barbed, but with these plants barbed spines are not necessary to effect transportation; they are disseminated in an entirely different manner.

The species of Platopuntia being mostly prostrate or semi-prostrate, spread out with growth, forming large oval or circular patches. The branches creeping or bending to the ground take root at each joint. In the course of time, the original plant dying, the several branches become independent plants. This process is repeated until the product of a single plant may extend over a large area. Among specimens of *Opuntia pheacantha* growing a few miles east of Tucson I have traced nearly twenty plants to a common center, some of them being several rods distant. As a rule a dozen or more plants, in the immediate vicinity, indicate that they are the product of a single plant. Usually it is not difficult to locate the position of the original plant long after every vestige of it has disappeared. I am convinced that nearly all of our flat-stemmed opuntias are disseminated in this manner. It does not apply of course to the few upright forms like *Opuntia chlorotica.* Although these upright forms are not disseminated in the same way as the prostrate plants, vegetal dissemination is not entirely eliminated. The young joints of the upright species are much more easily detached than in the prostrate species. Cattle and other animals feed to some extent upon them. From one cause or another many of the joints are broken off. The spines, although but slightly barbed, are of some aid in dissemination. They raise the detached stems from the ground so that they are more easily disturbed by animals or other moving objects coming in contact with them and they are scattered further from the parent plant than they would be if devoid of spines.

In a recent observation on *Opuntia chlorotica* growing at Steins Pass, N. M., detached joints were found, at least two rods from the plant upon which they grew. They were all firmly anchored by long roots penetrating the ground from under side of the joint.

It is with the cylindrical opuntias, however, that the spines have an important part to play in vegetal dissemination. Nearly all of this large group depend almost entirely for dissemination upon the readiness with which the terminal branches break off and upon the highly developed barbed spines which cover them.

One of the species best adapted for dissemination is *Opuntia Bigelovii*, a plant abundant on the mountains and foot-hills of south-central Arizona. The tubercles are crowded and the pulvilli are covered with numerous, radiating, highly barbed spines. These formidable spines are so numerous that they completely hide the epidermis of the plant. Although the joints are from two to five inches long and more than an inch in diameter, the point of union with the old stem is very slight, the scar left at the place of detachment being but two or three lines in diameter. The slightest touch will detach the young joints and they cling as formidable burrs to any object with which they come in contact. It is not an unusual sight on the Arizona plains, to see cattle with scores of these burrs firmly fastened to their legs and head. They are sometimes carried for miles and when finally detached, even after weeks of travel, are in condition to grow. This plant depends so completely upon this method of dissemination that it has almost entirely lost the power of seed-production. In fifty fruits examined last fall, but two perfect seeds were found. Forty-eight of the fruits were sterile and the other two had but one perfect seed in each.

Of the fourteen species of Cylindropuntia which I have examined in the field, all are more or less adapted for dissemination in this manner. Some species, such as *Opuntia Bigelovii*, *O. fulgida*, *O. mamillata*, *O. echinocarpa* and *O. prolifera*, are exceptionally well adapted for this method of dissemination; the joints are easily detached and are well armed with strong barbed spines.

The fruits of the larger number of the above species are seldom sterile but the seeds are small, and in our unfavorable climate, seldom germinate. Among the thousands of specimens of Opuntia Bigelovii and Opuntia fulgida that have come under my observation, I have never as yet seen a single seedling developed under natural conditions. The ground in the vicinity is strewn with numerous detached joints, all capable of becoming new plants.

In some of the smaller species, as *Opuntia leptocaulis*, *O. tessellata*, and *O. arbuscula*, numerous short, lateral joints are developed; which, although small, retain their moisture for a long time after being detached. Evidently the function of these small, easily detached joints, is for vegetal dissemination. The fruits of two of these plants, viz. O. tessellata and O. arbuscula, are usually sterile.

Opuntia arborescens, *O. Whipplei*, *O. versicolor* and similar species are not so well adapted for this method of dissemination. With these plants the joints are not readily detached and the spines are not so strongly barbed; they depend to a much greater extent upon seed dissemination, as is illustrated in the fact that it is not an unusual thing to find seedlings of these plants in all stages of development.

As a generalization it may be stated that with this great group of plants the adaptations for vegetal dissemination are inversely as their seed production.

University of Arizona, Tucson.

A study of some anatomical characters of North American Gramineæ. V.

THEO. HOLM.

WITH PLATE XXVI.

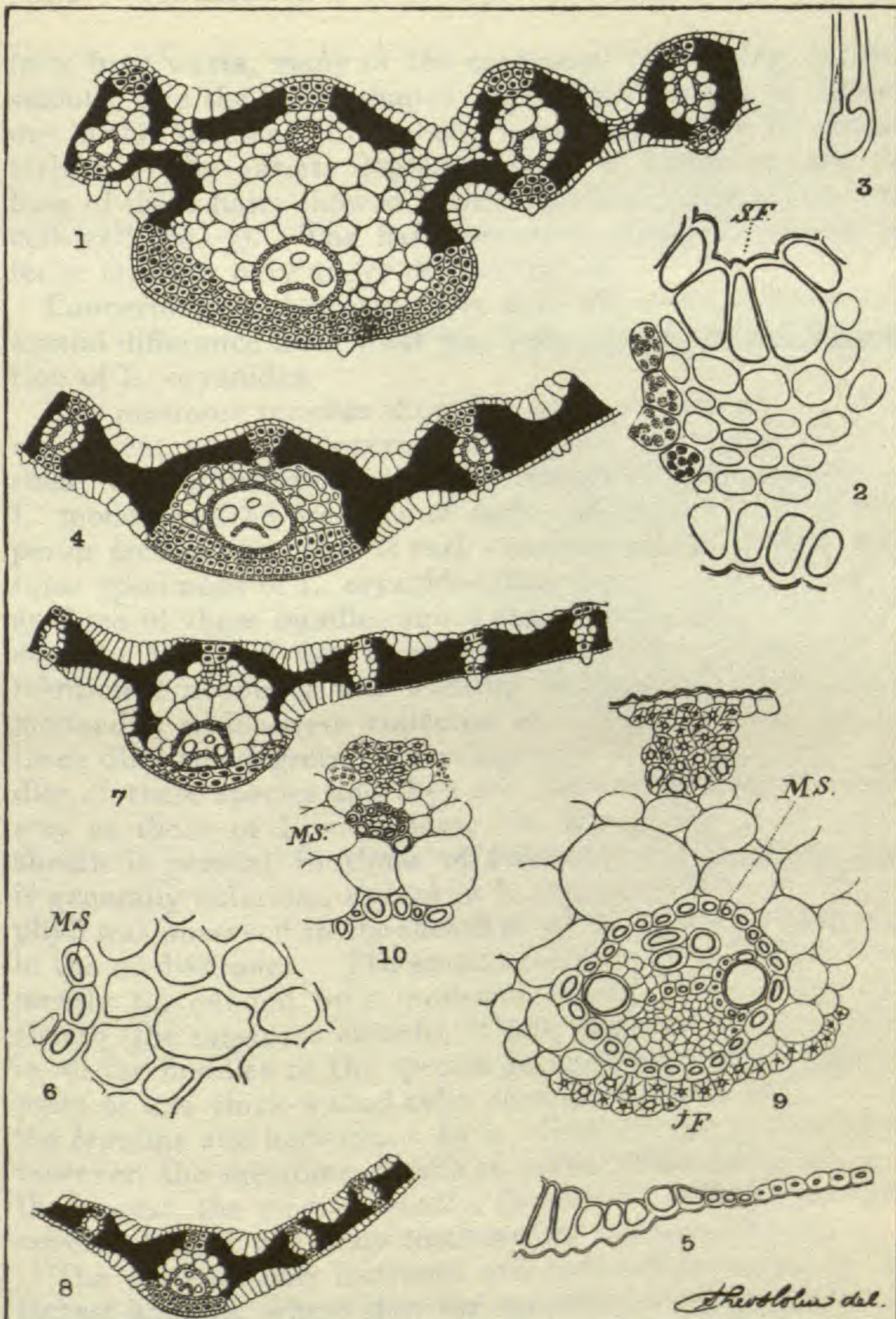
The genus Leersia.

In a previously published paper[1] we have described the leaf-structure of Leersia oryzoides, and we will now consider the other species of this genus, *L. lenticularis* Michx., *L. Virginica* Willd., *L. monandra* Swtz., and *L. hexandra* Swtz.

The anatomical structure of the leaf appears to be very uniform in this genus, and transverse sections of the midrib and the surrounding tissues show very few differences from what we have already mentioned for L. oryzoides. This uniformity in structure is undoubtedly due to the fact that the species in question inhabit the same kind of localities, viz., borders of lakes, ponds, or swamps. Leersia hexandra, however, very often grows in deep water, and therefore this species shows a greater development of the bulliform cells and the colorless parenchyma than any of the other species.

The structure of the epidermis in regard to shape and size of the single cells is very nearly the same for all our species, and agrees in most respects with that of L. oryzoides. In L. lenticularis, however, the cells of epidermis underneath the mestome bundles are very thick-walled, and remind one of stereome, when examined in transverse section (fig. 5). The bulliform cells, also, are well developed in these species and show the same arrangement as described for L. oryzoides, with the exception that L. hexandra (fig. 1), possesses groups of these cells between all the mestome bundles and on both faces of the blade; the other species have only two groups on the inferior face, there being one on each side of the midrib, while the superior face shows one group between each mestome bundle (figs. 4, 7 and 8). Epidermal expansions, warts and thorns, are present in large numbers in L. Virginica, L. lenticularis and L. monandra, on both faces of the leaf, as we have seen in L. oryzoides. L. hexandra is much

[1] BOT. GAZETTE 17: 358. 1892.



HOLM on LEERSIA.

freer from warts, many of the epidermal cells being entirely smooth, and the thorn-shaped expansions are not so numerous in this species. Long hairs were observed to be characteristic of the variety depauperata of L. hexandra, and the base of these hairs showed a distinct constriction of the inner cell-wall (fig. 3). The hairs occurred especially on the inferior face but only under the mesophyll.

Concerning the stomata there does not seem to be any essential difference from what has been stated in our description of L. oryzoides.

The mestome bundles show the same development and arrangement as in L. oryzoides, with the exception that the small ventral bundle above the midrib is often wanting in L. monandra; the presence of such small bundles on the superior face of the blade is very characteristic of Leersia, and some specimens of L. oryzoides show the presence of as many as three of these bundles above the midrib. The species we describe here did not show more than one bundle, and, as mentioned above, it was wanting in some specimens of L. monandra, which were collected in Texas. There are also three different degrees of development in the mestome bundles of these species and they are characterized in the same way as those of L. oryzoides. A thin-walled parenchyma sheath is present in those of first and second degree, and is generally colorless, except in L. lenticularis, where chlorophyll was observed in the sheath of all the bundles, though not in the median ones. The small ventral mestome bundles are merely surrounded by a mestome sheath. Concerning this sheath (the mestome sheath), it was observed to be present in all the bundles of the species in question, and consists of more or less thick-walled cells, forming a closed ring around the leptome and hadrome. In L. Virginica and L. hexandra, however, the mestome sheath is rather thin-walled, even in the largest, the median bundle; the variety depauperata had, nevertheless, a distinctly thick-walled mestome sheath.

The leptome and hadrome are well differentiated in the largest bundles, where they are separated from each other by a single or sometimes double layer of thick-walled mestome parenchyma, as in L. lenticularis. The smaller mestome bundles, those of second degree, have the hadrome part less developed, and have no layer of thick-walled mestome parenchyma. The ventral bundle is still more reduced and contains only leptome in L. monandra, hexandra and lenticularis. By comparing the development of the mestome bundles of all our species of Leersia it is readily seen that those of L. hexandra (fig. 1), are the strongest, and that they form prominent ribs in connection with the heavy layers of stereome. This species, L. hexandra, possesses also larger groups of stereome than any of the other species in question. In regard to the arrangement of the stereome, however, there does not seem to be any difference between the various species of Leersia.

The mesophyll shows very near the same development and arrangement as we have seen in L. oryzoides. L. hexandra is an exception, however, and the section (fig. 1), shows that this tissue is separated in groups by the large colorless parenchyma.

The colorless parenchyma has therefore its greatest development in L. hexandra, where it is especially observable in the middle of the blade, besides this smaller groups of similar, but somewhat thickened, cells connect the bulliform cells of the dorsal and ventral face of the blade in this same species. The other species of Leersia agree with L. oryzoides in regard to development and arrangement of this form of parenchyma.

By considering now the leaf-structure of the genus Leersia the following characters may serve for the discrimination of the species:

Epidermis.

Hairs on the inferior face outside the mesophyll	*L. oryzoides.* *L. hexandra*, var. *depauperata.*
Bulliform cells forming groups between all the mestome-bundles on both faces .	*L. hexandra.*
Epidermal-cells of the inferior face outside the mestome-bundles very thick-walled with narrow lumen	*L. lenticularis.*
Epidermal-cells very warty	*L. oryzoides.* *L. Virginica.* *L. monandra.* *L. lenticularis.*
Epidermal-cells often perfectly smooth	*L. hexandra.*

Mestome-bundles.

From one to three small bundles above the midrib	*L. oryzoides.*

Only one small bundle above the midrib	*L. hexandra.* *L. Virginica.* *L. lenticularis.*
Sometimes no small bundle above the midrib	*L. monandra.*
Parenchyma-sheath chlorophyll-bearing in all the mestome-bundles excepting the median-ones	*L. lenticularis.* *L. oryzoides.*
Mestome-sheath thin-walled	*L. Virginica.* *L. hexandra.*

Mesophyll.

Separated in groups by large uncolored parenchyma	*L. hexandra.*

Colorless parenchyma.

Forming groups which connect the bulliform cells of the superior and inferior face	*L. hexandra.*

U. S. Dep't of Agriculture, Washington, D. C.

EXPLANATION OF PLATE XXVI.

Sections of leaves of *Leersia hexandra, L. lenticularis, L. Virginica* and *L. monandra.*

Fig. 1. *L. hexandra* (North Carolina). Transverse section of the middle of the blade. The black part represents the mesophyll. × 75.—Fig. 2. Same species (Texas). Transverse section, showing the bulliform cells and the colorless parenchyma between two mestome-bundles. *S. F.*, the superior face. × 320.—Fig. 3. The variety *depauperata* of *L. hexandra* (Florida). The base of a hair from the inferior face of the blade. × 320.

Figs. 4–6. *Leersia lenticularis.*

Fig. 4. Transverse section of the middle of the blade. × 75.—Fig. 5. Bulliform and thick-walled epidermal-cells; the last from underneath a mestome-bundle. × 320.—Fig. 6. Colorless parenchyma from the midrib, bordering on the mestome-sheath (*M. S.*). × 320.

Fig. 7. *Leersia Virginica.* Transverse section of the middle of the blade. × 75.

Figs. 8–10. *Leersia monandra.*

Fig. 8. Specimen from Texas. Transverse section of the middle of the blade. × 75.—Fig. 9. The median mestome-bundle; *J. F.*, the inferior face, *M. S.*, the mestome-sheath. × 320.—Fig. 10. Specimen from Florida. A small mestome-bundle above the midrib, surrounded by a mestome-sheath (*M. S.*), but only containing leptome. × 320.

Daniel Cady Eaton.

GEORGE E. DAVENPORT.

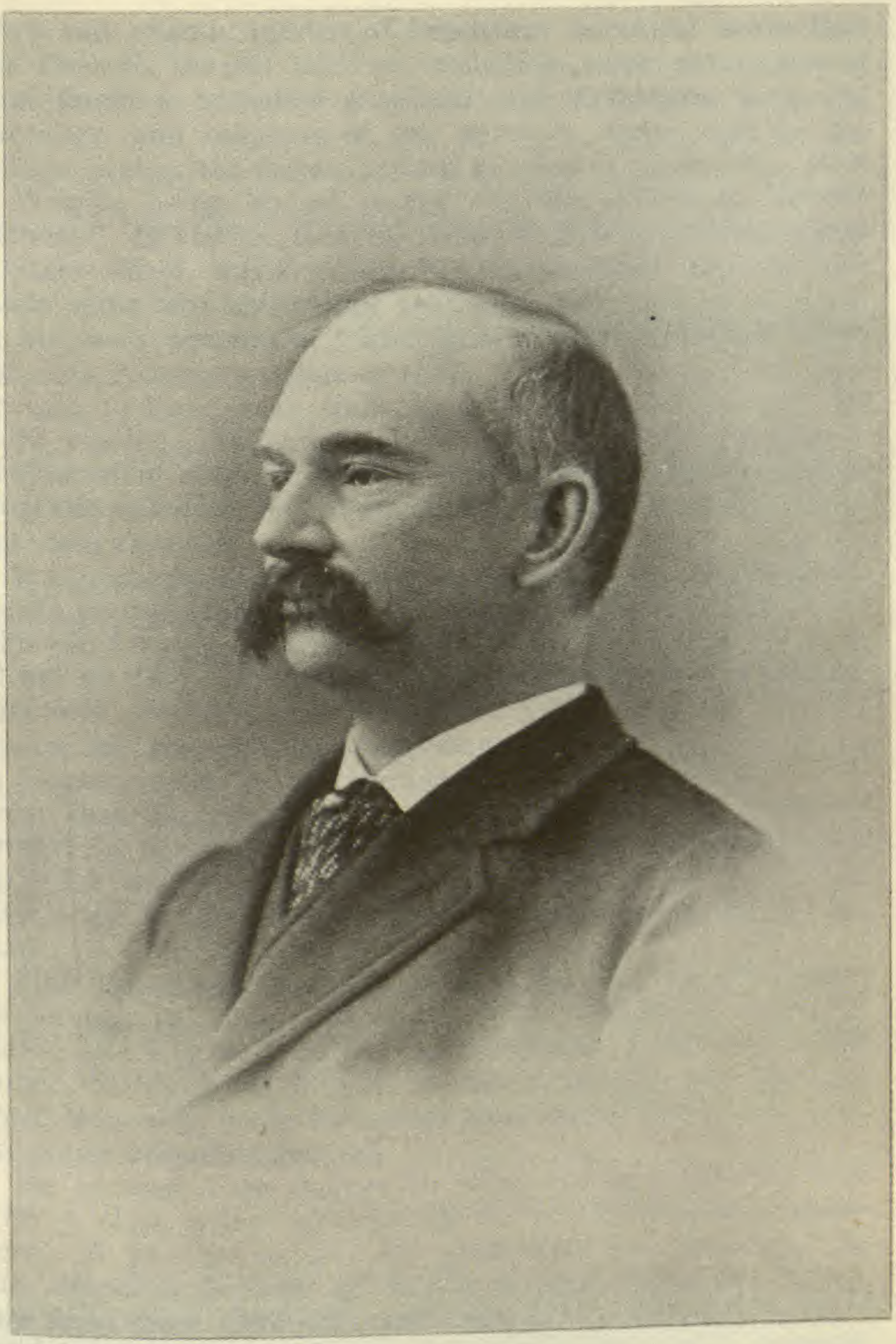
WITH PORTRAIT; PLATE XXVI A.

The death of this eminent pteridologist, who has been for so many years our leading authority on the ferns, will be felt most keenly by all who love those beautiful plants with which his name has been so long associated that we cannot think of them without thinking of him, and it will be a long time, a very long time before we become reconciled, if we ever do, to his loss.

There are always some with whom one does not like to associate thoughts of death. The places which they fill and adorn seem to be so essential to the good and happiness of others that we wish to think of them as being always with us, an ever living presence. But when the sudden taking away of such awakens us, however rudely, from this dream, and when the shock of the blow which stuns for the moment passes away, we happily find that we are left with the heritage of a memory sweeter and more precious far than even the living presence, and with a richer benediction that is immortal in its influence. Among such we can always think of Prof. Eaton as a conspicuous example.

Charles C. Frost, of Brattleboro Vt., who made his name famous as a botanist while working at his trade as a shoemaker, once told a friend of the writer that Prof. Eaton first had his attention called to the ferns during a woodland stroll by the young lady to whom he was engaged, and who subsequently became his wife; and that the desire to aid her led to his becoming so much interested in the ferns as to make of their study the specialty which has given to his name the reputation it has since borne. If this be true, we owe to her an everlasting debt of gratitude, and our hearts will go out to her with stronger and deeper sympathy in the great sorrow which has come to her now.

It is certain, however, that Prof. Eaton must have inherited a love for botany. His grandfather, Prof. Amos Eaton, of the Rensselaer Institute, Troy, N. Y., was one of the pioneers of American botany. He published between the years



DANIEL CADY EATON.

1816 and 1840 a number of important botanical works that ran through several editions, including some catalogues of local floras, a botanical grammar and dictionary, botanical exercises, and manuals of the northern states, and of the United States, the latter, revised in 1840 in conjunction with J. Wright, being known as the "eighth edition of Eaton's Manual." His father, General Amos B. Eaton, a distinguished military officer, was also interested in scientific pursuits, and made some fern collections that were subsequently included in his son's account of "The ferns of the southwest," published in Wheeler's report in 1878. So that Prof. Eaton may be said to have been well equipped by inheritance for the work which he had undertaken to do. That he rendered a good account of the talents thus entrusted to him is evident from the splendid record which he has left for others to admire and emulate.

It is probably not generally known that Prof. Eaton had a cousin younger than himself, bearing precisely the same name, who was for some years professor of the history and criticism of art at Yale. In consequence of this fact the two professors have sometimes been confused. It is probably for this reason that the erroneous statement of his having been born in Johnstown, N. Y., has been published, as well as the statement that his name appears on the Yale "roll of honor" as private in the seventh New York regiment, although he did serve for several years as inspector of stores at New York city in the United States commissary department during the war.

Prof. Eaton was, however, born at Fort Gratiot, Michigan, September 12, 1834, and was the son of General Amos B. Eaton and Elizabeth Selden, of Rochester, New York. His father distinguished himself in the Seminole and Mexican wars, becoming major by brevet after Buena Vista, and subsequently brigadier-general.

He entered Yale College in 1853, and graduated in 1857 with a class noted subsequently for its distinguished members. A year previous to his graduation he contributed to the *American Journal of Science* a short paper on "Three new ferns from California and Oregon." Immediately after graduation he entered Harvard as a member of the Lawrence Scientific School, where he began the systematic study of botany under Prof. Asa Gray.

Here was formed that intimacy and friendship between two kindred natures which continued without interruption until the death of Dr. Gray, and which led him to dedicate to his revered instructor and friend, his magnificent work on "The Ferns of the United States of America and British North American Possessions," published in 1879–80.

In 1860 Prof. Eaton received the degree of bachelor of science from Harvard, and in 1864 he was elected professor of botany at Yale, with duties chiefly in the Sheffield Scientific School, where he remained until his death.

Previous to this time he had published papers on the ferns of Japan, and eastern Cuba, and contributed the chapter on Filices to Chapman's "Flora of the southern United States." During the thirty-one years of his professorship at Yale he published more than sixty papers, mostly on the ferns, mosses and algæ, with an occasional diversion, as in his "Vegetable fibres in an oriole's nest;" "Tea, coffee, and chocolate; their nature and their effects;" and his botanical definitions in Webster's "International dictionary."

In 1867 he elaborated the ferns for the fifth edition of Gray's "Manual of the botany of the northern United States," and the "acrogens" for Gray's "Field, forest and garden botany" a year later, continuing the revisions through all subsequent editions of those works to the present time.

Two of his most important works of this period were his report on the Compositæ in Watson's "Report on the botany of the geological survey of the fortieth parallel under Clarence King," published in 1871, and his splendid elaboration of the ferns for Lieut. Wheeler's "Report on the United States geological surveys west of the 100th meridian," published in 1878. It was in this latter work that *Nothalæna Hookeri* was elevated to specific rank and dedicated to Dr. Hooker who had previously treated it as a variety of *N. candida* under the name of *fido-palmata.* The entire scope of this elaboration was broadened so as to include all the ferns known to have been collected west of the 100th degree of longitude, and south of the 40th degree of north latitude, under the head of the "Ferns of the southwest."

This work was supplemented later on by an elaboration of the vascular cryptogams for the "Botany of California" published in two volumes under the direction of Sereno Watson. One of the writer's botanical treasures is a nearly complete proof copy of Prof. Eaton's share of this work from his own hands. Not the least valuable of Prof. Eaton's many papers have been his notes on "New and little known ferns of the United States," which have appeared inthe *Bulletin* of the Torrey Botanical Club from time to time, and which have always been anticipated eagerly by botanists, while his check list of ferns has been invaluable as a medium for exchanges.

Latterly he has been engaged with Edwin Faxon and others in preparing for distribution fascicles of the sphagna, and from January, 1891, to April, 1895, has contributed reviews of botanical works to *The Nation.*

A complete enumeration of his many papers, or an extended notice of even a portion of them here is out of the question in a notice necessarily brief, however much one might be inclined to dwell upon it, but it is not too much to say that the one monumental work by which he will always be best and most popularly known and remembered is the grand work on our North American ferns published in two superb volumes in 1879–80. It is much to be regretted that a third volume could not have been added to that splendid publication, to include the fern allies, out of the abundant material which has accumulated since the last part was issued.

Of Prof. Eaton's personality it is not possible to speak except in the very warmest terms of admiration. His was a regal nature possessing that true nobility of soul which subordinates self wholly, and is ever ready to acknowledge and correct errors of judgment.

It was this quality, the readiness with which he would always reconsider and carefully weigh evidence for or against any position he may have taken, that endeared him to the writer, who, though seldom having the pleasure of a personal meeting, yet through frequent correspondence extending over a period of some twenty years, had come to entertain for him the very highest regard.

It has been well said of Prof. Eaton that he was ever ready to aid those seeking light. "He was singularly but unobtrusively helpful in every social relation, generous and tender in his charities, and always eager with some self-sacrificing act of neighborly kindness."

For the passing away of such a man there can be but one sincere feeling, that of deep regret, and sympathy for those who remain.

Medford, Mass.

The nomenclature question.

A further discussion of the Madison rules.

In the preceding number of the GAZETTE, Mr. Coville attempts to waive an objection to the Madison rules, on the ground that the occurrence of such cases as I had presented, was a matter of "almost ridiculous improbability." To prove his point he has referred to the union by Dr. Kuntze of various genera with Aster, implying that it did not lead to the results depicted. It scarcely need be said in reply that of course it did not, because Dr. Kuntze did not follow the Madison rules. If on the other hand Mr. Coville means to say that the Madison rules, if applied to this combination of genera, would not have led to a number of just such cases as I have illustrated, he is greatly in error. To prove this statement the following examples may be cited.

Dr. Kuntze transfers to Aster, among many other species, *Aplopappus Chamissonis* DC., *A. Palmeri* Gray, *A. Parryi* Gray, *A. spinulosus* DC., *A. Watsoni* Gray, *A. Hallii* Gray, and *Solidago litoralis* Savi. All of these species had specific names, which duplicated younger specific names already in Aster, so that if the Madison rules had been followed the seven species of Aster with later names would all have been rechristened and, as I have pointed out in a former paper, could never, consistently with the Rochester and Madison rules, regain their original names, no matter how soon the genera were again separated. Having thus shown seven cases in point in the very example cited by Mr. Coville to prove their non-existence, I may leave it to the botanical public to judge whether the occurrence of such instances is of ridiculous improbability and whether Mr. Coville has really made any satisfactory answer.

In place of further argument, my critic has attempted to give to the discussion an unwarranted personal turn, which I greatly deplore. He accuses me of making a "depreciatory allusion to the botanists of the Madison meeting of the American Association both as to their number and their standing." The only portion of the paragraph, which he cites, which could possibly be so falsely interpreted, is as follows: "Considering that the 'List of Pteridophyta and Spermatophyta' has not to my knowledge received as yet the formal sanction of any considerable or representative body of American botanists," etc. When I wrote this I certainly had not the remotest thought of its being applied to the Madison gathering, and I can scarcely see how my critic can maintain that my words have the compromising purport which he ascribes to them. Certainly the "List" has not received the formal sanction of the Madison conference, for the simple reason that it was not published, nor in great part even written, until long after the Madison meeting, so that no one, who gave my statement a moment's thought could have read into it any slur upon the members of the Madison convention. It is a well-known and generally established custom for assemblies of all sorts to refer work to committees, but the results of such work cannot be said to have received the formal sanction of the body until the committee has made its report, and the report has been accepted.

While Mr. Coville's examples of the doctrine of homonyms are lucid, the felicitous effect of that theorem is not yet apparent to all. The case may be presented in the following somewhat modified form. When it is found that a valid species has by chance received the same name as an older defunct one, relegated to synonymy, the former is, according to the doctrine of homonyms, to have its name changed at once, while according to the usage now prevalent in all foreign countries and among a number of our own botanists, such a valid species would be allowed to retain its name until there was a practical reason for changing it. This reason could in general only be the revival of the older homonym as a good species, which would certainly not occur oftener than once in four or five times, so that there would in most cases be no occasion for change at all. That the former course, which makes a host of premature changes many of which need never be made, is conducive to greater stability is, to say the least, not self-evident. Mr. Coville advocates immediate renaming in case of all such homonyms for the rather singular reason that future specialists doing critical work may not have to disturb nomenclature. But would it not be safer to entrust such changes to the specialist when he has in due time demonstrated that they are necessary than to the enthusiastic reformer, whose basis of action is only a theory of botanical language as yet endorsed only by a small part of the active botanists of the world? Certainly we should scarcely need a better example of the difference between the theoretical and practical in nomenclature, a distinction already brought out in the recently published recommendations and quite clear to many of our American botanists.—B. L. ROBINSON.

BRIEFER ARTICLES.

Deanea, a new genus of Umbelliferæ from Mexico.—(WITH PLATE XXVII.)—We have just completed a report upon what is perhaps the largest and most valuable collection of Umbelliferæ ever made in Mexico. This collection, the joint work of Mr. E. W. Nelson, of the Department of Agriculture, and of the veteran collector, Mr. C. G. Pringle, of the Gray Herbarium, comprises more than fifty species and contains four undescribed genera. One of these, *Neogoezia*, has recently been published by Mr. W. Botting Hemsley, of Kew Gardens. We now present a description and illustration of a second one.

Deanea, n. gen. (PEUCEDANEÆ.)—Calyx-teeth obsolete. Fruit oval, glabrous, with 2-parted carpophore and broad conical stylopodium bearing a short style. Carpel, with dorsal and intermediate ribs thickened, filiform; lateral wings broad and thin, surrounding the fruit. Oil-tubes, one to three in the intervals, six to eight on the commissural side. Seed strongly flattened; the face with a narrow sulcus which connects with a narrow cavity extending laterally across the face of the section, making a strongly involute seed.—Short caulescent perennials, with filiform or tuberous roots, ternately or pinnately dissected leaves, involucre wanting or of a single bract, involucels of small linear bractlets, and purple flowers.

There is a general resemblance in habit to *Rhodosciadium* Watson, but the obsolete calyx-teeth, more prominent stylopodium, and especially the peculiar cavity of the seed face, plainly separate it. *Prionosciadum* Watson has a somewhat similar seed-face, but its species are high caulescent, even shrubby plants, with much larger and more prominently ribbed fruit, depressed stylopodium and short calyx-teeth.

The genus is dedicated to Mr. Walter Deane, of Cambridge, Mass., whose interest in American botany and botanists deserves commemoration.

Deanea nudicaulis, n. sp.—Shortly caulescent or acaulescent, 3 to 5^{dm} high, from thick branching roots: radical leaves dark green, two to three times ternate; leaflets ovate, lobed and toothed, acute, glabrous; stem leaves reduced to inflated sheaths, with one to three small leaflets, often opposite: fruiting rays (three to eight) spreading, 2.5 to 5^{cm} long, slightly scabrous on the angles: pedicels 3 to 6^{mm} long: fruit 5^{mm} in diameter; wings thin, as broad or half as broad as body; oil-tubes three to four in the intervals, six on the commissural side.

C. F. Faxon del. B. Meisel, Lith. Boston.

DEANEA NUDICAULIS Coult. & Rose, nov. gen. et sp.

Collected by Mr. C. G. Pringle, on the Sierra de San Felipe, altitude, 7,500 to 10,000^{ft}, May 28, 1894, and August 3, 1894, no. 4,663; and by E. W. Nelson, on the Sierra de San Felipe, at an altitude of 10,000 to 11,000^{ft}, September 20 to 30, 1894, no. 1,087.

Deanea tuberosa n. sp.—Shortly caulescent, 5 to 7.2^{dm} high, from a globose tuber: leaves twice pinnate; leaflets sharply toothed or cleft into linear segments, slightly scabrous beneath: peduncle 2 to 3^{dm} long: rays five to eight, unequal, 1.2 to 5^{cm} long; pedicels 2^{mm} long: fruit about 6^{mm} in diameter; wings thin, about as broad as body; oil tubes one to three in the intervals, six to ten on the commissural side.

Collected by Mr. C. G. Pringle in low meadows, valley of Toluca, Mexico, Oct. 3, 1892, no. 4,295. This plant was distributed by Mr. Pringle as a *Rhodosciadium*.—John M. Coulter and J. N. Rose, *Lake Forest and Washington.*

Explanation of Plate XXVII.—Fig. 1, flowering specimen; fig. 2, fruiting umbel; fig. 3, dorsal view of carpels; fig. 4, cross section of the same; figs. 3 and 4, somewhat enlarged.

The pignuts.—There is some question as to the exact distribution of the common pignut (*Carya porcina* or *Hicoria glabra*) and the related *Carya* or *Hicoria microcarpa*, and the undersigned will be grateful for herbarium specimens and especially nuts with their husks, representing both. In the recently published seventh volume of Professor Sargent's Silva, the range of *glabra* is given as southern Maine to southern Ontario, through Michigan to southeastern Nebraska, southward to the shores of the Indian River and Peace Creek in Florida, and to southern Alabama and Mississippi, through Missouri and Arkansas to eastern Kansas and the Indian Territory, and to the valley of the Nueces River in Texas. *H. microcarpa* (treated in the Silva as a variety of *glabra*, under the varietal name *odorata*) is said to occur in eastern Massachusetts, Connecticut, eastern and central New York, eastern Pennsylvania, Delaware, the District of Columbia, central Michigan, southern Indiana and Illinois, and Missouri.—William Trelease, *St. Louis, Mo.*

EDITORIAL.

UNDER THE CAPTION "American nomenclature," the editor of the *Journal of Botany* prints in the July number a portion of a private letter from some American correspondent in which occurs the following: "The only two botanical journals are controlled by reformers. . . . The journals in question will not accept articles which give a true account of what has been said against the American system in Berlin and Vienna. A notice stating the facts was sent to *Science*, and . . . suppressed. It was then sent to the BOTANICAL GAZETTE, but was declined."

Inasmuch as the editor has sufficient grace to recognize this charge of suppression of the truth as a serious one, it would seem to have been his duty to determine whether it was true or false before publishing it. He could hardly have failed to observe that the GAZETTE has been publishing articles adverse to the reform movement in nomenclature, and had he re-examined them he would have found four of the six on this topic by opponents of reform and only two in favor of it. Another, likewise adverse, is published in this number. We challenge our readers to say whether this shows a spirit of fairness or a desire to suppress discussion. Does it even indicate an inclination to refuse "articles which give a true account of what has been said against the American system?"

So much the editor of the *Journal* could have inferred from the action of the GAZETTE. It is enough to raise at least a presumption that his correspondent's statement was untrue. But he prefers to assume that what the GAZETTE has rejected has been rejected for the purpose of suppressing the truth.

AS A MATTER of fact the GAZETTE has rejected but one article on the subject of nomenclature. The article "suppressed" by *Science* was rejected by us because it contained numerous objectionable personalities. In returning the MS., we took pains to inform the author that we objected only to the personalities, *not* to his opinion on nomenclature, and that if the personalities were eliminated the paper would be accepted. When the MS. was returned to the editor, however, it had been so greatly amplified that it would have filled at least thirteen pages of the GAZETTE. It was therefore returned to the writer with a request to condense it, and he was offered any space up to five pages (about the space required by the original paper), but he declined to alter the MS., and finally withdrew it.

IT IS DIFFICULT to believe that a wish to be fair to what he is pleased to call "the arbitrary dicta of certain American botanists" animates the utterances of the editor of the *Journal of Botany*. If it does it is at least curious that two scientific men should come to such opposite conclusions upon the same facts as do Mr. James Britten and a strenuous but gentlemanly opponent whose name we withhold but whose voluntary words we are permitted to quote:

"I have greatly regretted the ill-natured statements of J. Britten, especially those in which he implies that there has been any unfair suppression of opinion by the GAZETTE. I am confident that whatever has been rejected by the GAZETTE has been refused for the best reasons and for the sake of harmony and the best good of all concerned."

CURRENT LITERATURE.

The fertilization of Flanders flowers.[1]

In the first part of the introduction the author gives a review of the literature of fertilization and pollination, considering the works of Camerarius, Koelreuter, Sprengel, Darwin, Hildebrand, Delpino, Axell, Müller, Loew, Burck, Weismann, Wallace, and others. In the second part it is insisted that too much importance has been attached to the colors of flowers, and that many characters regarded as adaptations to insects can be otherwise explained. This part also contains a discussion of the Knight-Darwin law, and of the theory of Naegeli, and observations on methods of elucidation of floral mechanisms.

The body of the work, (pp. 130–562), contains descriptions of the indigenous, and some cultivated, species, original and accompanied by many original illustrations, or based on the authority of persons cited. The insects observed on flowers of the entomophilous species are given in each case. The remainder of the work is concerned with general considerations and is followed by a résumé in French.

The region is characterized by being low, having numerous slow streams, frequent rains, fertile soil, mild winters, and summers of moderate heat. There are many anemophilous plants, 215 in a total of 675 species, and few flower-loving insects. In a region which is said to be the most densely populated of the most densely populated country of Europe, the influence of man must be considerable, and this factor is justly estimated by the author.

MacLeod records the results of extensive observations upon the

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[1] McLeod, Dr. Julius.—Over de bevruchting der bloemen in het Kempisch gedeelte van Vlaanderen. pp. (1–694). Figs. 125. Ghent. 1894. Reprint from the Botanisch Jaarboek **5**: 156–452. 1893.—**6**: 119–512. 1894.

phenological positions of the anemophilous flowers, as well as the entomophilous flowers and anthophilous insects. It may be worth while to compare these results with those obtained in Illinois, as regards the seasons of some dominant families, giving the number of species in bloom in each month. In the following table, under each family, the first figures are for Flanders, the second for Illinois.

Family.	*No. sp.*	*Mar.*	*Apr.*	*May.*	*June.*	*July.*	*Aug.*	*Sept.*
LILIACEÆ	11	..	2	8	6	2	2	1
	17	1	9	12	6	3	..	..
ORCHIDACEÆ	11	..	..	3	10	7	..	..
	6	..	..	4	2	1	..	1
POLYGONUM	10	..	..	1	4	10	9	6
	11	..	..	.	3	8	11	11
RANUNCULACEÆ	19	..	5	15	17	13	9	5
	19	3	11	14	10	4	2	..
CRUCIFERÆ	31	1	13	25	28	19	14	9
	13	..	9	12	7	5	3	3
ROSACEÆ	24	..	8	15	19	12	9	3
	23	..	8	16	14	8	4	4
LEGUMINOSÆ	31	1	2	14	27	26	23	17
	37	..	2	7	12	20	25	16
UMBELLIFERÆ	26	..	..	7	16	23	23 (1)	13
	19	..	4	12	12	6	4	3
GENTIANACEÆ	6	..	..	1	2	5	5	4
	4	..	..	1	1	1	1	2
BORRAGINACEÆ	11	..	1	10	11	8	5	4
	4	1	3	3	2	1	1	1
LABIATÆ	28	2	5	8	18	24	24	20
	23	..	..	3	8	16	18	18
SCROPHULARIACEÆ	27	2	5	12	22	24	19	13
	20	..	3	8	9	8	11	9
COMPOSITÆ	65	4	5	9	32	63	60	49
	86	..	3	9	17	41	64	75

A comparison of the groups will show that the maxima of the more highly specialized approach more nearly those of the less highly specialized than is the case in Illinois. Several families show June maxima, which is not true of any of them about Carlinville, Ills. The curves given in the *American Naturalist*, Feb. 1895, are based on the actual phenological positions of the plants as indicated in lines representing the blooming periods. This gives quite different results from those obtained by estimating the number of species in bloom during the month. For example, in the table I give nine species of Scrophulariaceæ in bloom in June. There are three species which go out of bloom early in the month and three which come in late, and these are separated by an interval in which only three species are in bloom. My curve for Scrophulariaceæ, therefore, shows a June depression. It will be observed that the maximum number given by MacLeod approaches more nearly the total number of the species in each group. This seems to indicate long blooming seasons, for it is not often that these numbers approximate except when the seasons are long, so as to bring most of the species under the maximum point. Long seasons, on the other hand, may indicate that the natural conditions of competition have been disturbed and that the plants are assuming the habits of introduced plants. As a rule, modification of the flowering season must result inevitably in an alteration in the character of the insect visits.

The seasonal development of the insect groups resembles what I have observed for Illinois. The lower Hymenoptera (allotropic) reach their maximum in June, while my observations indicate a maximum in July, and it may prove to be even later. The *hemitrope* Diptera agree in showing a late maximum, but in Illinois the Syrphidæ preponderate early.

Warming has shown that in Greenland, where flower insects are less abundant, the plants with rich vegetative reproduction are adapted to cross-pollination, while those lacking this power of multiplication are self-pollinating. The former may hold their own, at least for a considerable time, if pollination fails, but in the latter failure to pollinate must soon result in extinction. According to MacLeod certain sacrifices must be made in order to attract insects. The materials which serve for the production of nectar and attractive odors are derived largely from reserves which the plant holds when the flowering season commences. If these reserves are considerable, the plant will attract numerous insects and will become adapted to cross-pollination. If, on the other hand, the reserve materials are slight, the plant can use only a small part of them for the attraction of insects, a greater part being reserved for the nourishment of the fruit and seeds. The expenses in that direction being limited, the flowers are less likely to be visited by insects, and accordingly will self-pollinate more frequently. For this reason, the author divides the plants into two sets, capitalists and proletaires, the former consisting of trees, shrubs, herbaceous perennials, biennials and some annuals, the latter containing most of the annuals. It is admitted that a reduction of capital results from a shortening of life, in which man is an important factor. The proletaires are found almost exclusively upon cultivated lands where as a rule it is impossible for the capitalists to endure. They offset the disadvantages arising from the continual disturbances of the soil by a great fertility. On lands which for some time are not disturbed by cultivation MacLeod observes that the proletaires are rapidly crowded out by the capitalists. The self-pollinated plants thus show an advantage over the cross-pollinated only under the pseudo-ecological conditions induced by the hand of man. This disposes of one of the objections of the apostles of self-pollination who have long been distinguished for a facility in mixing heterogeneous data.

On the relation between the mode of pollen transfer and the structure of fruits, the author calls attention to the fact that in wind-pollinated plants, in a great majority of cases, the fruit is one-seeded or few-seeded, while among entomophilous plants the fruit is commonly many-seeded. This is explained as owing to the fact that in the latter case the pollen is more readily carried in quantity sufficient to fertilize many ovules. Among the indigenous plants *Populus* and *Juncus* are the only anemophilous species which are polyspermous. The case of *Juncus* may be explained by the fact that many of the species can self-pollinate. That of *Populus* may be accounted for on the hypothesis that the plants are descendants of entomophilous forms. I suspect that this hypothesis may be shown to be quite probable. Warming has observed that in the Arctic regions *Salix* shows a disposition to resort to anemophily, and this will support us in the supposition that *Populus* has gone through an entomophilous stage. To the indirect agency of insects, therefore, it seems that we must attribute the development of the great variety of polyspermous dehiscent fruits. The theory suggests that the union of many pollen grains in compact masses, as a favoring condition, may explain the development of a high degree of polyspermy in the orchids.

MacLeod has produced an admirable work which well deserves being cited by Willis[1] as a model of this kind of investigation.—CHARLES ROBERTSON.

Minor Notices.

ANOTHER VOLUME in the botanical series of Ostwald's Classics[2] introduces the reader to Andrew Knight[3] and his writings. Six of Knight's interesting articles from the Transactions of the Royal Society, beginning with that most famous one of all which proved that roots and stems take their position in response to gravity, are given, followed by a brief sketch of his life, notes by the translator, and an enumeration of 93 titles of articles on plants published between 1795 and 1838. Knight wrote in a very attractive way, and for many reasons these essays are rightly considered classical. This neat little volume merits a warm reception from the public.

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[1] The Natural History of the Flower. Natural Science **4:** 351. My 1894.

[2] Earlier numbers are reviewed in this journal, **19:** 207.

[3] KNIGHT, THOMAS ANDREW.—Sechs pflanzenphysiologische Abhandlungen (1803–1812). Uebersetzt und herausgegeben von H. Ambronn. Ostwald's Klassiker der exakten Wissenschaften, Nr. 62. 12mo. pp. 63. Leipzig, Wilhelm Engelmann, 1895. *M*1.

NOTES AND NEWS.

DR. G. J. PEIRCE, who has been reading in the botanical libraries at Harvard during the past year, takes the place of Prof. Mottier in Indiana University while the latter goes abroad.

MR. W. C. MCDONALD of Montreal has presented thirty-five acres of ground, conveniently situated and suitable, for the use of the botanic garden in connection with McGill University.

DANIEL CADY EATON, professor of botany in Yale University, died at his residence in New Haven, Conn., on June 29th, after a long illness. A biographical sketch is printed elsewhere in this number.

MR. B. M. DUGGAR AND MR. W. H. RUSH have received the degree of Master of Arts from Harvard University. Mr. Duggar is to join the staff of the Agricultural Experiment Station, Champaign, Ill., and work on entomogenous fungi; Mr. Rush goes to Washington University, St. Louis, Mo., as general instructor in botany.

THE CELEBRATED Japanese lac with which the finest lacquering is done is produced from the latex of species of Rhus. M. G. Bertrand has pointed out (Compt. Rend. **118**: 1215. 1894) that the hardening and blackening of this material, upon which its use as lac depends, is not due to a sudden oxidation alone, but also to the operation of a ferment, laccase.

DANGEARD thinks that he has discovered the sexual process in Ascomycetes. In *Peziza vesiculosa* he has seen two thick filaments lying near each other, and at the tip of each a terminal cell with a nucleus is cut off. These cells copulate and their nuclei fuse. Then the "egg" thus fertilized sends out a prolongation which becomes an ascus into which the nucleus wanders and divides to form the spore nuclei. Cf. Compt. Rend. **118**: 1065. 1894.

HENRY HOLT & Co. announce the publication in December of the second volume of Beal's "Grasses of North America." This volume is to contain descriptions of about 1,000 species and varieties of grasses, native and introduced, with carefully drawn illustrations of at least one species of each group, together with a chapter on the geographical distribution of the plants of this family and a list of some of the most important contributions to their study.

THE DOCTOR'S DEGREE was conferred upon three candidates in botany at the recent Harvard commencement. The recipients were E. A. Burt, thesis: The development of the receptaculum in the Phalloideæ; B. M. Davis, thesis: Considerations on the carposporic type of reproduction; H. M. Richards, thesis: On some points regarding the morphology and parasitism of certain Uredineæ. Dr. Burt goes to Middlebury College, Middlebury, Vt., as Burr professor of natural history; Dr. Davis to Chicago University, as instructor in cryptogamic botany. Dr. Richards has been appointed to a Parker travelling fellowship, and is to study abroad, at Leipzig.

An interesting Ustilago on Zizania latifolia was described by P. Hennings in *Hedwigia* (**34**: 10). It is sold in the markets of Tonkin as a vegetable. In the May number of the Tokyo *Botanical Magazine* K. Miyabe gives an account of it as it appears in Japan, where it is gathered and sold, but not for eating. Japanese women color the eyebrows and hair with the spores mixed with oil. The spores are more largely used in the lacquer industry to produce rusty colored wares by mixing with lac. The smut is also interesting for its development. It starts in the terminal meristem when the shoot is young. The culm remains short, but the spore mass enlarges to four or five inches in length and three fourths of an inch in thickness. The spores are massed into peculiar small granules in cavities in the tissues of the host.

Eriksson's studies on the forms of rusts on cereals deserve special attention. In collaboration with Henning he has already[1] called attention to the extensive development of forms among the different species. These forms differ not only in slight morphological characters, such as the structure or dimensions of the spores, but also in the fact that infection with uredospores from a certain species of grass will be efficient in producing disease in the same host species, and not as a rule in other species of grasses. In a later paper[2] he shows that in five species of Puccinia, growing on thirty-five species of grasses, twenty-two forms can be separated with greater or less certainty. The correctness of such distinctions has been sustained by the negative results of experiments in which he sought, by using the aecideal form as a bridge, to transfer the forms to other hosts than those to which they are specially adapted. It will be readily seen that these experiments open up questions of great physiological and taxonomic significance.

On account of serious financial difficulties and a distrust of the progressive and enlightened educational policy of President John, the trustees of DePauw University, at Greencastle, Indiana, have forced the resignation of the president and set about a return to the old paths. The department of biology having been founded by Dr. John was among the first to suffer. It was summarily abolished, the announcement being made, without previous warning, only the day before commencement. From a professor of zoology and one of botany at the beginning of the last college year, the instructional force is reduced to a single tutor, who is expected to give instruction in the elements of both sciences. Dr. Lucien M. Underwood. whose ability and success as professor of botany have won him the high esteem of both faculty and students, has sailed for Europe and will return in the autumn with his family, who have spent the past year in Germany. He will take up his residence in Syracuse, N. Y.

[1] Zeits. f. Pfl.-Krankh. **4**: 71. 1894.

[2] Ueber die Specialisirung des Parasitismus bei den Getreiderostpilzen. Ber. d. deut. bot. Gesells. **9**: 291. 27 D 1894.

BOTANICAL GAZETTE

SEPTEMBER, 1895.

Development of Vegetable Physiology.[1]

J. C. ARTHUR.

There is a certain fitness in bringing before the section of this Association which has been most recently established some account of that department of botanical science which is one of the latest to be brought into notice as a grand division of the subject. For vegetable physiology, the topic which is to engage our attention, is like a western or African domain, long inhabited at the more accessible points, more or less explored over the larger portion, but with undefined boundaries in some directions, and with rich and important regions for some time known to the explorer, but only now coming to the attention of the general public. In fact, our domain of vegetable physiology is found to be a diversified one, in some parts by the application of chemical and physical methods yielding rich gold and gems, in other parts coming nearer to every man's daily interests with its fruits and grains. Thus it comes about that, before the public is well acquainted with the name of the science, it has differentiated itself into two or three sciences, having quite separate objects in view.

It is the purpose of this address to acquaint you with the growth and present outlines of the group of sciences, which, for convenience, are included under the heading of vegetable physiology, and also to show why they deserve recognition as important constituents of a liberal education along with other natural sciences. The point of view at all times will be that of the American botanist.

In the development of botany in America the science has passed through successive waves or stages of popularity, constantly increasing in momentum, widening its scope by evo-

[1] Vice-presidential address before section G, A. A. A. S., Springfield meeting, August 29, 1895.

lution of new interests, and more and more exhibiting virility by its adaptability to the needs of the times. That botany has in it something that may be transmuted into money has only recently been discovered, but it is a discovery that is likely to work benefit not only to the practical man who makes application of scientific truths to commercial ends, but also reciprocally to the investigator who thinks only of uncovering a new fact or establishing a new law. To adequately meet the requirements of modern botany in the way of laboratories, gardens, herbaria, libraries and apparatus, requires a capital that not long since would have been deemed fabulous. The money to meet this demand of a growing science must be expected to come in the main as the voluntary contribution of an interested public, the reciprocal response to the attitude of botany toward the general welfare.

I have mentioned the economic aspect of botany thus early, because it is one of the significant changes which has come over the science within the last decade or two, and to which vegetable physiology in some of its features is, I venture to say, about to add further important contributions. Science no longer shrinks into the shadow of the closet for fear of being implored to lend a hand at securing revenue, but steps forth and curiously scrutinizes every process of the practical world, often finding there its most fruitful fields for fundamental research.

The problems of vegetable physiology possess to a greater or less degree a special element of interest not inherent in those of other departments of botanical science. They embrace the dynamical property of motion, which never fails to exercise a fascination over the human mind. Physiology, in fact, deals with what plants do, their methods of activity, their behavior; while the other divisions of botany treat of what plants are, or have been, their form, structure, and relation of parts. The one is the study of the organic machine in action, and the other the contemplation of its component members.

Movement in plants does not attain the rapidity exhibited by animals. Some movements in both cases are ultra-visual, as the translocation of molecules in metabolism, the diffusion of gases, and in plants especially the flow of liquids. In plants even the movements of the organs are comparatively slow. While the leaves of the sensitive plant, telegraph plant, and

Venus's fly-trap, and the petals of certain orchids excite the wonder of the casual beholder, most plant organs move too slowly to be readily detected without mechanical magnification. This does not prove a detraction to the interest of the subject, however, as it has led to the invention of ingenious and complicated machines, whose numerous wheels and bands inspire a sense of importance, particularly appealing to a large class of persons in this age of machinery, and constituting an element in securing favorable attention from the public, while it adds a charm to the work of the investigator, rivaling that of the microscope. It is yet but the dawning of day for the display of mechanical contrivances as aids to botanical research, and the future gives promise of notable achievements. The names of Barnes, Anderson, Stevens, Stone, Golden, Thomas, Frost, and Arthur at present are representative of the American inventive spirit in botany. The most perfect and interesting pieces of apparatus yet turned out by them embrace Frost's and Golden's auxanometers for recording the increase in length or thickness of growing organs, Thomas's apparatus for recording the variation in pressure of sap resulting from root action, Anderson's automatic balance for registering the rate and amount of change in the weight of an object, used in studying transpiration and growth, and Arthur's clinostat for neutralizing the action of gravity and light, and his centrifugal apparatus for substituting mechanical force for that of gravity.

While having in mind the public interest in our science, it may be well to notice the very small basis of information on which this interest is founded. Only the vaguest notions are current regarding the nutrition of plants, the uses of the leaves, the movements of sap, the purposes of color, and the means by which new positions are assumed. This ignorance is primarily due, of course, to the same cause which has so long delayed the development of the science upon the technical side: the fact that almost nothing can be learned of the functions of plants from direct observation. In regard to the physiology of animals, even the lowest, much may be inferred by observing their behavior, and analyzing the phenomena from a human standpoint, but there are no obvious similarities between plants and the higher animals, and it is necessary to resort to careful experimentation and profound study to arrive at a fair understanding of the vital actions of plants.

Physiology is an experimental science, and the public must perforce derive its knowledge second hand without much opportunity of verification. It must be admitted that, although a view of this portion of the *res publica naturæ* has its fascination, yet the attainment of vantage ground for the survey is necessarily difficult and slow.

The term public, when used in connection with vegetable physiology, needs to be construed liberally. It will include, without doubt, some able scientists and men of liberal education. I may be permitted to cite an occurrence to which some in this audience were witnesses. Some time since the subject of gases in plants was before the Association and induced an animated discussion. Probably half of those participating confounded respiration, which is a general function of all plants, as well as animals, under all conditions of existence, with the photosyntactic function of fixation of carbon by the green parts of plants in the presence of sunlight. Both processes have to do with oxygen and carbon dioxide, but the resemblance goes no further. It is an error dating back to the last century, when the two processes were discovered, and one for which botanists themselves are by no means without responsibility. Another error not yet dislodged from the cobwebby corners of many a well-read man's intellectual storehouse is the old fiction of a circulation of sap, so dear to those who desire to find analogies in plants with the physiological processes of animals. It is not much over fifty years since the learned French Academy exhibited its ignorance of vegetable physiology by awarding the grand prize to an essay founded upon this error; and the error still lives.

But the general ignorance of even the best established and most readily apprehended facts of physiology may be justly extenuated when the pedagogical status of the subject is examined. Botany, as a substantial part of the curriculum, cannot be said to have received recognized standing in the American educational system until the time of Asa Gray. In the latter part of the decade of the thirties his first text-book, the "Elements of Botany," appeared, and in the decade following the "Text-book for Colleges" and the "Manual," all of which works showed a true appreciation of the best features of the science and the needs of the time. They were so well conceived, and so much in demand, that new editions rapidly succeeded one another; and to the present day they hold a high place in the estimation of botanical teachers. These works possessed a specially potent element of virility in being the expression of knowledge at first hand, the words of the master. In so far as inspiration was drawn from foreign sources it came chiefly from French and English scholars, of whom De Candolle the eldest and Robert Brown were the representatives.

A half century ago vegetable physiology, in the fulness of the modern meaning of the words, did not exist. Structural botany was then the dominant phase, and in elementary instruction took the shape of close attention to the form and arrangement of the organs of flowering plants, with the ulterior object of being able readily to determine the names of the plants of the field. Even then physiology presented some attractive features, but they appeared largely extra-territorial, as the title of the book from which most of us received our early botanical pabulum testifies: "First Lessons in Botany *and* Vegetable Physiology," by Asa Gray, issued in 1857, and continuing its supremacy as a text-book until 1887, when it was revised and renamed.

In the seventies botanical laboratories began to form a necessary feature of the best institutions, each with its quota of compound microscopes and reagents, in which we followed the example of Germany, such laboratories having been established at Halle, Breslau, Munich and Jena a decade previous, and subsequently at many other centres of learning. With the advent of Sachs's "Text-book of Botany" in English dress about this time, the science in America took on a new and vigorous phase of development. The method of this work found more convenient expression in Bessey's "Botany" (1880), which for a decade was the recognized standard of instruction. A wealth of laboratory guides soon appeared, and American botanists became devotees of microscopic anatomy. I scarcely need call your attention to the triumphal advancement of botany during the decade of the eighties, it is so fresh in every one's mind. It amounted to a revolution; the work of the herbarium was wellnigh abandoned for the study of the cell. Those of the older systematic botanists who took no part in this upheaval became alarmed, and put forth vigorous protests, claiming with much justice that pupils so trained lost breadth of view and proper perspective. An editorial writer in the BOTANICAL GAZETTE very clearly contrasted the two methods of instruction. "The ancient method," said he, "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," he continues, "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."

But under both ancient and modern methods of instruction, whether the teacher were a systematist or histologist, whether the pupil pulled apart flowers under a hand lens, or dissected tissues under a compound microscope, botany flourished in America. There was, in reality, a better philosophy abroad than usually appeared in practice. The layman, remembering his school days, might assert with Julian Hawthorne that "botany is a sequel of murder and a chronicle of the dead," but the professional botanist, imbued with the spirit of the times, resented the imputation as no fault of the science; and while deploring the well enough known mediævalism and incompetence of teachers, who only disclosed a descriptive and classificatory science, with marvelous wealth of terminology to be sure, but as lifeless and unbiological as mathematics or astronomy, pointed to the motto held by all the progressionists, "the study of the plants as living things."

The revivifying spirit which was pervading the botanical world, which strove to find in plants more than objects for the glossologist and the cataloguer, which interrogated the plant upon matters of action as if a dumb intelligence, which diffused a new light and a higher significance into every fact of the science, had its source in that all-pervading influence which emanated from the observations and interpretations of Charles Darwin. The brilliant series of works upon the behavior and relationship of plants by this author, beginning with the fertilization of orchids in 1862 and extending through a score of years, left a profound impress upon botanical

ANDREWS on JEFFERSONIA.

thought, based as they were upon the connecting thread of evolution. So different now was the point of view that there sprang up what was called the "new botany." Although the inspiration of the "new botany" was general, yet it manifested itself pedagogically chiefly in elementary instruction and in special studies. We may pass the delightful brochure of Asa Gray on "How Plants Behave" (1872) with a bare mention, as it appeared too early to show any peculiarities of method not familiar to the readers of Darwin, and call to mind the much less pretentious presentation of the new way as understood by Beal under the title of "The New Botany" (1881). He declares it to be a study of "objects before books," in which "the pupil is directed and set to thinking, investigating, and experimenting for himself." The new method did not fit equally well into all departments of botany, and found its best expression for the most part in developmental and physiological subjects. It was in fact the chief agent in preparing the ground for the crop of physiology that is now being sown, and sown in a field selected and staked out by Darwin and Sachs.

Having shown how the field for the reception of the latest botanical husbandry was prepared, I may now briefly trace the source of the ideas with which it was implanted, and in doing so it is necessary to point out that vegetable physiology, as the term is generally employed, is not a homogeneous science.

The advancement of any subject is promoted by a clear understanding of its outlines, and it is in the interest of clear concepts and convenient usage that certain natural limitations should be respected by physiologists. Not that intergradation and mutual dependence do not occur, but that certain natural boundaries may be more or less distinctly recognized which will throw the subject matter into sections and simplify the presentation of the numerous facts of the science.

The most obvious distinction to be made in the physiological aspect of organisms is in regard to their maturity. The organism in its embryonic or juvenile condition manifests functional peculiarities of the highest import, quite unlike those of the adult. The physiology of reproduction belongs here, and includes not only a study of the formation and increase of the young plant, that is, embryology, but genesiology as well, that is, the philosophy of the transmission of qualities and powers from the parent to the offspring, both in vegetative and sexual reproduction. It is a curious fact, to which Vines has recently called attention, that even vegetative reproduction, as in the case of the growth of a plant from a cutting, brings about rejuvenescence of the protoplasm, the new individual showing the characters of youth, and not of maturity. In both sexual and asexual reproduction the attention should be focused chiefly upon the behavior of the cell, and a wonderful complexity will be found in these minute structures. The mystery of a world is bound up in this bit of protoplasm, and corresponding to the *multum in parvo* aggregation of properties there seems to be an unsolved intricacy of structure. By the study of what was originally supposed to be essentially homogeneous protoplasm, we have gradually distributed and extended the properties of the cell to the cytoplasm, the plastids, the nucleus, the nucleoli, the fibrillar network, the chromosomes, the centrosomes, the kinoplasmic spindle, and the polar bodies. What further distribution of function will eventually be found, it is too early in the history of investigation to prognosticate.

But it is not every dividing cell that points the way to a new individual. Plants with complex structures possess tissues of embryonic character, such as the cambium, whose utmost power of division only leads to the production of additional tissues like those adjoining it, but are wholly incapable of originating a new individual, or even a new organ. From this histogenic extreme all gradations and variations occur, to the perfectly reproductive spore, which by its growth forms another individual without contributing anything to the support of the parent organism.

Beside the elementary riddles of life bound up in the processes of cellular reproduction, or cytiogenesis, there are others relating to nutrition, growth, and irritability, which comprise what animal physiologists group under the term "cellular physiology," for which Professor Verworn, of Jena, made such an impassioned plea in the *Monist* about a year ago. "We find," said he, "that even the minutest cell exhibits all the elementary phenomena of life, that it breathes and takes nourishment, that it grows and propagates itself, that it moves and reacts against stimuli," and therefore he urged that far more attention should be given to this department of physiology, as the key to many complicated processes. The physiological study of the cell, including both its reproductive and vegetative aspects, in so far as they may be considered the nascent functions of the elementary parts of the organisms, may be conveniently considered under a single heading, "caliology."

Passing to the physiology of the adult organism, a little reflection will show that the activities of the plant may be considered from two standpoints: that of the plant's individual economy, and that of the plant's social economy, or its relation to other plants and animals and the world at large. Looking at the latter phase more closely, we shall find that the subject contains some of the most interesting topics in the range of botany, which appeal especially to the lover of nature, without losing their value as problems of the deepest scientific import. Among the relations of plants to the world at large may be mentioned the influence of climate, the means of protection against rain, drouth, and cold, adaptation to the medium in which the plant grows, and the establishment of rhythmical periods. Among the relations of plants to animals are those interesting chapters in the fertilization of flowers by insects, the contrivances by which plants with a predilection for highly nitrogenous food may capture and feed upon insects, and the means adopted by plants to prevent injury from large animals, which are more or less familiar to the general public through the writings of Charles Darwin. Among the relations of plants to one another comes foremost the struggle for existence, bringing into play the laws of natural selection and the survival of the fittest, together with much else that is now known under the head of evolution, followed by various phases of parasitism, mutualism, and other topics. Is it not evident from this hasty and by no means complete outline that here is a portion of physiology which appeals to all classes of thoughtful persons, rich in possibilities for the philosophical and speculative mind, and bristling with queries demanding experimental solution?

Although this department of physiology has received much attention here and there for a long time, and some of its topics are well understood, yet only very recently has it fallen into place as a systematic part of the general subject, and no separate presentation of it has yet appeared in English, and only two works in German. There is some confusion regarding the name of the science. The Germans call it "biology," which may serve to emphasize the importance of regarding the plant as a living, plastic being, but it is not an exclusory term, and also does violence to its philological derivation. Even the recently proposed modification into phytobiology does not much improve the term. The English usage of the word biology, as so admirably set forth by Huxley, and more or less consistently adopted in this country, leaves no place to introduce the imperfect usage of the Germans. Two years ago, in his wholly delightful "Chapters in Modern Botany," Patrick Geddes proposed the term "bionomics." The same year, however, a better term was advocated almost simultaneously in England and America. The Madison Botanical Congress endorsed the word "ecology" as the designation of this part of physiology; and only a few days later Professor Burdon-Sanderson, in his Presidential Address before the biological section of the British Association, outlined the science and traced the origin of the name ecology, of which he made use.

Ecology, therefore, is the name under which we are to attempt the orderly arrangement of the facts, observations and deductions composing the science, in which, to quote Burdon-Sanderson, "those qualities of mind which especially distinguish the naturalist find their highest exercise." The first independent treatise on the subject is by Wiesner (Vienna, 1889), and is an excellent model, while Ludwig's work, issued a few months since (Stuttgart, 1895), which is the second and to the present time only similar work, cannot be so highly praised. A work in English is greatly to be desired.

Having disposed of the external or sociological economy of the adult plant under the heading of ecology, we turn to the consideration of the internal or individual economy. This is the portion of physiology now in the ascendency, and the part which is usually more particularly intended under the present usage of the term vegetable physiology. The tendency is to restrict the titular use of the term to this part of the subject alone, which is to be approved. This gives us three well defined departments in the science of the activities of plants; caliology, ecology, and physiology.

Physiology, in the restricted sense, deals with the most vital of problems, how the individual lives. It pertains to the way in which plants breathe, secure and use their food, adjust themselves to light, heat, moisture, and the contact of other bodies. It deals with what botanists in the days of

Linnæus, and even down to within the last fifty years, would have called the products of the *vis vitalis*. It desires to know what the specific energies of the plant are capable of accomplishing, in short, what is going on within the plant in the way of life processes. As will be readily seen, the whole matter is summed up in an exhibition of energy, which in former days was called vital energy, and thought to reside exclusively in living organisms, but now held to be only a special manifestation of the general physical forces of the universe.

The energies of plants fall into two categories, those which bring about changes in the intimate structure of vegetable substances, and those which bring about movement; and hence we call physiology a superstructure whose foundation is chemistry and physics. The present great advance in the science may, in large measure, be traced to the wonderful advances in the sciences of chemistry and physics, which have supplied facts and methods to assist the physiologist in his study of life processes.

Yet it would be an egregious mistake to suppose that physiology is but a dependency of chemistry and physics. The substitution of the so-called mechanical philosophy of life for the old vitalistic philosophy has not in any way rendered the vital activities less wonderful, or the protoplasmic display of energy less complex, less inscrutable, or less *sui generis*. The meaning of the word life shows no likelihood of being solved until the chemical and physical constitution of the protoplasmic molecule is understood, and that is too far away to make speculation at this time worth while; and so we need not quarrel with those who fancy that even when that advanced goal is reached the problem will not be solved, but a mysterious residuum will still exist to endow protoplasm with autonomy. Be that as it may, the path of present advancement keeps steadily onward in the clear light of physical laws, and ignores the nearness of mystical, unfathomable shadows.

But returning from this long digression in separating physiology into the three reasonably distinct sciences—caliology, ecology, and physiology proper—we will proceed with the inquiry regarding the present scientific status and its course of attainment in each of the three branches. It is not, however, any part of my purpose to give a philosophical or historical disquisition upon the subject, but merely to point out a few land-marks to enable us to get our bearings, so that we may spy out the land and obtain some opinion of what there may be good or bad in it.

The subject of caliology, that is, the various phases of juvenescence, including especially the dynamics of the young cell, has not yet received systematic presentation. Although a vast array of facts has been recorded, mostly to be sure as the concomitants of morphological studies and scattered so widely as to be almost lost, yet the value of the subject as a separate inquiry has not yet much impressed itself upon botanical students. There are, doubtless, most excellent reasons for this, not in any wise dependent upon the importance or attractiveness of the subject. The action of a machine as a whole depends upon the interaction of its parts; and to fully understand its operation requires a knowledge of its mechanism. No adequate theory of the physiological processes in the mature organism was possible until the character of the cellular framework and the distribution of tissues had been well worked out: and in the investigation of cellular physiology there occurs the same inherent difficulty. The structure of the cell in all its microscopic detail must be ascertained, and when the microscope fails us, there must be well-framed theories of the physical organization of the parts, before solid advancement in understanding cellular activity can be expected.

The labors of Strasburger have been especially noteworthy in establishing an adequate morphological basis for the interpretation of cellular activity. If we were to point to a single work as particularly conspicuous in this connection, it would be his *Zellbildung und Zelltheilung* (1875), which introduced hardening and staining methods into the study of the cell, and may be said to have created a new school of histologists, even more conspicuously represented among zoologists, possibly, than among botanists. Great accuracy and a far clearer interpretation have been attained by the new methods, causing a rapid accumulation of trustworthy facts regarding the parts of the cell, especially of the reproductive cell and its neighbors, and of the succession of changes as the young organism or as the histogenic elements pass toward maturity. In this important work America can count some able investigators and valuable contributions, especially in making known the development of the metaspermic embryo and accompanying changes.

Morphological knowledge of the cell and of the stages in reproduction must necessarily be followed by inquiry into physiological processes. Already the writings of De Vries, Strasburger, Klebs, Vöchting, Wiesner, and Vines have indicated the directions for study. The greatest impulse to the physiological study of reproduction, however, has been given by Weismann, although not himself a botanist, and not drawing heavily from the botanical storehouse to support his theories. Nägeli's idioplastic theory of 1884, and De Vries's later theories, have not of themselves been sufficient to arouse botanical enthusiasm. The whole domain of caliology is suffering, in fact, for leaders, men chiefly known for their researches in this field. The science needs a Linnæus, a Sachs, or a Gray to bring it into prominence and to inspire enthusiasm and a following. Some day it will be in vogue.

Upon turning to ecology, we find the conditions wholly changed. There are elements of popularity in the science that have made some of its topics familiar to the general reader, even before the boundaries of the science have been mapped. The fascinating and epoch-making observations of Charles Darwin on the pollination of orchids and other flowers, at the same time bringing to light the long lost Pompeian-like treasures of Sprengel, gave an impulse to a line of study still full of promise. The extensive writings of Müller, Delpino, and in our own country Charles Robertson, have provided large stores of knowledge, and at the same time opened up attractive vistas for further observation.

Thus we might enumerate many other topics, which are more or less familiar to every one having the slightest acquaintance with botany, and to some others as well. If we ask how these matters came to be so widely known, the answer is not far to seek, and not obscure. The marvelous inspiration which came with the writings of Charles Darwin, and the fact that he cultivated ecological subjects more than any other, together with his theories of adaptation and natural selection which provided a key to the riddles of nature, making what were before matters of course now matters of the liveliest import, turned the attention of the botanical world, and of all other lovers of plants as well, even of some who cannot be placed in either class, in this direction. We may call Darwin the father of vegetable ecology, for had he not written, the field would have lain largely uncultivated and uninteresting.

In America the year 1887 saw the establishment of a series of state institutions, which gave a wonderful influence to the study of ecology. American botany owes much to the Agricultural Experiment Stations, especially in promoting a knowledge of vegetable pathology and ecology. Together with the Agricultural Department of the general government, they have enabled American botanists to become the leading investigators and writers upon pathological subjects, giving a position and imparting a value to the science of plant diseases, both scientific and practical, that ten years ago would have been inconceivable. What has been done for pathology is likely to be done for ecology, as it is the second subject in importance cultivated by station botanists. In the latter science the assistance of the Agricultural Colleges is also important, for in a few years the subject will undoubtedly hold a commanding position in the curriculum of the agricultural and general science courses of these institutions, and be regarded as the culminating and leading feature of a course of botanical study. It may seem presumptuous and fanciful to claim so much and be so positive in face of the fact that at the present time the subject is a *nomen incognitum* to the makers of curricula in these institutions; but careful examination of the subject matter of the science shows that even in its present rather chaotic condition it embraces more points of vital interest to the lover and cultivator of plants than other departments of botany, being less recondite, and yet at the same time underlaid with a broad and attractive philosophy. What is most needed at present is a suitable textbook; for the value of the subject will be more quickly recognized when it is displayed in well arranged form.

It would be interesting and profitable to take a survey of the development of the different branches and topics of the science, but I shall content myself with barely mentioning one or two which especially flourish in this country. Recently a new life has been infused into the study of floras and the distribution of plants by what is called the "biological" method, the inspiration having been derived in the first place from the zoologists. This method, which has so far been most successfully applied to limited areas in the western part of the United States, undertakes an explanation of the present location of forms by considering severally and collectively the various external and inherent factors promoting and restricting their development, including the reciprocal influence of proximity. Of the names prominent in this connection, those of Coville, Trelease and Macmillan are especially worthy of mention. The last has done good service by calling attention to the significance of tension lines, in his account of the "Metaspermæ of the Minnesota Valley." There is a phase of phylogenetic study which has received some attention of late, in form of the breeding of plants. It is a subject especially adapted to experiment station work. The leader in this line of research, L. H. Bailey, has also materially promoted ecological studies by his numerous biogenetic and other writings.

Coming to physiology, *sensu stricto*, we find the domain of the science so well defined and its several areas so well cultivated that a clear statement of its main problems is now possible. Not much advancement was made before the beginning of the present century. The most notable achievements had been the publication of Hales's brilliant work on the pressure and movement of sap, which introduced the physical side of physiology to the world, and Ingenhousz's equally entertaining volume upon his discoveries regarding the uses of green organs, which introduced the chemical side of physiology to the world. The century was ushered in by Knight's classical essays, in which it was first pointed out, among other things, that there was a substantial reason why roots grow downward and stems upward, and by De Saussure's researches upon respiration and other chemico-physiological matters. It is worth mention that Hales, Ingenhousz, Knight and De Saussure were not botanists, although they cultivated botanical subjects; neither were Senebier, Du Hamel, Dutrochet, Liebig, Boussingault and others, who assisted in laying the foundations of the science, but were physicists, chemists and horticulturists. And to this day many important data are contributed to the science by workers in other fields.

Thus facts accumulated, important discoveries were made, and the mysteries of the life processes in plants were gradually unfolded. But it was not until 1865 that the science was given the commanding position due to it. Then appeared the first treatise which set forth the phenomena and laws of vital processes with due regard to proportion, and with clear philosophical insight. Sachs, in his "Experimental Physiology," became the founder of the science in its modern aspect. He set forth with critical discrimination the most important matters pertaining to the organism's relation to light, heat, electricity and gravity, the processes of metabolism, nutrition and respiration, and the movement of water and gases in the plant. With rare foresight he excluded all, or nearly all, topics not strictly belonging within the true scope of the science, and presented the whole subject matter in an entirely original form, breaking away from the customs of his predecessors and adopting advanced scientific methods. It was an epoch-making book. As Strasburger has recently said in his history of botany in Germany, "the work at once restored vegetable physiology to its place at the centre of scientific research."

The book has never been translated into English, and so, while it stimulated the study of physiology in Germany, and physiological laboratories soon became common, led by the famous one at Würzburg presided over by Sachs, American botany felt little of the new movement until the appearance of Sachs's "Text-book" in English dress a decade later. Even then the new science (for such it was in America) gained but an insecure footing. After another decade, in 1885, appeared the first, and to the present the only, treatise on physiological botany by an American author. This was written by Goodale in response to the desire of Asa Gray to have the several parts of his "Text-book for Colleges" expanded into separate treatises, in order to more fully represent the status of botanical science. As late as 1872 Dr. Gray contemplated writing the work himself, but, his time proving insufficient, he assigned the task to his worthy colleague. The title is used in its broad sense, and included histological anatomy, ecology, and caliology, as well as physiology proper, the last being by no means the most conspicuous part of the book. The encyclopedic fulness of the work better adapted it for a reference book to accompany a course of lectures than as a text book. It greatly helped the science in America, however, especially as it stimulated experimental study by a set of laboratory exercises given as an appendix. The year following appeared Vines's "Physiology of Plants," in some respects the most philosophical and well-digested presentation of the science yet written in any language; and only a year later still came Sachs's new treatise on the same subject. These two works were too bulky to serve well as text books for undergraduate students, but were a source of inspiration to maturer students and to investigators. The present year, completing the third decade since the physiological epoch began, has seen the altogether admirable, although brief, account of the science by Vines, forming part of his "Text book of Botany" and two excellent laboratory manuals, one by Darwin and Acton of England, and the other an English adaptation by MacDougal of a German work. With these treatises elementary instruction is well provided for, and their effect is already seen in the rapid introduction of the study as a portion of botanical instruction in colleges, and even high schools, throughout the country.

Thus far only the pedagogical side of the science has been brought prominently forward; but what can we say of the research side? So far as America is concerned, there is no research side; the science is equipped and expanded with facts and theories from foreign sources. A few papers embodying original investigations have been published by American teachers, but they were the result of studies carried on in German laboratories. A dozen or two papers have, indeed, been issued from our own laboratories within the last five years, but all of them have been the work of students, mostly in preparation for a degree. America has nothing to show that can in any wise compare with the important discoveries made and still being made by Francis Darwin in England, De Vries in Holland, Wiesner in Austria, or Sachs, Pfeffer, Vöchting, Frank, and others in Germany. There are ample reasons why this state of things need not be considered humiliating, and yet it is to be deplored as most unfortunate.

Let us turn to a hasty examination of some of the problems of physiology which await solution. They stand out prominently in every chapter of the science, and suggest to the scientific mind most tempting opportunities for original investigation. The nutrition of plants is so imperfectly understood that it may appropriately be said to be a bundle of problems. So little do we know of the processes that even what constitutes the plant's food is in doubt. We know, for instance, that lime and magnesia are taken into the plant, but whether they are directly nutritive by becoming part of living molecules, or whether they serve as aids to nutritive processes, or become the means of disposing of waste materials within the organism, cannot be definitely stated. And to a greater or less extent similar conditions exist respecting potassium, phosphorus, sulphur, iron, and chlorine, which in fact embrace all the so-called mineral elements of plants. The movements and transformations of the two most characteristic elements of organic structures, carbon and nitrogen, are a little better known. Some progress has been made in tracing the steps by which the simple molecule of carbon dioxide derived from the atmosphere is built up into the complex, organic molecule of starch. But the further process by which the starch molecule combines with others to form the most complex and important of all plant substances, protoplasm, is yet an almost complete mystery. The story of the progress of discovery in ascertaining the means by which plants get their nitrogen is a fascinating one, and is not yet ended. These matters in part lie at the very foundation of the most fundamental of industries, agriculture. Intensive farming, and the highest success in the raising of all kinds of crops, is greatly promoted by a knowledge of the nutritive processes in plants. The botanists, who thirty-five years ago demonstrated that carbon was taken into the plant through the leaves, and not to any material extent through the roots, struck a theme that revolutionized agricultural practice and added greatly to the wealth of the world. The more recent discovery of the connection of symbionts with leguminous and some other plants, by which the abundant supply of nitrogen in the air is converted into food available for higher plants, has also greatly affected agricultural practice. The whole subject of the nutrition of plants is so bound up with intelligent farming and all manner of plant cultivation that advancement of this part of physiology means an increase in material prosperity as well as in scientific knowledge. Ample provision for its prosecution would be a valuable investment for any people, and particularly so for the people of the United States.

There are many ways in which plants show similar physiological processes to those of animals; and plants being simpler in organization, their study may often be made to promote a knowledge of animal physiology. The greatest similarity between the two kingdoms lies in various phases of nutrition, respiration, and reproduction. The greatest divergence is to be found in the manifestation of irritability. Those fundamental processes upon which being and continued existence depend are much the same throughout animate nature, but the processes by which the organism communicates with the world outside of itself, and through which it is enabled to adjust itself to environmental conditions, the processes which in their highest development are known as sensations, have attained great differentiation, running along essentially different lines of development. The prevalent view that plants occupy an intermediate position between the mineral and the animal kingdoms is not true in any important respect. Neither is it true that the faculties of animals, especially of the lower animals, are foreshadowed in plants. No just conception of animate nature can be obtained by conceiving it to lie in a single ascending series. It constitutes two diverging and branching series, like the blades and stems in a tuft of grass, which we may assume have been derived from a common germ. There are two fundamental characters which manifested themselves early in phylogenetic development, one structural and one physiological. The structural character of the histologic integument of the organism, in animals soft and highly elastic, in plants firm and but slightly elastic, gave rise to the two series of forms, structurally considered, which we call animals and plants. The physiological character of free locomotion for most animals and a fixed position for most plants, determined the line of separation for the development of those powers of the organism classed as irritability and sensation. So great have been the differences which these fundamental characters have brought about, that the stimulating action of external agents, such as light, heat, and gravity, have produced very diverse powers in the two kingdoms. Animals have a wonderful mechanism which enables them to see, while plants have a no less wonderfully specialized sensitiveness by which they assume various positions to secure more or less illumination. Animals have a sense of equipoise, but plants have a very dissimilar and even more remarkable sense of verticality. And so on throughout the list of stimuli, the reactions are not the same, but are differentiated along entirely separate and divergent lines. The period is fortunately well past when physiology was chiefly cultivated with an *arriere pensée* as to its value for interpreting the functions in man, and hence, in claiming for this department of study the most exalted position, and the most intricate and interesting of botanical problems, we need not be distracted by any lurking *cui bono*, or feeling of having come short of ample returns for conscientious effort, although the facts do not elucidate any point in human or animal physiology. Some of the dissatisfaction which caused G. H. Lewes to abandon the pursuit of his early dreams of a comparative psychology, and M. Foster to discontinue his early study of comparative general physiology, as both authors have assured us they did, may possibly be traceable to a lack of singleness of purpose in taking the good of the organism itself in each grade of development as the point of view in pursuing the study. But as all vital activity rests upon a common basis, it is not improbable that the key to some of the fundamental mysteries of physiological action will yet be found in a study of the well developed functions exhibited in the simpler, nerveless structure of plants, and thus a truer philosophy of life in general be attained.

In closing, a few words in regard to the future of vegetable physiology in America may not be out of place. In many ways the conditions under which botany exists in America are very different from those in other countries. In Europe the class-rooms are filled chiefly with medical students, for whom a moderate amount of botany is considered essential, and the incentive for advanced work in most instances is not strong. In this country the botanical classes are larger, with more varied interests, of which medicine forms only a small part, and the study usually stands upon the same footing as that of the other sciences. The attainment of equal recognition as a substantial element of an educational course, superseding the notion that it constituted only an efflorescence to be classed with belles-lettres and other refinements, was the beginning of a prosperous period. One of the effects of this prosperity was to make the botanist more jealous of his reputation, and with the beginning of the nineties he entered a vigorous protest against the appropriation by the zoologists of the terms "biology" and "biologist." It was fair evidence that botanists had awakened to a recognition of common interests with the rest of the world, and of the advantages of keeping well abreast with the times. Later, the systematists, finding that other departments of natural history had devised improved ways for naming natural objects, undertook to fall into line and reform the method of naming plants, which led to the first serious break in unanimity which American botanists have known. So warm has been the contention that a few have descended to personal reflection and invective, which were never before known to mar the amicable adjustment of differences of opinion among American botanists. But this storm is likely to pass and leave the atmosphere clearer, brighter, and more invigorating; and it is to be hoped that no trace will remain of an interruption of good fellowship and general *camaraderie* which has heretofore distinguished the botanists of this country.

It is the broadened horizon for botany in general which makes the outlook for vegetable physiology so especially auspicious. This is the country of all others where its practical and educational importance is likely to be most fully recognized, and where the best equipped and most independent laboratories can most readily be established. One difficulty yet besets it, the difficulty of making known what is needed. Botany has not before required much more than a table near a window for its microscope and reagents, a case for the herbarium, and a few shelves for books, and it is difficult to make it understood that the new department needs rooms with special fittings and expensive apparatus. If there were only one well equipped laboratory in the country, it might be cited as a model, but even that advantage is yet lacking. It can be explained that the chemical side of the subject needs much of the usual chemical apparatus and supplies with many special pieces, that the physical side requires similar provision, and that many pieces of apparatus are demanded which can not be obtained in the markets owing to the newness of the subject, necessitating provision for making apparatus of both metal and glass; but the explanation rarely conveys a full appreciation of how essential and extensive this equipment is expected to be. In the fitting of the laboratory there should be rooms for the chemical work, with gas, water, sinks, and hoods, and rooms for the physical work, with shafting for transmitting power to clinostats and centrifugals, with devices for regulating moisture and temperature, and with as ample provision for light as in a greenhouse. There should also be dark rooms into which a definite amount of light may be introduced by means of arc lamps, and other special rooms for special lines of study. It is easy to see that a well stocked greenhouse is required to supply healthy plants when needed for study, but the value of a botanic garden may not be so apparent. It need only be pointed out here, however, that Charles Darwin examined 116 species of plants belonging to seventy-six genera to prepare his brochure on climbing plants, and it might have been more complete with greater opportunities.

The man who is to preside over a department of this kind, in which research work is to be carried on, and instruction undertaken suitable to a university, can not be one of St. Thomas Aquinas's *homo unius libri*, for physiology touches upon the adjacent sciences to a far greater extent than do other departments of botany, and requires a more intimate acquaintance with a wide range of knowledge.

After careful consideration of the subject, it seems safe to predict that the next great botanical wave that sweeps over America will be a physiological one. As the green chlorophyll grain of vegetation is the great primal storage battery, absorbing and fixing the energy of the sun, and making it available for doing the work of the world, in fact supplying nearly all the power, except that from wind and water, required in commercial enterprise, whether derived finally from animal force, wood, coal, steam, or electricity, so the subject which includes the fundamental study of a matter of such universal importance will without doubt eventually attain to a place in public esteem commensurate with its importance.

Lafayette, Ind.

Botanical Society of America.

TUESDAY, AUGUST 27TH.

The first annual meeting of the Botanical Society of America was held in Springfield, Mass., August 27 and 28, 1895.

The council met in the high school building at 3:00 o'clock, all the members being present. Candidates for membership proposed by three members of the society were first considered. Five of the eight names proposed were approved by the council. Other business being prepared for the action of the society, the council adjourned, and the society was immediately called to order by the president, William Trelease.

The report of the council was read by the secretary. The names proposed for active membership were laid over for balloting until the next day, as provided in the constitution, as was also the single nomination by the council for honorary membership.

The election of officers for 1896, by ballots mailed to the secretary, was reported. There had been no election of a president, two nominees having received an equal number of votes. Other officers were elected as follows: Vice-president, William P. Wilson; treasurer, Arthur Hollick; secretary, Charles R. Barnes. The society proceeded to elect a president, choosing Charles E. Bessey.

An invitation to hold a winter meeting in connection with the Society of American Naturalists, at the University of Pennsylvania, was received. It was voted not to hold a winter meeting.

A book having already been sent to the society, it was ordered that all books and pamphlets received be deposited in the library of the Missouri Botanical Garden, and that the secretary report annually the volumes so received.

The report of the treasurer was read and referred to an auditing committee, J. C. Arthur, G. F. Atkinson and Arthur Hollick.

After announcement of the program for Wednesday, the society adjourned.

WEDNESDAY, AUGUST 28TH.

The society was called to order by the president at 10:00 A. M. The special business was action upon the nominations for membership approved by the council. The following were elected active members: M. S. Bebb, Rockford; James R. Dudley, Palo Alto, Cal.; D. P. Penhallow, Montreal, Canada; and W. A. Setchell, New Haven, Conn.

The council having also recommended that Dr. A. W. Chapman, of Apalachicola, Florida, who by his advanced age is practically precluded from active membership, be elected an honorary member, he was unanimously so chosen.

The following papers were then read:

BRITTON, ELIZABETH G.: *Some notes on a revision of the genus* Mnium, *illustrated with specimens and photographs of types.*—The author showed how nearly the American specimens correspond with European types and descriptions.

BRITTON, N. L.: *The New York Botanical Garden.*—Mr. Britton gave an account of the movement for the establishment of the garden and the plans for its development so far as matured. A fund of $250,000 has been subscribed, obligating the city of New York to supply $500,000 for buildings. Two hundred and fifty acres have been set aside in Bronx Park for the garden, and a large-scale topographic map is now being made. It is the intention to provide laboratories and equipment for all departments of research.

Discussed by Messrs. Bailey and Robinson.

ATKINSON, GEO. F.: *A contribution to a knowledge of North American phycophilous fungi.*—Mr. Atkinson gave an account of the morphology and life history of a large number of new or imperfectly known fungi parasitic upon fresh-water algæ, for details of which the paper itself must be awaited.

At the opening of the afternoon session the following resolution was presented by L. H. Bailey:

Resolved: That the Botanical Society of America express its thanks to Dr. N. L. Britton for his account of the condition and progress of the movement for a botanical garden in the city of New York, and congratulate the people of that city on the prospect of its rapid development; and, furthermore, that the society commend the Board of Managers of the Garden and the Board of Scientific Directors for their wisdom in securing a broad foundation and an assurance of liberal management.

The resolution was adopted, and a copy was ordered to be forwarded to the proper officers of the garden.

The following papers were then read:

HOLLICK, ARTHUR: *The genus* Liriodendropsis *Newb.*—Mr. Hollick described the peculiar forms of liriodendron-like leaves found in Amboy clays, and showed ten plates illustrating them. These are paralleled by the rudimentary leaves and early stages of perfect leaves of Liriodendron, so that the history of the fossil species is epitomized in the living.

THAXTER, ROLAND: *The Laboulbeniaceæ.* — Mr. Thaxter displayed a number of plates prepared in illustration of his monograph on this group, and used them in explaining some very important and novel points in the morphology and life history of its members.

THAXTER, ROLAND: *Notes on aquatic fungi.*—The author described the structure of Monoblepharis, and then gave an account of the morphology of a new genus with multiciliate zoospores, a description of which will be published later.

COVILLE, FREDERICK V.: *A synopsis of North American rushes.*—Mr. Coville discussed the probable phylogeny of the various groups of the genus Juncus, and pointed out the correspondence of some forms to the area of their geographical distribution.

BRITTON, ELIZABETH G.: *Some corrections in the description of Coscinodon Raui and C. Renauldi, and a comparison of the two species.*—Read by title, at the author's request.

BARNES, CHARLES R., and TRUE, RODNEY H.: *Summary of a revision of the North American species of the genus Dicranum.*—This paper was presented by Mr. Barnes. A preliminary list of species recognized was distributed, and comments made upon the more puzzling groups. A list of excluded species contains seventeen out of the eighteen "new species" recently proposed by Kindberg and Carl Müller.

At the close of the reading of papers the society proceeded to elect by ballot two members to serve as councilors for the ensuing year. B. L. Robinson, of Cambridge, and George F. Atkinson, of Ithaca, were elected.

The society then adjourned *sine die.*

Section G, A. A. A. S.

Proceedings of the Section.

The section of botany was called to order on Thursday morning by Vice-president Arthur, Mr. B. T. Galloway being secretary, and proceeded to organize by electing the following officers: councilor, B. L. Robinson; members of sectional committee, N. L. Britton, Wm. Trelease, C. R. Barnes; member of nominating committee, David F. Day; committee to nominate officers of section, F. V. Coville, F. H. Knowlton, William Trelease; press secretary, W. T. Swingle.

Mr. Galloway being compelled to leave on Friday, Mr. M. B. Waite was then elected secretary for the remainder of the meeting.

Mr. J. E. Humphrey gave a brief account of the undertaking of Dr. H. H. Field in securing the cooperation of scientific bodies and governments in the establishment of an international bureau, with headquarters at Zürich, for indexing zoological literature.

A committee on international bibliography was appointed to watch the workings of this Swiss bureau and to report to the section a plan of cooperation by which botanical literature may be included if the scheme seems to promise success. The president named Messrs. Humphrey, Coville and Underwood as this committee.

The committee on bibliography presented a report of its work during the past year.

Your committee beg leave to submit the following report:

The author index to American literature has been continued throughout the past year with the cooperation of the editors of the *Bulletin* of the Torrey Botanical Club. Various difficulties arising in the publication of this index suggest to the committee the following necessary limitations to its contents. It is therefore recommended,

1. That all bacteriological, horticultural and agricultural titles be omitted: but in any case of doubt the title is to be included.
2. That all references to exsiccatæ be excluded.
3. That all references to reviews be excluded.

The committee also report that the journal index, which it was hoped would be begun in the past year, has been delayed by the desire to cooperate with and obtain the benefit of the similar work of the Boston Public Library. The committee expect that this will be published very shortly.

We have also made arrangements for the publication of a subject index of American literature. This will be begun with January, 1896.

The committee received a grant of $25.00 from the A. A. A. S. to cover the cost of printing the rules for citation adopted by the section and the cost of distributing the same. The stereotyping, printing, and distributing of nearly 1,000 copies of these rules has left a balance in the hands of the committee of only $0.64. As a small additional expense will probably be incurred, the committee recommend that the council of the A. A. A. S. be requested to grant $5.00 additional for the expenses of the committee.

C. R. BARNES,
N. L. BRITTON,
A. B. SEYMOUR,
Committee.

The report was received and adopted.

The Committee on Geographic Botany submitted the following report:

Your committee, in considering the importance of this subject in scientific, educational, and economic aspects, have thought it best simply to point out for the use of those desirous of taking up the matter some of the more recent works on geographic botany, and certain salient points relative to its terminology and its study.

We would call attention first to Drude's Handbuch der Pflanzengeographie[1] as the most complete résumé of the subject, and to his Atlas der Pflanzenverbreitung[2] as containing the most comprehensive floral maps. For the United States, we would recommend to the student the biologic maps issued about once a year from the Division of Ornithology and Mammalogy, U. S. Department of Agriculture, in which are graphically represented the general results of a distributional study of our animals and plants.

The terminology of geographic botany has not yet attained that degree of uniformity and definiteness which proper scientific expression demands. As a beginning in this direction the following definitions of certain terms in common use are recommended for adoption:

Range: the region over which a type spontaneously grows. The word type is here used as a general term for which in particular instances variety, species, genus, or the name of any group may be substituted.

Locality: the approximate geographic position of an individual specimen. A locality may be given in general terms as "Virginia," or more definitely as "near Washington, D. C.," or still more specifically as "Analostan Island, D. C."

Station: the precise spot upon which a specimen has been collected or observed. The stations of plants, while useful in local catalogues, will seldom be employed in monographic or cartographic works, an approximate location such as that cited under the definition of locality being sufficient for these purposes.

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[1] OSCAR DRUDE. Handbuch der Pflanzengeographie. pp. 528. 8°. Stuttgart 1890.

[2] OSCAR DRUDE. Atlas der Pflanzenverbreitung. pp. 8. Eight maps. f°. Gotha 1887. (Berghaus' Physikalicher Atlas, abth. 5.)

Habitat: the character of the place in which a type occurs. As examples of the use of this term, may be cited the expression "in moist woods," or "in sandy pine barrens," or "in sphagnum bogs."[3]

Your committee wish furthermore to point out one phase of work in geographic botany in which almost every botanist may render important service to the science, namely the study of the "Pflanzenformation," or as it may be styled in English, the *plant formation.* This is an assemblage of plants, living together in a community, subjected to the same environmental conditions, and working with each other to maintain their existence under these conditions. The sphagnum bog of New England, the savannah of North Carolina, the pine and oak scrub of Florida, the prairie of Iowa, the chaparral of California, the yellow pine forest of the New Mexican plateau, and many other types of vegetative growth, are examples of such formations. The extent of each formation, the identification of the plants of which it is composed, their relation to each other, and their combined relation to their environment, are matters of the deepest interest, awaiting the investigation of the systematist, the anatomist, and the physiologist.

Respectfully submitted,

FREDERICK V. COVILLE,
N. L. BRITTON,
WALTER T. SWINGLE,
Committee.

The report was briefly discussed, and adopted.

A resolution requesting a grant of $100.00 for the support of a botanical table at the Marine Biological Laboratory at Woods Hole, was presented and unanimously endorsed by the section for transmission to the council.

Abstract of papers read before Section G of the A. A. A. S.

The address of the vice-president of the Section, Dr. J. C. Arthur, on "The Development of Vegetable Physiology," was delivered on Thursday, August 29th, before a large and appreciative audience. The address is given in full in another part of this number.

Papers were read before the section on the following Friday and Monday as follows:

FRIDAY MORNING, AUGUST 30TH.

RUSSELL, H. L.: *A leaf-rot of cabbage.*—Mr. Russell described a bacterial disease attacking the petioles of cabbage leaves near the base and manifesting itself by a wilting of the leaf. It spreads into the parenchyma until it reaches the fibro-vascular bundles, in whose *alkaline* tissues the bacteria

[3] For a somewhat more detailed discussion of these definitions see Contributions from the U. S. National Herbarium **4:** 10, 11. 1893.

find good conditions for rapid development and spread. The germ apparently finds access to the tissues by longitudinal checking. The disease has not proved serious except in wet weather or on plants copiously sprinkled. It seems to be a different disease from that described by Garman.

SMITH, ERWIN F.: *The southern tomato blight.*—The more important points brought out by this paper were the non-identity of the disease with the cucumber wilt, and its identity with the potato wilt, the susceptibility of various other solanaceous plants, including the egg-plant, and the establishment of the cause of the disease. It was found that a bacillus, not yet fully studied, will set up the disease by inoculation, which after a time is followed by other organisms that produce the stinking wet-rot. The primary infection of the host takes place, as a rule, through the parts above ground.

GALLOWAY, B. T.: *Observations on the development of Uncinula spiralis.*—The development of the mycelium, conidia and perithecia, was described, bringing out many new details. The germination of the ascospores was described. It was found that material kept in thin muslin sacks staked to the ground was in good condition for study throughout the winter. The ascospores could not, however, be made to germinate until spring. A curious growth of mycelium from the resting perithecial cells was observed, which appeared to be a possible method of continuing the life of the fungus. The paper will be given in full in a later number of this journal.

TRUE, RODNEY H.: *The effect of sudden changes of turgor and of temperature on growth.*—Radicles of Vicia Faba were used for the experiments. The variations in turgor were secured with solutions of nitrate of potassium. It was ascertained that a period of retardation of growth followed a change in the concentration or in the temperature, whether the change were in an increasing or decreasing direction. The reaction is that of a shock to the irritable organism.

FRIDAY AFTERNOON, AUGUST 30TH.

WOODS, ALBERT F.: *Recording apparatus for the study of transpiration of plants.*—Describes an automatic device for continuous registration of the loss of water by transpiring plants. The apparatus is a modification of the weighing rain gauge used by the United States Weather Bureau, the principal change being to secure greater sensitiveness. This paper will appear in full in a later number of this journal.

BRITTON, N. L.: *Notes on the ninth edition of the London Catalogue of British Plants.*—The author compared the number and character of the changes in generic names in this edition with those of the "check list" of American plants, stating that only three per cent. differed, in all other cases the oldest name being accepted.

HOLFERTY, GEORGE M.: *Pressure, normal work and surplus energy in growing plants.*—Mr. Holferty first discussed the pressure exerted by roots when they meet an obstacle, showing that if the growing part is free this pressure begins at once, that the pressure increment sets in with its full amount at once, and that it reaches a normal maximum. In stems, on the contrary, pressure begins only after a latent period of half an hour, the pressure increment is an increasing quantity at first, constant for a short time, and finally a decreasing quantity for a long period. It was shown, second, that the surplus energy of plants is high when compared with normal work. The average ratios are, in the laboratory 21.8:1, in the greenhouse 5.5:1, and in the garden 4.6:1. Garden plants show a capacity of lifting weight of nearly 400^{gm} per sq. mm. of cross section.

HOLM, THEO.: *Obolaria Virginica; a morphological and anatomical study.*—The author presented a general sketch of the systematic position of the plant, based upon its morphological and anatomical characters in comparison with those of some saprophytic and parasitic plants. Its affinities are believed to lie more with Orobanchaceæ than with Gentianaceæ.

COVILLE, FREDERICK V.: *Botany of Yakutat Bay, Alaska.* This paper embodied a report upon a collection of plants made at Yakutat bay by Frederick Funston, in 1892, with a general account of the relation of plant life to environmental conditions and to native industries.

MONDAY MORNING, SEPTEMBER 2D.

The morning session was a joint session with Section F.

ARTHUR, J. C.: *The distinction between animals and plants.*—The advantages of using structural characters in distinguishing plants and animals was pointed out, and attention called to the fact that physiological characters only had heretofore been proposed. The necessity of drawing the characters from the mature vegetative individual was also urged. The following definitions were suggested: Plants are organisms possessing (in their vegetative state) a cellulose investment; animals are organisms possessing (in their vegetative state) a proteid investment, either actual or potential.

MINOT, CHARLES S.: *Rejuvenation and heredity.*—The paper traced the rôle of the embryonic type of cells in plants and animals as a necessary predisposition of structure for the action of heredity. The rôle of these cells in animals and plants in reproduction and regeneration was discussed, especially to show that their functions render it impossible to accept Weismann's theory of heredity. It was pointed out that the theory in all essential particulars is Nussbaum's and not Weismann's, whose attitude towards his critics was incisively criticized.

SWINGLE, WALTER T.: *Fungus gardens in the nests of an ant near Washington, D. C.*—The nests of *Atta tardigrada* Buckl. near Washington are small subterranean cavities 6–10^{cm} in diameter, situated from 2 to 15 or 20^{cm} below the surface. Almost the whole cavity is filled with a grayish material loosely and irregularly cemented together. A large part of this substance consists of the excrements of a leaf-eating larva which the ants carry in. On these pellets the ants cultivate a fungus whose free hyphæ end in glistening spherical knobs similar to those described by Möller from the ant gardens of southern Brazil and designated by him "kohl-rabi." They are 22–52μ wide and 30–56μ long, while the supporting hyphæ are only 4–8μ in diameter. No septum divides the kohl-rabi from the stalk. The whole appearance of the fungus is strikingly similar to that described by Möller (except in being nearly twice as large) and it is not impossible that it will prove to be the same species.

BAILEY, L. H.: *Variation after birth.*—Read by title.

COVILLE, FREDERICK W.: *Poisoning by broad-leaved laurel, Kalmia latifolia.*—Read by title.

MONDAY AFTERNOON, SEPTEMBER 2D.

MACDOUGAL, D. T.: *The transmission of stimuli-effects in Mimosa pudica.*—The author showed that Haberlandt's explanation of transmission of stimuli by the "Schlauchzelle" was not tenable. Stems or petioles killed by a steam jacket for 5–10^{cm}, and those from which the phloem region (including the "Schlauchzelle") had been removed, were still able to transmit the stimulus-effect. Sudden application of a hydrostatic pressure of five to twenty atmospheres and sudden diminution of normal hydrostatic pressure entirely failed to produce any effect though the contact stimulus was promptly effective on the experimental plants. Excluding the hydrostatic theory of Haberlandt, at present it seems necessary to assume transmission by the tissues of the entire cross-section.

MACDOUGAL, D. T.: *The physiology of Isopyrum biternatum.*—The first recognizable carbohydrate in this plant is amylo-dextrin, starch of the ordinary type not appearing in the leaves. At certain periods a starch appears in the tubers which reacts red with iodine, a form which has been believed to be characteristic of parasitic plants.

COOK, O. F.: *Personal nomenclature in the Myxomycetes.*—Of the two systems of nomenclature, the "personal" and the "priority," only the former has been used in the Myxomycetes. This is illustrated by two recent monographs. Of 41 genera and 430 species in Massee's *Myxogastres* only 33 generic and 160 specific names appear in Lister's *Mycetozoa.* If, however, uniformity with the future is to be secured, the still more radical changes necessitated by the principle of priority should be made. Nearly all the genera established by Rostafinski must be supplanted by names disused for fifty years or longer. It also appears that the older generic names were so applied that the usual method of application of the law of priority will necessitate the shifting of generic names from one family to another, according as certain characters are looked upon as of greater or less importance. Thus there are three generic conceptions to which the name Physarum may be applied. This confusion would be avoided if we adopt the principle of considering the first species under a genus to be the generic type from which the generic name can not be separated.

CAMPBELL, DOUGLAS H.: *A new Californian liverwort.*—The author describes a liverwort, allied to the genus Sphærocarpus, collected near San Diego, which probably constitutes a new genus.

JEPSON, WILLIS L.: *The number of spore mother-cells in the sporangia of ferns.*—Read by title.

BOLLEY, H. L.: *The constancy of the bacterial flora of fore-milk.*—This paper is a report of a number of original investigations bearing upon the constancy of the species and physiological types of bacteria present in the normal fore-milk. In general it may be said that the species may be quite constant in the udder of an individual animal, but there is slight evidence of constancy among different animals even under the same conditions.

SMITH, ERWIN F.: *The watermelon wilt and other wilt diseases due to Fusarium.*—Read by title.

MACLOSKIE, GEO.: *A root fungus of maize.*

MACLOSKIE, GEO.: *Antidromy in plants.*—The author claims to have discovered two kinds of flowering plants as to phyllotaxy, inflorescence, and, in some cases, the seeds. Of every species there appear to be dextrorse and sinistrorse individuals in about equal numbers. This difference is dependent upon the origin of the ovules being from the right or left margin of the carpel and is a primitive character which he designates by the term antidromy.

PILLSBURY, J. H.: *On the analysis of floral colors.*—Read by title.

BARNES, CHAS. R., and TRUE, RODNEY H.: *A summary of a revision of the North American species of the genus Dicranum.*—Read by title.

WEBBER, H. J.: *Experiments in pollinating and hybridizing the orange.*—Read by title.

HART, CHARLES PORTER: *History and present status of orange culture in Florida.*—Read by title.

PATTERSON, MRS. FLORA W.: *An Exoascus upon Alnus leaves.*—Read by title.

The Botanical Club of the A. A. A. S.

A meeting of the Botanical Club for organization was convened immediately following the vice-presidential address before Section G, on Thursday afternoon, August 29th. In the absence of the officers for 1895 the meeting was called to order by Geo. F. Atkinson, president for the Brooklyn meeting. David F. Day, of Buffalo, N. Y., was chosen as chairman *pro tem.* and H. L. Bolley of Fargo, N. D., as secretary. Adjourned.

FRIDAY MORNING, AUGUST 30TH.

The Club was called to order at 9:00 o'clock A. M., with President Douglas H. Campbell in the chair, and H. L. Bolley acting as secretary. About fifty persons were in attendance.

HALSTED, BYRON D.: *Field experiments with beans.*—Beans grown for the third successive crop upon a plot of ground (one-tenth acre) gave 25 per cent. of pods that were spotted with anthracnose. An adjoining plot of the same size as the first and in every way similar except that it had borne no previous crop of beans, gave only six per cent. of spotted pods.

COVILLE, F. V.: *Crimson clover hair-balls.*—These balls, measuring two or three inches in diameter, were taken from the stomach of horses, whose death they had caused. They were compact, and much resembled the hair-balls often found in stomachs of ruminants, but were entirely composed of the small barbed trichomes from the mature calyx of crimson clover (Trifolium incarnatum).

COOK, O. F.: *A peculiar habit of a Liberian species of Polyporus.*—This species produces long stipes, each successive one starting from the upper portion of the preceding one, or even from the pileus, in a proliferous manner. This continues until the plant becomes top heavy, and falls over upon the ground. Specimens were shown. The habit enables the fungus to lift the pileus well above water during the wet season.

BOLLEY, H. L.: *An apparatus for the bacteriological sampling of well waters.*—This is a modification of the apparatus already in use to secure samples of deep sea waters.

POLLARD, C. L.: *Methods of work on the National Her-*

barium.—The transfer of the herbarium from the rooms of the Department of Agriculture to those of the Smithsonian Institution was spoken of, and the method of mounting and caring for the specimens described.

In the discussion it was developed that the resolutions of the Club and the requests of the botanists of the country had had material effect in bring about the transfer of the collections to a fireproof building.

BRITTON, ELIZABETH G.: *Some notes on Dicranella heteromalla and allied species.*—A drawing of a small mountain form with curved pedicels was shown, and it was pointed out that D. Fitzgeraldi is referable to D. heteromalla orthocarpa.

The report of the committee of the Club to prepare a check list of plants of northeastern North America was called up and somewhat discussed, but owing to the lateness of the hour was interrupted by adjournment.

FRIDAY AFTERNOON, AUGUST 30TH.

The Club met immediately after adjournment of the afternoon session of section G. The unfinished business was a pending motion to accept the report of the committee on the check list. It was agreed that a discussion of the principles upon which that list is based was in order. After a prolonged discussion of various points, by Messrs. Robinson, Coville, Britton, Cook, Fernow, Barnes, Galloway, Bailey, Greene, and others, a resolution was offered by Mr. Britton increasing the committee on nomenclature by the addition of C. S. Sargent and B. L. Robinson, and directing the committee to report to the Club desirable modifications and additions to the present code. Mr. Robinson having repeatedly declined to serve as a member of the committee, Mr. L. H. Bailey was appointed in his stead. The Club then adjourned.

MONDAY MORNING, SEPTEMBER 2D.

The Club was called to order at 9:20 o'clock, A. M., with David F. Day, president *pro tem.* in the chair, and H. L. Bolley acting as secretary. About thirty persons were present.

Upon motion a committee to nominate officers for the next meeting was appointed, consisting of Messrs. Britton, Seaman and Deane. The report of the treasurer was received, which showed a balance in the treasury of $6.57.

Papers were then read as follows:

BRITTON, ELIZABETH G.: *Corrections in descriptions of Coscinodon.*—A drawing of C. Raui was exhibited, some mistakes in the description of the leaf, and peristome corrected, and a comparison with allied species made.

The following papers, in the absence of the authors, were read by title only:

TRELEASE, WILLIAM: *Notes upon pignut hickories.*

HALSTED, B. D.: *Experiments with lime as a preventive of club-root.*

SMITH, ERWIN F.: *Notes on the alkaline reaction of the vascular juices of plants.*

ATKINSON, GEO. F.: *Continuation of experiments upon the relation between the fertile and the sterile leaves of Onoclea.*

ROLFS, P. H.: *A hybrid between an egg plant and a tomato plant.*

WOODS, A. F: *A method of using formalin gelatin as a mounting medium.*

This completed the printed program, and additional papers were called for.

ARTHUR, J. C.: *A new clinostat.*—An apparatus was shown and described, which would slowly revolve four flower pots at the same time, with a uniform speed, two of the pots having a position at right angles to the other two. By the movement of a lever it could be converted into an intermittent clinostat, the pots turning half around each half hour, or hour, as desired.

SEYMOUR, A. B.: *Description of the collection made by Miss Gilbreth to illustrate seed distribution.*—This paper was read by Mrs. Flora W. Patterson, the author being absent. It described quite fully this admirable collection, and request was made for donations or exchanges to extend it and make it more complete. A discussion followed upon various modes of seed dispersion.

David F. Day called attention to the curious intermittent method of twining observed in Dioscorea, and also to a circumnutation of the pedicels of Anemone Virginiana.

The report of the nominating committee was now received and adopted, and the following officers of the Club for 1896 were thereby elected: President, F. V. Coville, Department of Agriculture, Washington, D. C.; Vice-President, Conway. Macmillan, University of Minnesota, Minneapolis, Minn.: Secretary and Treasurer, John F. Cowell, Buffalo, N. Y. Adjourned.

Noteworthy anatomical and physiological researches.

The rhizoids of filamentous algæ.[1]

While a few theories have been advanced to explain the occasional formation of rhizoids on those forms of filamentous Chlorophyceæ on which rhizoids do not normally occur, the author is the first to attempt to demonstrate their cause by experiment.

The observations were made from artificial cultures of two kinds, the so-called "contact cultures" and suspended cultures. In the former, the cultures were made either on a slide, between a slide and a cover glass, or in a hanging drop. In the suspended cultures a tuft of algæ is tied about the center with a slender linen thread, all rhizoids having first been removed, and suspended in a culture fluid. By this means liability of one filament coming in contact with another is in most cases removed. Various substances were used in making the media, and these in different degrees of concentration. The author gives in detail cultures made in solutions of agar-agar, gum, albumen, urea, cane sugar, milk sugar, erythrite, asparagine, glucose, dulcite, mannite and glycerine, and mentions cultures made in solutions of citric acid, berberine, potassium tartrate, sodium chloride, potassium nitrate, potassium sulphate, magnesium sulphate, sodium nitrate, aluminum sulphate, potassium alum, and in stained solutions of indigo carmine and nigrosin. None of the latter, however, were very successful, as the staining prevented the free action of light, and in the others the algæ died, even in very weak solutions.

The first results were obtained in contact and water suspension cultures; these were followed by the various other suspension cultures. As a result of these experiments he concludes that rhizoid formations of Spirogyra depend upon certain external influences from contact with a firm body. Notwithstanding the great number of cultures made, he confesses that his investigations are insufficient to fully explain the nature of these external influences.

At the two extremes of the series are the contact cultures

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[1] BORGE, O. *Ueber die Rhizoidenbildung bei einigen fadenformigen Chlorophyceen.* Upsala, 1894.

and the water suspension cultures. In the one, rhizoid-like outgrowths were obtained in all cultures (thirty-one) of *Spirogyra fluviatilis* Hilse, *S. inflata* (Vauch.) Rab., *S. orthospira* Naeg., and in four undetermined species. In the other, in no case did the formation of rhizoids result. In some cases water suspension cultures which showed no result, when transferred to contact cultures developed rhizoids in from two to four days.

That other conditions influence this development is shown by the growth in different media, the required density differing with the different media, as well as with the species; *e. g.*, in agar-agar, the lowest limit favorable to the formation of rhizoids, was a .05 per cent. solution, while for a gum solution it lay between .5 and 25 per cent.

The development of rhizoids by contact culture was also attempted under the influence of darkness, but the conditions were unfavorable for the development of the filaments themselves although in some cases rudimentary rhizoids occurred during the first few days.

One of the most interesting results derived from the research was in connection with *S. varians* (Hass.); in this species no rhizoids were developed, but, contrary to the statements of Vaucher, Pringsheim and DeBary, the author concludes after observing the germination of the zygote in three different cultures that the so-called "rhizoid cell" of the germinating tube does divide to form the cellular increase of the filament.

Cultures of Zygnema showed no rhizoid growth. In the cultures of Mougeotia the rhizoids were also conditioned by external mechanical influences since none were formed except in contact cultures.

Similar cultures were made of Vaucheria and of those forms in which the formation of rhizoids is more or less normal; *i. e.*, Cladophora, Draparnaldia, Œdogonium and Ulothrix. While no rhizoids were obtained on mature threads of *Vaucheria clavata* (Vauch.) DC., their presence was observed on germinating filaments. On *V. sessilis* (Vauch.) DC. none were produced under any circumstances. Both old and young threads of Cladophora, Draparnaldia, and Ulothrix formed rhizoids under all conditions. On early germinating threads of Œdogonium rhizoids were formed in all cases but the property seems to have become lost in older threads.

In summing up, the author advances the theory that the variations in the different species, at least in many cases, bear a close relation to the conditions of growth; so that those species which are generally found in rapidly flowing water formed rhizoids under all conditions and the rhizoid formation may be considered as a specific character. An entirely opposite condition exists in those species of Spirogyra which in no case formed organs of attachment (S. varians, Weberi and others not specifically named). *Spirogyra fluviatilis* and *Vaucheria clavata* may be regarded as a mean between the two extremes; these formed rhizoids but in contact cultures only, and he suggests that these might gradually have acquired this ability from species in which the necessity for rhizoids was originally wanting. This view confirms that of Klebs,[2] who suggests that *V. clavata* might be regarded as an offshoot of *V. sessilis* which has been removed from its accustomed habitat into rapidly flowing water.

The experiments were conducted in the laboratory of Prof. Klebs of Basel and the results are published in pamphlet form. Two plates illustrating the various results are appended to the text.

The work gives evidence of careful thorough investigation and it will be read with interest by all who have made a study of these forms of algæ.—BERTHA STONEMAN.

Investigations on bacteria.[3]

Under the above general title, Alfred Fischer has recently published a lengthy paper which, in part, deals with a subject that has received but scant attention from bacteriologists. The paper is divided into four parts, which treat respectively of plasmolysis of bacteria, physiology of motile organs, morphology of cilia, and systematic bacteriology.

In the first three parts, the author draws attention to many points of interest that he has observed in his studies, and discusses the relation of the same to the different theories that have been advanced from time to time.

I. He brings further proofs to substantiate his earlier claim[4] that the bacterial cell is subject to plasmolysis like the higher plant forms. Plasmolysis frequently occurs in the preparation of ordinary cover glass mounts where the evaporating

[2] Zur Physiologie der Fortpflanzung von Vaucheria sessilis. Verhandl. d. naturforsch. Ges. in Basel **10:** —. 1892.

[3] Untersuchungen über Bakterien, Jahr. f. Wiss. Bot. **27:** 1–163. 1895.

[4] Ber. d. konigl. sächs. Ges. d. Wiss. —: 52. 1891.

drop containing the bacteria undergoes a concentration of saline material sufficient to induce plasmolytic action. The lacunæ and uncolored areas so often noted in many different species of bacteria, when stained indicate where the protoplasm has shrunken from the limiting membrane under the action of the salt solutions. In certain instances plasmolyzed preparations recovered their turgor by the permeation of the salt solution into the bacterial cell. The protoplasm of the same species, however, is not permeable to different salts in an equal degree.

The importance of these observations on plasmolysis are considerable, as they have a direct bearing on the theory of the nature of the bacterial cell.

According to Bütschli[5], that part of the cell that absorbs the basic aniline dyes with ease is nuclear in its character. This large nucleus is surrounded by a membrane that does not easily stain. The cytoplasm of the cell is either entirely absent or is reduced to a mere film between the two layers.

In his preparations, Fischer finds an evident contraction of the interior cell substance when submitted to the influence of different salt solutions similar to those observed with higher plant forms when plasmolyzed. According to him, no nucleus has yet been determined. His results homologize the bacterial cell with that of higher plants as far as the cell elements are represented, and also with reference to plasmolytic action.

II. The view has been advanced that the cilia of swarm spores of different plants, and also bacteria, are protoplasmic processes that are extruded from the main part of the cell through minute openings in the limiting membrane, and that these filiform appendages are capable of being withdrawn entirely within the cell proper. If this were so, plasmolyzed bacterial cells would hardly be expected to show any appreciable degree of motility, yet, a number of different motile forms plasmolyzed in weak solutions (2.5 per cent. KNO_3, 1.25 per cent. NaCl), showed no cessation of movement. If strong solutions were used, motion ceased immediately. This was not, however, on account of the retraction of the cilia, but a rigor caused by the concentration of the solution.

The addition of disinfectants (carbolic acid, 0.1 per cent.) in proportions insufficient to cause a cessation in development, likewise sufficed to produce a similar state of rigor.

[5]Bau der Bakterien. 1890.

III. In taking up the question of the morphology of the cilia, details are given of a method of staining that is a simplification of the Löffler method.

After the general discussion of cilia and their separation into two classes, polar and diffuse, observations are noted on the changes that take place in the form and character of the cilia under different phases of development.

In several instances, sporulation took place without a cessation in motility, and in some cases degenerate phases of development, such as involution forms, were still characterized by movement.

The cilia are to a certain extent independent of the main protoplast of the cell. Ability of motion and contractility reside in the cilium itself, likewise a certain irritability which sometimes brings about an increase of motion, sometimes a rigor. At the same time cilia are not completely independent of the protoplast as they lose their motility if not in contact with the main body of the cell. Under the influence of plasmolytic action, they remain in close connection with a small fragment of the protoplasm within the cell.

IV. The final part of the paper takes up the vexed question of the systematic part of the science. In this, Fischer favors a system of classification founded on a morphological basis rather than an attempt to use physiological data for differential characteristics.

His proposed scheme is based (1) on the presence and arrangement of the cilia, (2) the formation of spores, and (3) the morphology of the spore-bearing cell.

A marked feature of the system is the use of the same root to designate the genera having the same form of cell although differentiated into various subfamilies on account of other characteristics. Thus, the genera, Bacillus, Bactrinium, Bactrillum, and Bactridium are all cylindrical spore-bearing rods characterized by a difference in arrangement of motile organs. The different genera in each subfamily are likewise characterized by the use of a uniform suffix, as for instance, the subfamily Bactriniei, has its genera terminating in *inium* (Clostrinium, etc.), while the genera of the coordinate divisions Bactrillei and Bactridiei end respectively in *illum* (Clostrillum) and *idium* (Clostridium).

This arrangement necessitates a large number of genera and by this method the author hopes to relieve the overburdened condition that is found in the present genus Bacillus. The logical nature of this scheme is praiseworthy but the present necessities of our classification hardly warrant the formation of a number of genera for which there are no known representatives.

The fact that the author himself is forced to note under many of the genera that "bisjetzt ist kein Vertreter dieser Gattung bekannt" and also that under the genus Bactridium, "hierher scheinen eine grössere Zahl von Stäbchenbakterien zu gehören" is evidence of the inherent weakness of the system.

The difficulty of founding any system of classification upon a characteristic so difficult to determine with accuracy as the presence and arrangement of such delicate organs as the cilia of bacteria is apparent. Even with much simplified methods of staining, the study of these motile organs is not an easy task and when used as a basis for classification would cause more confusion than now exists. The author ignores completely all reference to a similar system proposed by Messea[6] in 1891 which failed of acceptance on account of the many new difficulties that it introduced. Desirable as a system would be that is based on morphological data entirely, none has as yet been presented that is as convenient and practical as those that employ physiological characteristics in addition to the morphological variations of the cell.—H. L. RUSSELL.

[6] Contribuzione allo studio delle ciglia dei batterii e proposta di una classificazione. Rev. d'Igiene **1**: —. 1891. [No. 14.]

BRIEFER ARTICLES.

Development of the embryo-sac of Jeffersonia diphylla. (WITH PLATE XXVIII.)—*Jeffersonia diphylla* Pers. is a very favorable plant in which to study certain phases of embryology. This is due partly to its large cells and nuclei, and partly to the fact that its embryonic tissues are very readily stained and sectioned. Several stains were used, such as haematoxylin, fuchsin, and alum cochineal, with fair success, but for staining *in toto* alum cochineal proved most satisfactory. The sections were counter-stained on the slide with Bismarck-brown.

The mother-cell of the embryo-sac arises as an hypodermal cell at the apex of the nucellus. It contains but one nucleus and always stands with its long axis parallel to that of the nucellus (fig. 1). No tapetal cell is formed in this plant. In an ovule that has advanced somewhat in development we find that this mother-cell is preparing to divide into two similar cells by a transverse wall (figs. 2 and 4). This is indicated by the dividing nucleus (fig. 2).

In the next step toward maturity, it is noticed that the two cells just formed repeat in every detail (fig. 5) the process just described; so that there are now four cells resulting from two successive divisions of the mother-cell (fig. 6). Occasionally the uppermost of these four cells divides into two by an almost vertical wall (fig. 7). The transverse walls separating these four cells are somewhat swollen, and more distinct than the others (fig. 6). By repeated periclinal divisions of the epidermis of the nucellus, the row of four daughter cells is soon covered at its summit by four or more layers of cells (fig. 6). The number of these layers seems to increase quite uniformly with the age of the nucellus, though some exceptions were noted (figs 4, 5, 6).

In figure three (3) are shown two cells, the upper of which is much the larger. From my own observations it does not seem probable that the lower cell has arisen by division from the upper one, but that it is merely a cell of the axial row which did not divide but merely increased in size.

Of these four cells, which by successive divisions have arisen from the mother-cell, the lower one undergoes further development and becomes the embryo-sac. This cell increases in size at the expense of the three cells above it, together with the adjacent cells of the nucellus (fig. 10). The upper three cells are first absorbed and their cavities become almost obliterated by the surrounding turgid cells of the nucellus (figs. 8, 9, 10). Their disorganized remains now occupy a narrow cavity above the enlarging embryo-sac.

The further development of the embryo-sac is perfectly normal. The primary nucleus soon divides (fig. 9), one of the resulting nuclei passing to the upper and the other to the lower end of the sac. Further details need not be given here.

In this plant the mature embryo-sac does not reach the integuments, but is covered at its summit by a cap of about six cells in thickness, formed from the tissue of the nucellus. The cavity of the embryo-sac when nearly matured is very large, and is often readily seen by the unaided eye in section. Both the antipodal cells and the egg-apparatus are also very large. Of the former especially is this true, for they occupy about half of the entire length of the sac containing them (fig. 11). Shortly before they are absorbed, however, the embryo-sac has enlarged greatly, so that this relation is not maintained. The nuclei of the antipodal cells are also very conspicuous, while even the protoplasmic bridges or threads are plainly visible (fig. 11).

In the lower end of the synergidæ and below the nucleus of each there is a vacuole (fig. 11). One is also to be seen in the upper end of the oosphere by focusing, but as this cell lies below and is partially covered by the synergidæ, it is obscured from view.

The ovules of this plant are anatropous, but in one instance observed, an ovule was borne on a very long stalk which arose at right angles to the surface of the placenta, then by a long curve extended upward in the cavity of the ovary to a height of the second ovule inserted above it (fig. 12).

The foregoing may be summarized as follows:

1. The embryo-sac arises as an hypodermal cell at the apex of the nucellus.
2. This cell divides first into two cells. Each of these cells again divides, thus forming four. The lower of these alone undergoes further development and becomes the embryo-sac.
3. The upper daughter-cell is occasionally divided into two by an almost vertical wall.
4. The antipodal cells are unusually large.

This work was carried on under the direction of Prof. D. M. Mottier, who has very kindly supplied me with an abundance of properly preserved material.—FRANK M. ANDREWS, *Bloomington, Ind.*

EXPLANATION OF PLATE XXVIII.—Fig. 1. Longitudinal section of very young ovule showing hypodermal cell at apex of nucellus.—Fig. 2. Same, undergoing division.—Fig. 3. Division completed.—Fig. 5. Both cells again undergoing nuclear division.—Fig. 6. This is completed and walls formed.—Fig. 7. The upper of the four cells has divided into two by an almost vertical wall.—Figs.

8, 9 and 10. The first three steps in the development of the embryo-sac from the lower cell of the four shown in Fig. 7. Integuments are not shown.—Fig. 11. Outline only of embryo-sac with egg apparatus and very large antipodal cells.—Fig. 12. Ovule borne on a long stalk. × 150. Figs. 1 – 11 × 420.

Laphamia ciliata, sp. nov.—Perennial, fruticose, 15–30^{cm} high, with slender terete spreading branches, cinereous-pubescent throughout: leaves alternate or the lower sometimes opposite, deltoid or ovate, more or less punctate especially on the upper less pubescent green surface, somewhat decurrent on the petioles, these about half as long as the blades; lower leaves 10–15^{mm} long and about as broad, crenate or irregularly dentate: upper leaves decreasing in size, narrower in proportion to their length and more deeply toothed: heads on slightly clavate pedicels 5–15^{mm} long terminating the short upper branches, light-yellow, about 40-flowered, 5–7^{mm} in diameter; involucral scales usually 12, equal, obscurely biseriate, oblanceolate, about 2^{mm} wide near the apex, persistent, spreading or slightly reflexed at maturity: rays nearly white, crenately 3-toothed, 7-nerved, pistillate, about 3^{mm} long and 2^{mm} wide above the throat; disk flowers perfect, yellow, 4^{mm} long including immature akene 2^{mm} long; style branches exserted, recurved, 1^{mm} long, minutely pubescent; akenes flattened, oblong, slightly curved, 2^{mm} long, 0.5^{mm} wide, black, with white callous ciliate margins; pappus a callous crown with 2 subequal hispidulous bristles 2^{mm} long, from opposite margins.—Type specimen in National Herbarium collected by D. T. MacDougal, on rocks along Pine creek, near Pine, Arizona, August 21, 1891, no. 676. Cotype in National Herbarium, collected by J. W. Toumey, on Tucson mountains, near Tucson, Arizona, May 15, 1892, no. 629.

This species has the habit of *Laphamia rupestris* and agrees in all respects except the akene with the generic characters of *Laphamia.* The akene with its cartilaginous ciliate margin agrees with the characters of *Perityle.* The small many-flowered heads and the ciliate-margined akenes with a pappus of two slender bristles distinguish it from any similar species of Laphamia, while the fruticose much branched habit and nearly entire leaves distinguish it from any of the known species of *Perityle.*—LYSTER H. DEWEY, *Washington, D. C.*

EDITORIAL.

THE NOMENCLATURE QUESTION was opened in the recent meeting of the Botanical Club by the submission, on the part of the committee, of its report in the form of the printed "List of Pteridophyta, etc." Two diverse positions had developed previous to the meeting. Some advocates of reform declared that the list, being simply the expression of principles already adopted, was already the official utterance of the club regarding the plants included; while others held that the list was prepared for the purpose of furnishing a basis for discussion of the principles exemplified in it. The latter has been the position assumed by the GAZETTE.

The action of the club, in effect endorsing this position by receiving the report and continuing the committee with two additional members, appears to us therefore eminently wise. The duty of the committee during the coming year seems plain. Having in view (1) the objections to the Rochester and Madison principles which have been and may be made in this country and Europe, (2) the suggestions which have been made in other countries as to desirable amendments to the Paris code, and (3) the difficulties which have developed in specific application of existing principles, it is to be hoped that the committee will frame a complete code, based upon the DeCandollean, which may be perfected as far as possible and presented to the first international congress convened for that purpose, as the concrete expression of the views of American botanists.

THERE IS EVIDENTLY a good deal of misunderstanding regarding the status of the Rochester and Madison rules. They have been spoken of frequently as "the American code" and have been regarded as the settled and formal expression of the Botanical Club. It has also been assumed that they are to be forced upon the world by a handful of obscure botanists without reference to the action of other countries or of an international congress. Many of the signers of the "Harvard protest" and some of the radical reformers have held one or the other of these misconceptions. But the "American code" is yet to be formulated; its authority, which can rest only in the acquiescence of American botanists, is yet to be obtained; and its weight in the international congress to which it must be submitted is yet to be determined. The Rochester and Madison rules in the main commend themselves to the sober judgment, and we look hopefully for the complete code which the committee should prepare for our consideration.

THE MOST CONSERVATIVE botanists acknowledge that something of this sort ought to be done—nay, *must* be done in view of existing conditions. The real difference of opinion seems to be as to the advisability of using such a code as a guide in publication before it has been sanctioned by an international congress, and this question ought to be kept distinct from the approval of the reform principles themselves. In view of the history of nomenclatorial reforms, we feel justified in advocating such use; but there may well be difference of opinion here. Let it be so; but let us, in spite of this difference, unite in perfecting an American code in readiness for the congress, which must come sooner or later. Send to the committee all the objections and suggestions possible. Their all too thankless task has not been light, and conservative and radical alike should be grateful to them for the gratuitous service they have already rendered, and will, we trust, yet render.

***

THE FIRST MEETING of the Botanical Society of America must be looked upon as very successful. The membership is still small, and from the close scrutiny to which candidates are subjected will only increase slowly. Considering the limited membership, the attendance at Springfield (70 per cent.) was large. The following were present: Arthur, Atkinson, Bailey, Barnes, Britton (N. L.), Britton (Mrs. N. L.), Coville, Greene, Halsted, Hollick, Robinson, Sargent, Scribner, Thaxter and Trelease. The papers were of value and interest.

AN EXODUS from "the land of 'poco tiempo' " should be organized by our conservative friends. "The future," for which the law of homonyms is declared to be good, is like the small boy's promised "to-morrow"—difficult to define.

THE NOMENCLATURE QUESTION has received altogether admirable treatment in an article by Prof. Lester F. Ward in the July number of the *Bulletin* of the Torrey Botanical Club. No personal detraction diminishes its force.

ABSOLUTE UNANIMITY of opinion and action is demanded among the reformers. We fail to find such unanimity even among the advocates of a *laissez faire* policy, where it is much more to be expected.

OPEN LETTERS.

The nomenclature question: theoretical objections to a stable nomenclature.

In the August issue of the GAZETTE Dr. B. L. Robinson by a skillful argument endeavors to demonstrate a certain alleged weakness in the Botanical Club principles of nomenclature. In this case, however, as in all matters concerned with nomenclature discussions, we should, as Dr. Robinson has more than once insisted, deal with actual illustrations, not with theoretical objections. In the matter of Otto Kuntze's non-application of the principle known as the rejection of homonyms to his genus Aster, I stand corrected. Such correction, however, invalidates this particular case of the support it would otherwise offer to Dr. Robinson's objection to the principle in question, for he still occupies his original position of citing only suppositious cases. The validity of this objection, it must be pointed out again, rests not on what *might* happen but on what *has happened.* The Botanical Club list enumerates about four thousand species, to all of which the principle has been applied, and if it contains any cases approaching in absurdity those Dr. Robinson has held up as bug-bears, I do not know of them.

I accept with pleasure Dr. Robinson's explanation of his reference to the representative character of the Madison assemblage of botanists, and in my turn I must explain that my interpretation of his remarks on that topic was due to the fact that the alternative explanation, the one he now presents, seemed impossible of maintenance. The records will certainly show that the principles themselves were formally adopted by the Botanical Club. The committee was then instructed to prepare a list in accordance with these principles, and this they have done. As for making the list itself "official" by some kind of formal vote to that effect, I am inclined to think that I for one should oppose such action. Surely the list must be supported primarily, and it may perhaps be said exclusively, by its conformity to principle. Any errors it contains cannot be made correct by a mere vote, nor, if an error is demonstrated, can one be expected to go on repeating it.

Probably the greatest objections that can be urged against the Association principles of nomenclature are those which may be brought forward relative to this very rejection of homonyms. These objections Dr. Robinson alone, among all the opponents of a rational nomenclature, seems to have grasped. I may perhaps be able to render some assistance in the discussion and elucidation of the subject.

The vital reason for the rejection of homonyms may be expressed as *the rejection of revertible names.* If a *Juncus megacephalus* of Curtis, 1834, has been for insufficient reasons relegated to synonymy and it is now an open question whether the species may not be a valid one, surely no one, with a view to stability, can oppose the rejection of a *Juncus megacephalus* of Wood, 1865. The latter name being replaced by another, it matters not from a nomenclature standpoint whether the *J. megacephalus* of 1834 be treated as distinct or as identical with some older species. To go a step further: a variety *paniculatus* of Engelmann, 1868, must be erected into a species. The name *Juncus paniculatus* is already twice preoccupied by European plants, both now referred to other species. Who is to decide whether either of these is likely to prove valid? Are not different decisions likely to be rendered by equally reputable botanists, whose conceptions of these species may differ? The committee has answered these questions, as well as all the other questions which logically follow them, by saying, "We will reject not merely those homonyms which we know to be revertible and those which we suppose may perhaps be revertible, but we will reject all homonyms and thus make revertibility impossible." Considered from the standpoint of stability the wisdom of this decision is, it seems to me, incontrovertible. I am well aware, however, that the considerations I have just mentioned will have no weight with Dr. Robinson if he really believes, as I can hardly bring myself to think he does, that a stable nomenclature is impossible. If having reviewed the whole Botanical Club principles adversely and with critical care, he finds in them only one possible chance of instability, and if from a list of four thousand species he does not cite a single case in point, one surely cannot ask for a more favorable commentary on the stability-producing capacity of the system.—FREDERICK V. COVILLE, *Washington, D. C.*

Decapitalization.

Mr. Sheldon's open letter in the June number of the GAZETTE affords me another opportunity to speak against the tendency of many botanists to follow a bad example set by our friends the zoologists: that of decapitalization ot specific names derived from proper names.

If Mr. Sheldon writes his specific name *bajaensis* then Prof. Greene is right in his claim that it is a trivial and meaningless combination of Spanish and Latin. *Bajaensis* on the contrary leads us to the knowledge that the species came from Baja, a town in Mexico. His coreference to *nevadensis* as a good Latin specific name is another instance. *Nevadensis* claims the species to have been found in the state of Nevada, while *nevadensis* leads us to the belief that the species is *of the whiteness of snow*, and would be at the same time again a Latino-Spanish "jumble."—C. F. MILLSPAUGH, *Field Columbian Museum, Chicago.*

NOTES AND NEWS.

IN *Gardener's Chronicle* of August 24th, *Lilium Parryi* Watson is described and figured.

RODNEY H. TRUE, Ph. D. (Leipzig), has been appointed instructor in pharmacognostical botany at the University of Wisconsin.

DR. W. A. SETCHELL, instructor in botany in Yale University, has been appointed to a professorship in botany in the University of California.

A SPANISH translation of J. W. Harshberger's paper on "Maize" (Publ. of Univ. Penn.) has been made by Dr. Nicolas Leon of Guadalupe Hidalgo, Mexico.

IN HIS REVISION of the African species of *Eriosema* (a genus near *Rhynchosia*) now completed in *Jour. Bot.*, Mr. E. G. Baker enumerates forty-nine species, nineteen of which are new.

DR. J. E. HUMPHREY has been appointed lecturer in botany at Johns Hopkins University. This is a step in the right direction. We trust the department will be developed as rapidly as funds will permit.

GAUTIER AND ETARD have separately announced that the composition of chlorophyll varies. Thus far the differences pointed out are those of widely separated groups of plants, such as grass, spinach, and fern.

GINN & Co. announce this fall the "Elements of Plant Anatomy," by Emily L. Gregory, of Barnard College, and as in preparation "A High School Botany," by J. Y. Bergen, Jr., of the English high school, Boston.

THE CURRENT number (Bull. 9, Part 6, Aug. 26) of *Minnesota Botanical Studies* is entirely devoted to "A contribution to the bibliography of American Algæ," by Josephine E. Tilden. The titles, 1544 in number, are arranged by authors.

THE ATTENTION of botanists is called to the fact that the American Association table at Woods Hole is equally open to them as to zoologists. Up to the present time no botanist has occupied it. Inquiries may be addressed to the Director, Dr. C. O. Whitman.

THE IMPORTANT COLLECTIONS of the late Professor D. C. Eaton have been offered as a gift to Yale University if the institution will purchase the library. We are not informed as to how the offer has been received by the university. It is to be hoped that the library and collections will not be scattered.

THE VIENNA Botanical Exchange Society has determined upon extending its exchanges to extra-European plants. American botanists who desire to obtain European plants will find it to their advantage to write for rules and terms of exchange to J. Dörfler, Wien, Austria, III. Barichgasse 36.

MR. O. F. COOK will shortly return to Liberia to continue his studies of tropical fungi and other plants.

MR. D. T. MACDOUGAL, of the University of Minnesota, has returned from his trip abroad. Most of his time in Europe was spent in the laboratory of Professor Pfeffer at Leipzig in the study of the transmission of stimuli.

THE LIBRARY of the American Association for the Advancement of Science is to be deposited with the University of Cincinnati. It is especially rich in proceedings of foreign societies. Books may be drawn by members of the Association and forwarded as they may direct.

MR. E. P. BICKNELL (*Bull. Torr.* 22: 351) has described two new species of *Sanicula* from the eastern United States, dissociating them from the well known *S. Canadensis* and *S. Marylandica*, and naming them *S. gregaria* and *S. trifoliata*. In the same number Mr. John K. Small continues his studies in our southeastern flora, describing as new a *Sieglingia*, a *Rumex*, and a *Acer*.

STRASBURGER's statement of the period when the reduction of chromosomes observed in the gametes takes place is called in question by Haecker, as not consistent with observations on the same process by zoologists. He thinks there may be such a thing as "pseudo-reductions." The homologizing of this process in plants and animals is extremely important if possible.

MR. J. G. LEMMON has issued a third (pocket) edition of his very handy book on "West-American cone-bearers." The plea for good English names is strongly put, a thing which will be best established by just such a book as this, for it should find a place in the pocket of every one coming in contact with our western conifers who is at all interested in distinguishing them. Mr. Lemmon's address is Oakland, California.

THE CITY of Norwalk, Conn., is the home of the "Norwalk Tree Inoculation Co.," which, for a consideration, proposes to keep trees free from injurious insects. To this end (the consideration!) the trees are bored with from two to four 1-inch auger-holes, in which a secret compound (which consists of flowers of sulphur disguised with carbon), is placed, and the hole closed with a wood plug. Many persons in the Connecticut valley have been victimized. We understand that the state right for New Jersey was sold for $6,000. Mr. L. O. Howard, chief of the Division of Entomology, has exposed the fraud.

MASSEE's "British Fungus Flora" was promised to us in three volumes. In the third a supplementary volume was announced, in which the Pyrenomycetes and Tuberaceæ were to appear. This fourth volume is now at hand, but does not contain these groups, so that the inference is that there will be a fifth volume. The genus *Schweinitzia* of the fourth volume cannot be accepted, as we have a genus of flowering plants by that name in this country. It was given by Elliott and may be found among the *Ericaceæ* of Gray's Manual. It is also duly recorded by Bentham & Hooker in *Genera Plantarum*, 2: 606.

IN THE *Bull. de l'Herb. Boiss.* of August, G. Lindau describes twenty-two new species of American Acanthaceæ, ten of which are from Bolivia, and the rest from Brazil, Venezuela, Central America and Mexico. Ten of the species belong to *Ruellia* and six to *Aphelandra*. In the same number, studies in the African flora are continued by Schinz, assisted by numerous specialists. Hackel describes twenty-four new grasses; Schinz proposes a new zygophyllaceous genus (*Kelleronia*); Klatt describes twenty-seven new Compositæ, of which *Pentatrichia* is a new genus; and altogether eighty-nine new forms are presented.

RADAIS, from his study of the development and structure of the female flower of Conifers, claims that only in *Taxoideæ* does the seed remain naked until maturity, ample protection being afforded by the scales of the cone. We do not see that this has anything to do with the gymnospermy of these plants, as the ovule still remains naked so far as its own sporophyll is concerned. The homologizing of gymnosperm ovule with an angiosperm "pistil" is certainly questionable, for there is no reason why the somewhat loose term "flower" need be used in a different sense in the two groups. That Coniferæ are archegoniates whose method of fertilization has been modified by removal from water is certainly a reasonable conclusion.

THE FIRST botanical publication from the Field Columbian Museum (Chicago), is entitled "Contribution to the Flora of Yucatan," by Dr. C. F. Millspaugh, Curator, Department of Botany. Last January an expedition from the Museum visited Yucatan and certain neighboring islands, accompanied by Dr. Millspaugh. A small collection of plants was made which forms the basis of the present contribution. The list given includes not only the plants collected but also those credited to Yucatan by Hemsley, thus forming a starting point for the subsequent exploration of this very interesting flora. Thus far 264 species are recorded from the mainland, and 314 from the adjacent islands.

AN INVITATION to the botanists from Dr. Farlow to visit Cambridge on Saturday in lieu of the general excursion of the A. A. A. S. was accepted by a dozen, who were entertained with lavish hospitality. Under the guidance of Dr. Farlow and Dr. Robinson they visited the botanical laboratories in the Agassiz Museum, the Botanical Garden and Herbarium, and the Arnold Arboretum. They were received by Mrs. Gray at an afternoon tea and shown the first volume of autograph letters of botanists which has been prepared from those received by Dr. Gray, the original drawings by Sprague for the *Genera Illustrata*, an autograph of Linnæus, and various other things of interest to botanists. At the Aboretum, Mr. C. E. Faxon accompanied the party and explained the plans for planting.

HELIOTYPE PRINTING Co, BOSTON.

THAXTER on AQUATIC FUNGI.

BOTANICAL GAZETTE

OCTOBER, 1895.

Contributions from the Cryptogamic Laboratory of Harvard University. XXVII.

New or peculiar aquatic fungi. 1. Monoblepharis.

ROLAND THAXTER.

WITH PLATE XXIX.

The following notes are derived from observations made by the writer during the past season on certain aquatic fungi which have come under his notice, and, although other occupations have made it impossible to study some of the forms enumerated as thoroughly as their peculiarities merit, it is hoped that the notes and illustrations given may have a certain interest from the fact that they deal with plants which are either wholly new or have been unobserved for twenty years or more since their original description.

MONOBLEPHARIS Cornu.

In a brief preliminary notice which appeared in the Bulletin de la Société Botanique,[1] Cornu first announced the discovery of a most remarkable and important genus of aquatic fungi which, on account of the fact that it was supposed to produce zoospores having a single cilium, was named by him "Monoblepharis." In the following year this writer's well-known "Monographie des Saprolégniées[2] was published, in which he describes and figures two species of the genus, *M. sphaerica* and *M. polymorpha*, referring incidentally to a third, *M. prolifera*, which is neither described nor figured. The last name subsequently remained a *nomen nudum* until the form was rediscovered and sufficiently described and figured by Reinsch, in an important paper published in 1878,[3] under

[1] 28: 59. 1871.
[2] Annales des Sciences Nat. Bot. V. 15: 82. 1872.
[3] Pringsheim's Jahrb. f. wiss. Bot. 11: 293. —.

the name *Saprolegnia siliquaeformis*. In the following year a criticism of Reinsch's paper was published by Cornu in which he asserts that the *Saprolegnia siliquaeformis* of Reinsch is his own *Monoblepharis prolifera*. Since this time there have been no further contributions to our knowledge of the genus with the exception of certain further notes and figures by Cornu in Van Tieghem's Traité de Botanique. In 1892 A. Fischer[4] distinguished *Monoblepharis prolifera* Cornu under a new genus *Gonapodya*, placing the two genera by themselves in a family of Monoblepharidaceæ equal in value to the Saprolegniaceæ under the order Saprolegniinæ, in which he is followed a year later by Schroeter.[5]

Gonapodya being, however, apparently unrelated to Monoblepharis will be considered in a subsequent note and the order may be assumed to include the single genus from which it takes its name, of which but two species (*M. sphaerica* and *M. polymorpha*) have, up to the present time, been observed and described by Cornu alone as above stated.

The family owes its importance chiefly to the fact that among the whole group of Phycomycetes it presents the only instance in which a female cell or oosphere is fertilized through the agency of actively motile antherozoids. The striking resemblances which exist between its reproductive processes and those of algæ like Vaucheria or Œdogonium are too self-evident to need enumeration. To those who, like the writer, are unwilling to believe that the fungi form anything in the nature of a series derived like the series of Algæ from a common origin at its base, it has an especial interest; since it affords one of the strongest arguments in support of the theory which would view the fungi as a heterogeneous group of degenerate forms derived at different points from the different types of the algal series.

The species which have come under the writer's notice are four in number including *M. polymorpha*, and a second form related both to this species and to *M. sphaerica;* but like the former maturing its oospores outside the oogonium. The two remaining species which are considered in the present note, though closely allied to one another, are very distinct from either of the remaining forms, corresponding in the position of their antheridia to *M. polymorpha* while they resemble *M.*

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[4] Rabh. Kryptogamenfl. Abth. I. **4**: 378. 1892.

[5] Engler and Prantl, Natürl. Pflanzenfam. 93: 106. 1893.

sphaerica from the fact that they mature their oospores within the oogonium. Although the development of these forms confirms in most respects the observations of Cornu, a brief account of their life history may not be superfluous.

The hyphæ of all the species of Monoblepharis are almost always recognizable at a glance from their elegant and characteristic vacuolation, the protoplasm forming a network of finely granular strands the meshes of which are often remarkably regular in size and form, while in these strands the coarser granules may be seen moving with considerable rapidity. Thus in the smaller forms the strands commonly cross the filament nearly at right angles, and one seldom sees the more or less longitudinal arrangement of the granules so often characteristic of the Saprolegniaceæ. The fertile hyphæ may arise in considerable numbers from a more or less well developed creeping and branching base which is fixed to the substratum by terminal rhizoidal attachments, and in the two species under consideration, which may be called *M. insignis* and *M. fasciculata* respectively, are rigid in habit, tapering but slightly, rarely branched and without septa except in connection with the reproductive organs. According to Cornu the hyphæ, unlike those of other Phycomycetes, give no test for cellulose; but the writer does not feel as yet fully satisfied with his own observations on this point.

The antheridia in these species are invariably terminal organs, either at the tips of the main axes or of lateral outgrowths from them, while the oogonia are always intercalary. In *M. insignis*, for example, a terminal more or less conical cell is separated by a septum to form the first antheridium (fig. 1*a*). The portion of the hypha just below this septum then enlarges producing a lateral projection (the "neck" of the oogonium), the young oogonium thus formed separating itself by a second septum from the hypha below it. The antheridium thus appears to be borne directly upon the oogonium. In the species just mentioned, after the formation of the first oogonium, a lateral branch begins to form just below it (fig. 3), the tip of which is cut off as before to form a second antheridium, while its base and the upper part of the hypha below it enlarge together to form a new oogonium from which a neck is laterally developed as before. The whole is then separated from the unmodified axis below by an additional septum, so that as a result two oogonia are superposed at the tip of the filament on each of which is inserted an antheridium. The same process may be repeated until as many as eight superposed oogonia terminate the fertile hypha. In *M. insignis*, however, oogonia frequently occur in connection with which no antheridium has been formed. In *M. fasciculata* the process is essentially the same; the fertile axis in this species usually producing several terminal branchlets which become converted in a similar fashion into superposed oogonia, in this instance always associated with antheridia. While the oogonium is developing and before it is fully mature, the contents of the antheridium begin to divide into a variable number of antherozoids (in *M. insignis* often at least thirty-two) and after they are fully formed the tip of the antheridium becomes perforate and the male elements begin to escape slowly, emerging through an at first very small orifice, and dragging behind them a single slender cilium. Several antherozoids usually succeed one another in making their exit, collecting near the tip of the antheridium and going through continuous amoeboid changes of form. After about five minutes the cilia begin to vibrate and the antherozoids swim off with a rapid jerky motion. Meanwhile the remaining antherozoids creep about on the inner wall of the partly emptied antheridium escaping at irregular intervals singly, or several in succession, through the orifice which finally becomes so greatly enlarged that the last antherozoids are able to make their exit without any considerable change of form. Cornu states that both the zoospores and antherozoids make their escape in a quite characteristic fashion, each drawing out its successor from the antheridium by means of its cilium, but this seems certainly not to be the case, the exit being accomplished by means of amoeboid movements, each antherozoid escaping independently of those which have gone before it.

The free swimming antherozoids are nearly spherical or broadly oval in form, with a few refractive granules and a large central nucleus. They move with considerable rapidity, the cilium being directed backwards, and may often be seen to come suddenly to rest on an unfertilized oogonium over which they begin at once to creep with an amoeboid motion.

When the antheridium has become partially emptied, the escaping antherozoids do not all swim off in the surrounding water; but some of them at least begin to creep with amoeboid movements over the surface of the antheridium and thence over the oogonium, the single cilium projecting outward somewhat obliquely. In this way they may take journeys of considerable length, creeping around the oogonium, down to the hypha which bears it, and then back again; sometimes disengaging themselves and swimming away as already described.

In the meantime, usually after about one-third of the antherozoids have made their escape, the oogonium, having reached maturity, opens. Before this occurs the main body of the organ is filled by a mass of very coarsely granular protoplasm, its projecting neck being filled with a more finely granular contents which also extends around the coarser mass. The dehiscence of the oogonium is effected by pressure from within, a rupture occurring at the tip of the "neck," through which a large amount of the finely granular contents is discharged with considerable force (fig. 4). This discharge is occasionally so violent that a small amount of the coarsely granular content is also discharged, which, instead of becoming at once dissipated in the surrounding water like the finely granular protoplasm, coheres in aspherical mass and exercises an attractive influence on passing antherozoids (fig. 5). After the dehiscence of the oogonium its remaining contents contract into an oosphere of definite contour (figs. 4, 5) which is then ready for fertilization. The antherozoids soon creep up over the neck and through the opening at its tip, making their way into the oogonium and moving along its inner wall down to the oosphere. As many as eight antherozoids have been seen in a single oogonium; but only one appears to fuse with the oosphere in the fashion described by Cornu, the cilium projecting upwards and the body slowly sinking into the substance of the oosphere (fig. 5). In some instances an antherozoid which has just escaped from the antheridium may be seen to stretch across to the adjacent tip of the oogonium into which it makes its entrance without the usual preliminary perambulations. Fertilization having been thus accomplished, the oospore surrounds itself with a smooth thick wall, and, in both the species under consideration, remains within the oogonium at maturity. Although the oospores have been kept in water for several weeks, no signs of germination have been as yet observed; but it seems more than probable that this takes place by means of zoospores of the usual type.

The zoospores, which are very rarely produced in *M. insignis* but are found more commonly in *M. fasciculata*, are more than twice as large as the antherozoids. According to Cornu the zoospores resemble the antherozoids in all respects except in size; but, although the writer has not thoroughly satisfied himself on this point in his examination of fresh material, stained preparations of the zoosporangia of *M. fasciculata* show distinctly two cilia on zoospores which had not as yet escaped when the preparation was made (fig. 12). In both of the present species, as is also frequently the case in *M. polymorpha*, the zoosporangia resemble the oogonia in all respects (figs. 7, 11, 12) and are formed in exactly the same way, usually in connection with an antheridium. The long clavate sporangia, however, which are also characteristic of *M. polymorpha*, have not been observed in either of the new species. After the escape of the zoospores a large oil globule always remains within the sporangium. Further details concerning *M. polymorpha* and the additional species above referred to are withheld for the present. The two remaining forms may be characterized as follows:

Monoblepharis insignis, nov. sp.—Hyphæ straight, rigid, hyaline or very pale reddish brown, nearly cylindrical, rarely branched, 1.5–2.5^{mm} in length by 8–15μ in diameter. Antheridia broad, subconical to subcylindrical, straight or slightly divergent, the rounded tip often bent slightly inwards, nearly symmetrical or often with the base irregularly protruded on its inner side. Antherozoids numerous (about 24–32), 1-ciliate. Oospores maturing within the oogonium, smooth, pale amber-brown, spherical to long oblong or irregular in outline, 30–45 × 22–33μ. Oogonia single or several superposed at the tips of the hyphæ, irregular in form. Zoosporangia rare, similar to the oogonia; zoospores 2-ciliate (?), about 10–12μ in diameter.

On submerged sticks in pools and ditches, Weston and Medford, Mass., and Kittery Point, Maine.

This species appears not to be uncommon and is conspicuous from its large size and striking appearance. It was found growing with Œdogonium and other forms in the situations mentioned, and on account of its greater dimensions is better adapted than either of the much smaller remaining species to demonstrate the characteristic processes of reproduction. It varies considerably in the size of its filaments, as well as in the size and form of its oogonia and oospores, the latter often following the contour of irregular oogonia in which they may have been formed.

Monoblepharis fasciculata, nov. sp.—Hyphæ straight, rigid, cylindrical, simple or rarely branched except at the tips, 1–2^{mm} long by 6μ in diameter. Antheridia narrow, tapering slightly, straight, not divergent. Antherozoids about sixteen in an antheridium, 3μ in diameter. Oogonia evenly oval oblong or elliptical, the neck small and prominent, usually shorter than the antheridium which is always present, single and terminal or borne superposed on short crowded branches from the tips of the fertile hyphæ. Oospores more or less regularly oval oblong or elliptical, smooth, pale amber-brown, maturing within the oogonium, $22 \times 18\mu$. Zoosporangia lik e the oogonia, bearing antheridia: the zoospores 2-ciliate, about 5–6μ in diameter.

On submerged sticks with the last. Weston and Medford, Mass.

This species, which seems to be much more rare than the preceding, has been found but twice in the localities mentioned. It seems to be abundantly distinguished from the last by its constantly smaller size and the greater regularity and different form of its sexual organs and spores, as well as by its fasciculate habit.

Harvard University.

Explanation of Plate XXIX.

Monoblepharis insignis Thaxter.

Fig. 1. Group of fertile hyphæ bearing oogonia terminally. *a*, hypha from the tip of which an antheridium has been cut off.

Fig. 2. Oogonium and antheridium neither of which have yet opened. A new oogonium beginning to form below the first.

Fig. 3. An oogonium still closed, over which two antherozoids from the partly emptied antheridium are creeping.

Fig. 4. The same ten minutes later; the oogonium just opened and discharging the finely granular protoplasm at its tip; the coarsely granular part having contracted to form the oosphere: four antherozoids still remain within the antheridium, one of which is just escaping.

Fig. 5. Oogonium from which a portion of the coarsely granular contents has been discharged in two masses on the larger of which two antherozoids are creeping: within the oogonium are two antherozoids one of which has almost fused with the oosphere.

Fig. 6. An empty antheridium and an oogonium which has been entered by four antherozoids.

Fig. 7. An oogonium in which fertilization has taken place; below it a zoosporangium from which the zoospores are just ready to escape.

Monoblepharis fasciculata Thaxter.

Fig. 8. Group of fertile hyphæ with oogonia at their tips.

Fig. 9. Unopened oogonium and antheridium below which a branch is forming.

Fig. 10. Oogonium with mature oospore.

Fig. 11. Oogonium and zoosporangium from which a few zoospores have escaped: the sporangium terminated by an antheridium.

Fig. 12. A similar specimen in which three zoospores still remain in the oogonium together with a large residual oil mass.

*** **Note** —**Figures 1 and 8 are drawn with Zeiss obj. A, oc. 4. The remainder with obj. D, oc. 4.**

The regulatory formation of mechanical tissue.[1]

FREDERICK C. NEWCOMBE.

The prevalent notion of the influences which affect the progress on growth is doubtless that which one finds in the manuals on plant physiology most in use at the present day. In these manuals growth is set forth as governed largely by mechanical forces; by increase and decrease of pressure, and this pressure not acting as a stimulus but as a mechanical force. In Sachs' "Lehrbuch" of 1874 and again in his "Vorlesungen" of 1882 is a detailed elaboration of his mechanical theory; Vines' "Physiology of Plants" (1886) follows Sachs closely; while Pfeffer's "Physiologie" (1881) shows a little breaking away from the theory of Sachs, in that he gives contact as a stimulus to the formation of tissue, a phenomenon therefore of irritability.

It may not be devoid of interest to review briefly the steps by which this mechanical theory of growth gained its hold in the minds of botanists.

As the result of his well-known experiments, described in 1803, Knight[2] expressed the belief that the cortex of trees by its pressure exerted a restraining influence on growth in diameter, and that any means which reduced this pressure, such as the swaying by the wind, would allow a greater flow of nutritive fluid to the place and hence promote growth.

In 1859, Hofmeister[3] established the fact of interacting tissue tensions in a longitudal direction in growing plant organs.

Kraus,[4] in 1867, followed up the work of Hofmeister and discovered transverse tissue tension. Among his conclusions is this: that the curvatures due to geotropism, heliotropism, shaking by storms, and so forth, are accompanied by an excessive growth on the convex side, this excentricity of growth

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[1] Read before Section G of the A. A. A. S. at the Brooklyn meeting, August 1894.

[2] Knight, Philos. Trans. Roy. Soc. Lond. —: 280–3. 1803.

[3] Hofmeister, Ueber die Beugung saftreicher Pflanzentheile durch Erschütterung. Ber. d. k. sächs. Gesell. d. Wiss. —: 194. 1859.

[4] Kraus, Die Gewebespannung des Stammes und ihre Folgen. Bot. Zeit. **25**: 105. 1867.

being caused by the flow thitherward of nutritive fluid, made possible by the reduction of tension on the convex side.

It will readily be seen that while Knight assumed tension of tissues to be a controlling factor in the growth in diameter of trees, Kraus extended this causal relation to all kinds of increase of tissue. It remained now for that master-builder, Sachs, in the first edition of his Lehrbuch, in 1868, out of the material furnished by his pupil Kraus, by Hofmeister, and by Knight, to construct the framework of a mechanical theory of growth, which he subsequently elaborated in his later manuals, after the researches of de Vries and Detlefsen.

De Vries,[5] in the period from 1872 to 1876, had experimented in increasing and decreasing the pressure of the cortex of trees by winding about stems ligatures of twine in the first case, and by making longitudinal slits in the cortex in the second case. With his ligatures he obtained, so he believed, autumn xylem in the spring time; and by slitting he claimed to produce spring xylem in the autumn. His conclusion is obvious: cortical pressure must be the cause of the formation of annual rings.

Detlefsen,[6] another pupil of Sachs, published in 1881 his observations and deductions on excentric growth, and starting with the premises that all expansion of cells is due to the hydrostatic pressure of the cell-contents and that any external resistance to this internal pressure would diminish the effectiveness of the hydrostatic pressure, he drew the conclusion that the amount of growth was determined solely by the differences between these two forces. Thus he accounted for all excentricities of growth in stems and roots of woody plants according to the increase or decrease of the cortical pressure. Thus branches of trees that extend horizontally should show the more tissue below; and curving branches should show the greatest formation of tissue on the concave side, since during secondary growth a longitudinally concave cortex has its tension reduced, but a longitudinally convex increased.

Bringing together in small space the chief observations on

[5] De Vries, Flora —: 241. 1872; —: 97. 1875: —: 2. 1876.—De l'influence de la pression du liber sur la structure des couches ligneuses annuelles. Extrait d. Archives Neerlandaises **11**: —. 1876.

[6] Detlefsen, Versuch einer mechanischen Erklärung des excentrischen Dickenwachsthum verholzter Achsen und Wurzeln. Arbeit. d. bot. Inst. in Würzburg **2**: 670-87.

which Sachs and his school built their theory, we have the following eight statements, the truth of the last two of which is not without exceptions:

1. Between all growing tissues both longitudinal and transverse tensions are present, the outermost tissues seeking to contract while the innermost are seeking to expand.

2. Swaying of a plant promotes growth from the cambium.

3. Ligatures about woody stems decrease the number and size of the xylem elements.

4. Slitting the cortex longitudinally promotes growth from the cambium.

5. Abrading the dead part of bark promotes growth from the cambium (Knight[7]).

6. Normal clefts in the bark of trees deepen in the early spring.

7. Branches and roots of trees show excentricity of growth and the greatest growth is on the lower side, or when flexed on the concave side.

8. In the curving of stems due to geotropism, heliotropism, etc., the greatest growth in thickness is on the convex side.

Granting for the moment that all of the foregoing statements are facts, it is rather surprising that the mechanical theory of growth could have gained such general credence when two of its vital supports were pure assumptions. In the first place it was necessary to assume that extension of cells is but the stretching of hydrostatic pressure from turgidity; and in the second place, that the resistance offered by the cortex is great enough to control the amount and direction of cambium growth.

In 1884 Krabbe published a research which showed the incorrectness of the second assumption, and last year Pfeffer showed the untenableness of the first.

Krabbe[8] measured the compressing force of the cortex of many trees finding it to be always less than one atmosphere. Its increase of pressure from spring to autumn is never more than a fraction of one atmosphere while in many trees the increase is hardly to be measured.

By using a ligature with graduated weight this botanist

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[7] Knight l. c.

[8] Krabbe, Ueber das Wachsthum des Verdickungsringes und der jungen Holzzellen. Abhl. d. k. Akad. d. Wissensch. Berlin. 1884.

found that to check the growth of the cambium or to alter the size of cells required a pressure of three to five atmospheres, and from twelve to fifteen atmospheres to stop all growth. The pressure of the cortex must be, he concluded, from three to five times what it actually is to influence growth.

Thus the pressure of the cortex of woody trees is shown to exert little or no influence on the growth of the cambium; and this assumed support for the mechanical theory falls. With it also falls the time honored explanation of the cause of annual rings.

That the first assumption in support of the mechanical theory of growth—that extension is mere stretching—does not rest upon fact was demonstrated by Pfeffer.[9]

This author by an ingenious method was able to determine that cell membranes will extend till they feel no internal stretching force. Now if extension were the result of stretching alone, this condition could not be brought about, for the membrane would then be always in a state of tension.

If now growth is not controlled in a merely mechanical way by the pressure of tissue, we must look for some other explanation. Without attempting a discussion of the broad subject of growth, it has been and can be shown that growth especially of mechanical tissues is very often the result of self-regulation. It is true that the last statement does not propose the real cause; it is a confession of ignorance. But it removes the growth referred to from a mechanical phenomenon to one of irritability. This is the argument which I am making.

Let us now in the light of what has last been said examine some of the phenomena on which the founders of the mechanical theory based their argument, not forgetting however that the falsity of the theory has already been shown.

De Vries' experiments in placing ligatures about branches of trees gave the effect of unnatural pressure, not at all comparable with normal cortical pressure, and produced in the spring time, not autumn wood, as he said, but a deformed growth with smaller cells than in normal spring wood and with thinner walls than in normal autumn wood. There can be no doubt of the truth of this statement, for all of Krabbe's

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[9]Pfeffer, Druck- und Arbeitsleistung. Abhandl. d. k. sächs. Gesells. d. Wiss. **20**: —. 1893.

results in similar experiments on trees as well as mine on several herbaceous and shrubby plants point to the same conclusion. Knight's result on removing the outer dead part of the bark and de Vries' on making longitudinal slits in the cortex of trees should be referred to irritability and border closely upon regulatory action. Krabbe showed conclusively that the xylem formed subsequently to slitting in the autumn is not spring wood as de Vries thought. It is a response made to the injury of the knife.

The excentricity of branches and roots considered by Kraus and made much of by Detlefsen does not conform to the rules laid down by these two authors. I have found that the strongest development of tissue is often present on the convex side, but often also on the concave side. *Gladiolus communis* is an example of a plant forming an excess of tissue on the convex side of a geotropic curvature of the stalk, while *Ailanthus glandulosus* Desf. furnishes an example of excessive growth on the concave side. Detlefsen stated that horizontal branches have the greatest development on the lower side. In the Quince (*Pirus cydonia*) I have found it greatest on the upper side. Moreover a branch that in part of its extent is convex upward, and, farther out, convex in the opposite direction, does not change its excentricity with the change of curvature. If this statement does not hold true for all plants, it does for many, as my own observations have convinced me. According to Detlefsen's rules, the buttresses which extend on the trunk of a tree from the base of the branches downward and from the roots upward ought to reverse their position.

If we refer these variations to phenomena of regulation, we have a theory that is tenable; for one plant may regulate in one way and another in another way.

The formation of a larger amount of mechanical tissue under the stimulus of swaying agrees well with the notion of regulatory formation. What better illustration could be desired? What greater need of strengthening itself could a plant feel?

Another case of regulatory growth is furnished by the behavior of climbing organs as determined by Darwin[10] and by Treub.[11] Cause such an organ to grow free from contact

[10] Darwin, Climbing Plants 48, 50, 51. 1876.
[11] Treub, Ann. du Jard. Bot. de Buitenzorg **2:** —. 1882.

and it remains weak. Mere contact with a solid body, however, calls forth a great development of strengthening tissue, which increases still more when the organ begins to feel the weight of the stem which it supports. The first strengthening tissue is here laid down as a response to contact; its increase is the regulatory response of the plant to the strain which it feels. Increase artificially the strain on the suspending organ and by regulation it will increase enormously its mechanical tissue, as I have had an opportunity to observe by examining the material prepared by Herr von Derschau, the description of which is soon to be published.

Similar results were obtained by Hegler[12] when he subjected stems and petioles to a pulling force. The petioles of a certain plant, for instance, in their normal condition, broke when subjected to a pull of 700^g; they were given for five days a pull of 500^g, and then broke at $1,600^g$; others, pulled for five days by 500^g, were then pulled by weights of $1,200^g$ for five days longer, and then broke at a strain of $6,500^g$. In ten days these petioles had increased their tensile strength five-fold. The strengthening was brought about in some plants by the development of collenchyma or sclerenchyma in the cortex, in others by the increase of the hard bast, in others by a greater growth of xylem, and still in others by a combination of two or more of these methods.

Corresponding results to those of Hegler I have recently obtained in the roots of young plants of *Helianthus annuus* and *Cucurbita pepo*, by attaching to the plants weights suspended over pulleys. In these experiments not only was the tissue strengthened, but the roots grew with a larger diameter than normally.

Thus far the attempt has been made to show that when an unusually heavy stress has been laid upon the plant, the plant responds by increasing the mechanical tissue. But if the plant be a self-regulatory organism, it might be expected that when the normal stress is reduced, the plant would form less than the normal amount of mechanical tissue. And the surmise has been proven to accord with the fact, first by the experiments of Knight ninety years ago, when he prevented the swaying of young trees in the wind by fastening them to

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[12] Pfeffer reported these experiments as, R. Hegler's Untersuchungen über Einfluss von Zugkraft. Ber d. k. sächs. Geselsch. d. Wissensch. December, 1891.

stakes, and secondly, by the results which I have obtained by enclosing internodes of stems in plaster casts.

A general result in all my experiments, performed on scores of plants, embracing twenty-five species and a dozen genera, is the lack of the development of the mechanical tissue. The casts employed were from 3^{cm} to 5^{cm} in length, and thus a segment of the stem was freed from the most of the strain to which it would normally be subjected. There could be no lateral swaying, nor could the confined segment feel the full weight of the stem above. It is, of course, true that with an envelope of plaster, growth must soon be brought to a standstill by mechanical means, and therefore that less than the normal amount of supporting tissue could be formed. But that the lack of formation of mechanical tissue within the enclosed segments was not due merely to mechanical causes will appear from the two following reasons: In the first place, the young cells of the pith, of the collenchyma in the cortex, of the hard bast, and of the xylem that were formed before the casts were applied, did not, well within the casts, reach their normal thickness of wall. In the second place, corresponding tissues within but near the limits of the casts became thicker-walled than normally. Thus we have, at two places within the same cast, tissues in the one case, where there is little or no external stress, remaining abnormally thin-walled, but in the other case, where there is great stress, becoming abnormally thick-walled. This abnormal increase in the thickness of membranes in the region of the limits of cast is worthy of more than passing notice. It must be at the limits of the plaster envelopes that these plants felt the greatest strains from lateral swaying by the wind and from supporting the stem, as the breaking of several of them by the wind demonstrated. The thickening of membranes was always greatest just at the surface of the casts, and from that level it decreased both upward and downward, extending into the cast for a distance of a centimeter. The contrast was very striking; within the distance of a centimeter one could pass from a cross-section composed wholly of thin walls to one composed mostly of unusually thick-walled elements. All kinds of tissue took part in this great development, but especially the pith and cortex, since the production of new cells from the cambium was mostly prevented by the mechanical conditions. I see no way of explaining the results of these experiments except as regulatory phenomena. Try the different hypotheses of pressure, tension of tissues, relation between size of cells and thickness of membrane, and so forth, and none of them is satisfactory.

There is no claim made here that all growth of mechanical tissue is regulated by stress. It is influenced probably by transpiration, as the researches of Kohl[12] seem to indicate, and there is doubtless also an hereditary factor.

There is yet one feature to be added to the subject of regulatory growth. In my experiments, *Vicia faba* and *Melianthus major*, after growing in casts for several weeks, were released, and then showed a great constriction at the place where the growth had been confined. Within three or four weeks this constriction had entirely disappeared. Microscopical examination showed that, since the removal of the cast, there had been in all the plants an excessive development from the cambium, in the place of constriction, reaching in one case 40 per cent. to 50 per cent. more xylem elements in the abnormal segment than in the normal parts, above and below it. On the removal of the casts the weak segments felt suddenly the full weight of the stem. They responded by building a sufficiency of supporting tissue. There is reason, too, why there should have been more than the normal amount formed. The plaster was laid about these stems while the pith was still expanding, and the vascular zone moving outward from the center. The cast checked this movement, and by subsequent development within the rigid envelope, the supporting xylem cylinder was fixed nearer the center than normally. When released from the confinement, a greater radial thickness of mechanical tissue was needed in the narrower cylinder than in the normal cylinder to give the same degree of strength.

By the expression "regulatory growth," we do not come to the actual means or to the specific stimulus for that growth. We may say that the plant has the ability to respond to stress, but the notion *stress* is complex, and will doubtless by future research be subdivided. But this much seems certain: The formation of such growths as have been recounted in this paper is no longer to be explained as simple mechanics, but rather as a member of the increasing number of phenomena of irritability.

University of Michigan.

[12] Kohl, Die Transpiration der Pflanzen. Braunschweig. 1884.

Synopsis of North American Amaranthaceæ. IV.

EDWIN B. ULINE AND WM. L. BRAY.

ALTERNANTHERA Forsk. Fl. Ægypt. Arab. 28. 1775.

Telanthera R. Br. (excl. Lithophila Sw.) Prodr. Fl. Nov. Holl. **1**: 417. 1810.

Mogiphanes Mart. Nov. Gen. et Sp. **2**: 29. *pl. 129, 134.* 1826.

Plant mostly herbaceous, very variable in habit, with flowers clustered in dense terminal heads (as in *Gomphrena*) or axillary (as in *Cladothrix*), usually inconspicuous bracts, five free often unequal sepals, two to five stamens (five in ours) coalescent into a tube, alternating above with the staminodia, which are entire, pointed, and sometimes much reduced, or wider and more or less laciniate, with an ovate or sometimes obcordate compressed slightly winged ovary, and capitate stigma.

**Staminodia simple.*

1. A. REPENS (L.) Kuntze Rev. Gen. Pl. 540. 1891.

Achyranthes repens L. Sp. Pl. **1**: 205. 1753.

Alternanthera Achyrantha R. Br. l. c. 1810.

Stem prostrate, freely branching and forking, pubescent, 15 to 50^{cm} long: leaves glabrate, orbicular to ovate, narrowed into a short petiole: glomerules axillary: flower slightly compressed: sepals lanceolate, with prominent median nerve, spiny-pointed, strongly unequal, the two short ones thickly pubescent with barbed hairs, fuscous: sterile filaments nearly equaling the fertile ones: utricle ovate, slightly compressed, encircled near the apex by an acute horizontal rim.—South Carolina, Georgia, throughout the gulf states in the region of the gulf, extending westward to Southern California and Chihuahua, and southward into Mexico as far as San Luis Potosi. Very near *A. paronychioides* in external aspect. Type unknown.

***Staminodia short, dentate.*

2. A. PUNGENS HBK. Nov. Gen. et Sp. **2**: 206. 1817.

A. Achyrantha leiantha Seub.

A. echinata Sm. Rees Cycl. Suppl. no. 10.

Very similar to *A. repens*, but with larger leaves, echinate heads, the bracts and two of the perianth segments armed with long aristæ and short wide dentate staminodia, which resemble those of *A. paronychioides*, but with fewer teeth.—Native of southern Mexico and South America, but introduced at Mobile, Alabama. It is not known to be abundant anywhere.

Although this species is referred to by Moquin-Tandon among "*Species non satis notæ*," one of the specimens studied (Paraguay *Morong* 39) was identified by Dr. Britton at Kew, thus further confirming the decision already reached *ex char*. The smaller-leaved forms approach *A. repens* very closely, but the staminodia character serves to give it specific rank. Type unknown.

3. A. PARONYCHIOIDES St. Hil. Voy. Brés. **2:** 43. 1823.

Habit of *A. repens*, but less diffuse, with glabrate stem freely rooting at the nodes, narrower leaves with longer petioles, strongly compressed flowers, thin acute sub-equal pearly-white hairy sepals, much exceeding the utricle, short wide 3-dentate staminodia, and strongly compressed obcordate broadly margined utricle.—North Carolina, southward throughout the gulf states near the gulf. Native of the lowland tropics.

This species has been generally confused with *A. repens*, to which the specimens in our herbaria have mostly been referred. It may be recognized at once by its thin, white, exaristate sepals, although its more deep-seated distinction lies in the staminodia. This, and the next preceding, show more strikingly than any other forms the intimate relation of *Alternanthera* to *Telanthera*, occupying a position directly intermediate between *A. repens* on the one hand, and *T. ficoidea* on the other, both in habit and in the character of the staminodia. Related also to *A. pilosa* of South America. Type unknown.

*** *Staminodia long (equaling or surpassing the filaments), toothed or fringed.*

+ *Calyx sessile.*

4. **A. Kerberi,** n. sp.

Diffuse, ascending, pubescent, with numerous joints, the lower ones putting out numerous long fibrous roots: leaves small (3^{cm} long or less), narrowly spatulate, crowded: heads very small, sessile in the axils: bracts short, wide, deeply laciniate-margined: flowers small (2^{mm}): sepals unequal, darkly colored on the back, scarious-margined: staminodia narrow, fringed at apex, equaling the filaments: mature utricle not seen.—State of Vera Cruz, Mexico. Our plant appears in every way to have grown in muddy or wet places. Cultivated forms from Washington and Philadelphia showing flower and bract characters identical with the type may have sprung originally from this form; but they differ strongly in plant habit, being glabrate, with larger and fewer leaves, and bearing no evidence of rooting nodes, although the lower part of these plants has not been seen. If there is such an indigenous form anywhere in existence, it undoubtedly belongs with *A. Kerberi* as a variety. The species may be recognized at once by its bracts.

Type (Atoyac, Vera Cruz, *Kerber*, May, 1883) in herb. J. D. Smith. Cultivated specimens here referred to are in herb. Columbia College and Nat. herb.

5. A. MARITIMA St. Hil. Voy. Brés. **2**: 43. 1823.
Illecebrum maritimum Sprengel Syst. Cur. Post **4**: 103. 1829.
Telanthera maritima Moq. l. c. 364. 1849.

Smooth and fleshy (black on drying): stem prostrate, angled, branching: leaves obovate, mucronate: flowers in small numerous axillary heads, triangular, closely sessile, leaving a wide depressed scar when removed: sepals rigid, indurate, ovate, acute, slightly aristate, about 5-ribbed, one-third longer than the wide keeled bracts: staminodia slightly longer than the filaments.—Southern Florida, where it has come in from the tropics by way of the West Indies. Type unknown.

6. A. STELLATA (Wats).
[*Telanthera stellata* Wats. Proc. Am. Acad. **21**: 436. 1886.

Herbaceous, ascending, branched, clothed throughout with short stellate pubescence: leaves ovate to lanceolate, acute, 2 to 5^{cm} long: heads sessile in the axils: flowers dorsally compressed: sepals unequal, the outer ones 3-nerved, rigid, pubescent with simple hairs, slightly aristate, somewhat recurved in maturity: staminodia exceeding the filaments.—Chihuahua and Sonora, Mexico.

Type (San Miguel, Chihuahua, *Palmer* 4, in 1885) in herb. Gray, Columbia College, Nat. herb. and herb. J. D. Smith.

A. STELLATA GLABRATA (Rose).
Telanthera stellata glabrata Rose in Nat. herb.

Plant glabrous throughout; otherwise not differing from the species.—Sonora, Mexico.

Type (Alamos, Sonora, *Palmer* 660*a* in 1890) in Nat. herb.

7. A. PHILOXEROIDES (Mart.) Griseb. in Goett. Abh. **24:** 36. 1879.

Bucholzia philoxeroides Mart. Beitr. Amarant. 107. 1825.

This species has been found at Pensacola, Florida (*Mohr* 26), and at Coosan, South Carolina (*Cohen* in 1885), where in both cases it is probably adventive.

+ + *Calyx pedicellate.*

8. A. BRASILIANA (L.) Kuntze Rev. Gen. Pl. 537. 1891.

Gomphrena Brasiliana L. Amœn. Acad. 4: 310. 1759.
Gomphrena patula Wendl. Beob. 43. 1798.
Mogiphanes straminea Mart. Nov. Gen. et Sp. Bras. 2: 35. *pl. 135.* 1826.
Mogiphanes ramosissima Mart. l. c. 31. *pl. 130.* 1826.
Philoxera Brasiliana Smith in Rees Cycl. 5: 27. —.
Celosia altissima Salzm. ex. Moq. l. c. 381. 1849.
Telanthera Floridana Chapm. Fl. S. U. S. 383. 1883.

Herbaceous or suffrutescent, mostly erect, slender, elongated, remotely jointed, forking or branched, often swollen at the nodes, from glabrate to villous: leaves small (1 to 7^{cm} long), ovate to lanceolate, acuminate, short petioled: heads ovate or sometimes cylindrical in maturity, long peduncled: bracts short, persistent: flowers 4^{mm} long, 3 times the length of the bracts, deciduous, raised on a short dilate 5-angled pedicel: sepals pubescent, yellowish: utricle crowned with a narrow rim as in *A. repens.*—Florida, where it has crept in from the lowland tropics.

Type unknown. Chapman's types of *T. Floridana* are in herb. Columbia College, and herb. J. D. Smith.

A careful test has been made with reference to the validity of the pedicels as diagnostic characters. It is found that the dilate, 5-lobed pedicels of this species are quite distinct and constant, having been seen nowhere else in the large number of both native and tropical specimens studied except in *Alternanthera rosea* (Morong) U. & B., which, unlike *T. ramosissima* Moq., has other peculiarities sufficient to keep it apart. Dr. Kuntze, disregarding this fact, has united certain species under *A. bicolor* OK l. c., which on this basis are seen to be clearly and constantly distinct. Moreover, his observations on the color of the flowers, even if correct, do not seem to offer sufficient ground for uniting so many species on that character alone. It is artificial in that he has relegated floral structure to a place of secondary importance. While there is no question that Moquin-Tandon has multiplied species far too freely, we are unwilling to accept this color basis as a satisfactory solution. Again, why has he not followed the law of priority and adopted the earliest published name from among the merged species, instead of naming *de novo?*

A. BRASILIANA MOQUINI (Webb.).

Telanthera Moquini Webb. ex Moq. l. c. 379. 1849.

Plant glabrate, suffruticose, with ovate leaves larger and wider than in the species, and slender 5-angled pedicel.—Florida Keys.

Type (Key West, Florida, *Blodgett,*) in herb. Columbia College. Only one Florida specimen was seen, but it conforms closely with authenticated South American specimens.

A. GRACILIS (Mart. et Galeot.) occurs as far north as Tampico, Mexico, but has not yet been reported from our territory.

A. FICOIDEA RADICANS R. & S. (incl. *T. polygonoides* Moq.)

was said by Moquin-Tandon to have been found in Carolina. Chapman has adopted this, on the strength of which he includes *T. polygonoides* in his Southern Flora. The very close resemblance of this variety (*ex descr.*) to the indigenous *A. repens* and *A. paronychioides* of that region, together with the fact that *T. polygonoides* has not otherwise been known north of the West Indies, make it quite probable that Moquin's plant was one of the above species.

Telanthera polygonoides brachiata (Schrad.) Moq. l. c.= ALTERNANTHERA FICOIDEA BRACHIATA (Schrad.).

Mogiphanes rosea Morong in Ann. N. Y. Acad. Sci. **7:** —. 1893 = ALTERNANTHERA ROSEA (Morong).

Telanthera Tuerckheimii Vatke ined. = GOMPHRENA TUERCKHEIMII (Vatke) U. & B. in Bot. Gaz. **20:** 161. 1895.

Lake Forest University.

Noteworthy anatomical and physiological researches.

The littoral flora of Belgium.[1]

The flora of the Belgian littoral presents so many points of interest in common with those which may be found along our own seaboards and the great lakes, that it has seemed fitting to give a somewhat extended abstract of this paper. As the original title suggests, it is not a mere list of plants growing upon the coast of Belgium. On the other hand the subject is treated entirely from a biological standpoint and is well deserving of the attention of American botanists, many of whom have unsurpassed advantages for undertaking similar lines of study.

The most important topics, are indicated by corresponding subheads in this résumé.

1. *Physical conditions*. The shore of Belgium consists of a continuous range of dunes of moving sand, varying in width from 3^{km} to a line so narrow that it is reinforced with dikes. Between these dunes are more or less deep and extended valleys.

The calcium carbonate and other salts which are dashed over these hillocks by the waves filter quickly through the light sand. The wind is continually changing the contour of the dunes, which are remarkable for their dryness. The valleys separating them, on the contrary, are kept more or less moist owing to an impermeable stratum of clay which underlies them. The largest valleys are called "pannes" and are frequently cultivated. Their flora resembles that of the marshes of the interior, and is devoid of any peculiarly littoral character.

Where the Yser empties into the sea the tide backs up carrying with it the particles of earth held in suspension by the river water. These are deposited along the estuary forming sheets of clay called "schorres."

Owing to the action of the waves a constant subsidence of the hills takes place, although this is sometimes counter-balanced by new dunes formed by the sand deposited by the ocean currents.

[1] La biologie de la vegetation sur le littoral Belge. Jean Massart. Bull. de la Soc. roy. de Botanique de Belgique. **32**: 7–43. *4*. 1893.

The dunes and the schorres possess each a distinct type of vegetation. The plants of the former, owing to the extreme dryness which prevails, obtain water with great difficulty and furnish a series of structures adapted to secure proper absorption and storage of the water taken from the soil, and a reduction of the loss of water by evaporation. The wind, too, offers a very serious obstacle to the dune plants in their development. It lays bare their roots, enfilades the plants with sand, or buries them deeply in the drifts.

Owing to unlike conditions of existence the schorre vegetation is quite different. The earth is so compact that rain does not penetrate it; moreover, twice each day it is entirely inundated by the sea. Instead of resembling the flora of the marshes, the schorre plants, like those of the dunes, are adapted to drouth. This is due to their xerophilous character. As is well known, vegetation becomes xerophilous not only in localities where water is rare, but also in places where, although sufficiently abundant, it occurs in such a state as to be absorbed with difficulty. Thus the frequent and apparently astonishing xerophilous character of arctic and alpine plants which push into the water, is due to a large extent to the reduction of the amount of water which they can take from the soil, resulting from the simple cooling of the earth.

In the case of vegetation in contact with the sea or an equally strong solution of salt, the plant absorbs water with difficulty since the liquid of the cells is much less concentrated than that of the external solution. Hence such plants need to economize their water so as not to be compelled to renew it frequently.

2. *Means of protection against drouth.* The winters on the Belgian coast are humid and comparatively mild, while extreme drouth prevails during the summer. Hence many of the dune plants are exclusively hibernal in their growth, and, dried and shriveled, pass the summer in a dormant state.

The schorres, on the contrary, are almost completely deprived of vegetation during the winter; the only plants which remain green are those with very short leaves (Glyceria, Armeria, etc.). This fact is probably due to the periodical submergence which the schorres undergo; the partly frozen water brought in by the tide tears up the soil and pulls out everything above its surface.

The faculty which dune plants possess of developing in winter and early spring has doubtless been acquired in order that they may escape the unfavorable conditions to which they would be subject in summer.

Various contrivances are possessed by the dune plants for securing the absorption of water and preventing its evaporation. Chief among the former is the very extensive root system with which nearly all of them are provided. Eryngium maritimum, for example, often has roots more than 3^m long.

A good number have their leaves so arranged as to protect the soil against evaporation; they are applied closely to the sand, as in Erodium and most of the Compositæ (Thrincia, Leontodon, Senecio Jacobaea, etc.). Upon pulling the plant up by the roots it is seen that the leaves bend back towards the base; the petiole forms a spring, probably due to a difference in turgescence between the upper and lower face, and presses the blade energetically against the soil. This prevents the wind from disturbing the superficial layers of sand, and thus checks evaporation.

Other species, very numerous, form a screen; the wind breaks against them before striking the earth. Some of these are shrubs, as Hippophaë, Ligustrum, Salix repens, etc.; others are low, cushion-like herbs, such as Galium Mollugo and G. verum, Ononis repens, Anthyllis Vulneraria, etc.

Contrivances for storing up water are common, advantage being taken of the intermittent rains to make provision for water against periods of drouth.

Fleshy plants, however, are rare in the dunes; only Sedum acre, Euphorbia Paralias, Lotus corniculatus var. crassifolius, Convolvulus, Soldanella, etc. are found. This dearth of fleshy plants is attributed to the destructive action exercised upon them by the wind charged with grains of sand; it is rare to find an adult leaf of a fleshy plant, of Lotus, for example, which is not injured in many places.

Wherever the land is subject to tides, as on the schorres and at the base of the dunes close to the sea, plants with fleshy leaves or stems predominate. Among such plants are Cakile, Salsola, Honckenya, Salicornia, Suaeda, Statice, Armeria, Glaux, Spergularia, etc.

The author attributes the stunted condition of the littoral plants to the fact that they seek in every way to limit the loss of water; transpiration is thus reduced and the amount of food correspondingly lessened. From the law that transpiration is more rapid on a convex than on a plane surface the author explains the fact that the epidermal cells of Glyceria, Agropyrum, and Lotus corniculatus growing in saline soils are almost flat while the same plants in aquatic situations have strongly convex epidermal cells.

The dune plants have an abundant clothing of hairs, which being feeble conductors of heat, considerably reduce transpiration. Many of the xerophilous plants have a very pronounced odor, e. g., the stems of Thymus Serpyllum belong almost exclusively to the variety citriodorus, which is much richer in volatile substances than the type. The evaporation of this volatile matter creates around the plant an atmosphere through which heat rays pass with difficulty.

Transpiration is also lessened in many of the grasses by the well-known phenomenon of the conduplication and inrolling of the leaves. In such grasses the stomata are almost always upon the upper side of the leaf. In others evaporation is hindered by the possession of thick cuticles, strongly impregnated with suberin, and in the case of Agropyrum and other grasses by the thickening of the walls of the cells composing the fibro-vascular sheath. The increased transpiration which results from shocks is hindered in the dune plants by their remarkable rigidity, which is due both to the rolling up of the leaves and the extraordinary development of sclerenchymatous tissue. The plants of the schorres owe their rigidity to their fleshy nature.

Injury from excessive light is prevented in some cases by the hairs situated upon the upper surface of the leaves, shading the green cells, thus hindering chlorovaporisation. In the genus Halimus the edges of the leaves turn towards the sun to secure the same object.

3. *Protection against the wind and animals.* The high winds exercise a very destructive influence upon the littoral flora, not only by breaking stems, tearing leaves and denuding the roots, but also by their great drying action. To obviate this the majority of the arenicolous plants are tough and elastic; others have strong hold-fast roots or a compact and prostrate habit; still others produce numerous stolons.

Protection against animals of the littoral, of which the rabbit is chief, is afforded to some plants by their hard character and impregnation with silica; some (Hippophaë, Eryngium) are armed with spines; others (Ononis) are covered with sand; still others have a bitter taste (Salix, Galium verum), or are acrid (Euphorbia Paralias); many contain essential oils displeasing to herbivora, finally, the fleshy plants, the most exposed of all, are strongly protected by their saline flavor (Cakile, Salsola, Salicornia, Aster, Statice).

4. *Origin of the littoral flora.* The paucity of species of the littoral flora is accounted for by the diversity of destructive causes at work, which also explains the great number of individuals in the case of those plants which are well adapted to the prevalent conditions.

In order to throw light upon this subject the author has sown and transplanted to Brussels a large number of the plants of the dunes and schorres. This will be followed by a study of whatever modifications take place because of this change of environment. The inverse experiment has also been tried of transplanting 400 species of perennials cultivated in the Botanic Garden at Brussels, to various places along the coast. —GILBERT H. HICKS.

Nature and life history of starch grains.[1]

The recently published work of Meyer forms the most important contribution to the knowledge of starch grains which has appeared since Schimper's researches in 1880. According to Meyer, starch grains are true sphere crystals in every way analogous to the sphere crystals of inulin, and are composed of two forms of amylose and a trace of amylodextrin. In an anomalous form which colors reddish-brown with iodine, the proportion of amylodextrin is very large. This red starch is characteristic of a large number of saprophytes but has been found in less than a score of the higher green plants. In opposition to the theory of Tammann, Meyer finds that the action of diastase on starch is a purely katalytic process and in every way analagous to the katalytic action of acids except that it is more easily influenced by external conditions, such as heat, etc.

Under diastatic action, amylose takes up water and splits into two molecules of amylodextrin, which is transformed into isomaltose and dextrin. Both of these substances pass

[1] Arthur Meyer. Untersuchungen über die Stärkekörner. Wesen und Lebensgeschichte der Stärkekörner der höheren Pflanzen. pp. xvi+318. pl. 9. figs. 99. Gustav Fischer. Jena. 1895.

into maltose. The validity of the observations upon which is based Nägeli's hypothesis as to the growth and structure of starch grains is denied in toto. The grains have their origin and growth entirely within chromatophores where they are held as long as the cell is living. Growth consists of the superposition of new layers of material on those previously formed. The layers or coats are due to the periodic activity of the chromatophore. The contour of the grains is due entirely to the pressure exerted on the chromatophore by the cytoplasm, and the size depends upon the biologic relations of the plant. Thus in rapidly germinating seeds or in other structures where rapid solution of reserve material is desirable, the grains are small, and easily fissured. The granula of the chloroplasts are regarded as the organs of synthesis of the carbohydrates, and the stroma as the organ of formation of starch material and diastase. In the consideration of the morphology of the chromatophore the author is led to conclusions in harmony with Berthold's theory of the emulsion structure of protoplasm. In a series of monographs which form an appendix to the chief thesis, he describes the results of his researches on the seasonal periodicity and other biologic relations of the starch grains of Dieffenbachia seguina, Pellionia daveauana, Hyacinthus orientalis, Cyrtodeira cupreata, Adoxa moschatellina, and Hordeum distichum. The book contains all of the author's work upon starch, much of which has been previously published. It is well illustrated and logically arranged. The great number of macro- and micro-chemical reactions given makes the work invaluable in the laboratory. With this work at hand the archaic views as to the composition, structure, and growth of starch grains which find place in the best botanical as well as chemical text books will no longer be excusable.—D. T. MAC DOUGAL.

Arctic and Alpine plants.[1]

The present paper by Bonnier points out the difference in structural development of some arctic plants as compared with the same species collected in the Alps and Pyrenees. The arctic plants were collected by Charles Rabot, who visited Jan Mayen and Spitzbergen in the summer of 1892. We must note, however, that since these plants were col-

[1] Gaston Bonnier: Les plantes arctiques comparées aux mêmes espèces des Alpes et des Pyrénées. Revue gén. de Botanique **6**: 505–527. *pl. 4*. 1894.

lected on the shore of these islands where heavy fogs prevail during the summer we do not get a complete illustration of the anatomy of the arctic plants. The climatic conditions vary greatly in the polar regions, and there are certainly many places, where the summer has sunny days with clear sky, at least during the months of June and July. The paper is nevertheless very interesting and we record some of the most important results. Oxyria digyna, Saxifraga oppositifolia, Salix reticulata, Silene acaulis, Cerastium alpinum, Potentilla nivea and Poa pratensis are described anatomically, and a few other species are briefly discussed. The anatomical examination comprises the leaf, the stem, the inflorescences and the root, and the accompanying plates contain several good figures showing the habit of some of these species and their anatomical structure. As compared with their alpine representatives the following modifications are observable as characteristic of arctic species:

1. The lignified elements are reduced in number; their cell-walls are less thick and the lumen of the vessels much narrower than in the alpine plants.

2. The leaves are thicker but less differentiated; the palisade tissue is less pronounced; the intercellular spaces are more developed.

3. The epidermis of the stem and leaves is less coherent and the cuticle less thick.

4. The cells of the various tissues of the stem, the leaves and the root show a tendency to a roundish outline; some of the cells often develop like trabeculæ, and these separate large intercellular spaces.

The author believes that the causes of these anatomical modifications are especially the atmospheric humidity and the character of the light. The most important factor is, of course, the light of the midnight-sun which is continuous in the summer months, but not so intense as the light in the Alps. The humidity of the soil and the temperature do not seem to cause any modifications of importance, at least not in the plants examined.—THEO. HOLM.

BRIEFER ARTICLES.

On the derivation of Linnæan specific names.—At page 360 (July issue) of *Popular Science Monthly*, is a paper by Dr. John P. Lotsy on "Herbaria in their relation to botany." While the paper has much of value, it rather underrates the services of those who can name at sight any plant presented to them, which, the author says, was "what was understood as a botanist in Linnæus' time." Morphology, histology, and physiology he regards as of greater importance. There seems no necessity for depreciating the study of systematic botany in order to elevate the other branches. The best proof of this is the fact that most of the ablest workers in these fields, are distinguished as systematists.

But the point I have in view in this note is to call attention to a very excusable error, into which Dr. Lotsy has fallen, that Linnæus is the *originator* of the so-called Linnæan names. He "resolved" says Dr. L., "to give every plant two names, the first one being the genus name, here Ranunculus, the second one expressing some particular kind of Ranunculus, and thus indicating the species. Thus he found, for example, that one buttercup had an acrid taste, and he called it the acrid buttercup in Latin, *Ranunculus acris;* that another one only grew in marshy places, he called it the marsh buttercup, in Latin *Ranunculus palustris,* etc."

A study of the work of Linnæus shows that when he took in hand to reduce the labors of his predecessors to a binomial system, he usually adopted some one of the specific terms already employed by them—frequently the last term, whatever that might be, or even though it might be on general principles inappropriate. Whenever there was no opportunity to make use of terms already in use for his specific names, his choice seemed to be geographical ones. The genus Ranunculus, already introduced by Dr. L. furnishes a good illustration of this. He did not "find that one buttercup had an acrid taste, and he called it" Ranunculus acris, for Bauhin had "found" this long before. He had styled it *Ranunculus pratensis erectus acris.* All Linnæus did was to strike out all but the first and last words of the sentence. In some cases he adopted the generic names of his predecessors for his specific names. Dodonæus, for instance, had a genus Flammula, represented by our *Ranunculus Flammula* as Linnæus reduced it. *Ranunculus reptans,* was the *R. foliis linearibus caule repente* of his early "Flora Lapponica." *R. gramineus* was Bauhin's *R. montanus gramineofolio.* *R. parnassifolius* was Tournefort's *R. montanus graminis parnassifolio.* *R. bullatus* is Bauhin's *R. latifolius bullatus.* Unfortunately for Dr. L.'s illustration he never established a *R. palustris.* There was, to be sure, Bauhin's "*R. palustris apiifolio lævis,*" but for once he ignored both the swamp and the smooth parsley leaf, and dubbed it *R. Sceleratus.* Thus we might go through the whole list of the Linnæan ranunculuses. *Ophioglossoides* is from Villars, *Ficaria* from Haller, *Thora* from Crantz, *Creticus* from Bauhin, *cassubicus* from Breyne, *aconitifolius* from Bauhin, *rutæfolius* from Bauhin, and so on of many others, a large number being Bauhin's names.

In the reorganization of systematic botany, Linnæus was a collator and condenser, rather than a creator, and the fact that, as far as possible, he preserved the work of his predecessors, and did all honor to their labors, justifies the high estimation of his personal character so generally entertained.—THOMAS MEEHAN, *Germantown, Philadelphia.*

A day-blooming Cereus grandiflorus.—Our Cereus grandiflorus has, on three occasions and with five different blossoms, made a fatal and in no instance entirely successful effort to expand during the day. In each case the abortive attempt was caused by a sudden marked lowering of temperature *when the bud was almost ready to open*, thus retarding the growth.

In the first instance, a year ago, the flower partly opened about 8:00 A. M. on the second day after it had to all appearances planned to expand had external conditions proved favorable. It soon drooped, however, as the sun's rays fell upon it.

This year the cold wave early in July, with mercury at 44° at 7 A. M., and but little higher at mid-day, caught two fine buds in a similar manner. Again expansion was retarded at least one, and, I am inclined to think, two days and several odd hours. They opened sufficiently to show the interior at 10:00 A. M. and 11:00 A. M. respectively, and like their abnormal predecessor soon drooped in the sunshine (the plant stands on a south porch), and did not revive with the approach of twilight as a friend fondly hoped.

Again, Aug. 1st, two other buds similarly retarded behaved in the same way. The day was cool and cloudy. At 9:00 A. M. the sepals of one had loosened at the tip. From 9:30 to nearly 10:00 o'clock the phenomena that attend the normal opening of this beautiful flower were present. At 10:00 A. M. the maximum was seemingly reached. The petals were then open nearly as wide as is their custom, the outer sepals, instead of bending back almost to the tube, opened at nearly a right angle with it; the stigma, as in all previous abortive efforts, only partly opened. On the whole, the flower was a very creditable specimen, and the novelty of seeing so fine a one in broad daylight was duly appreciated. In half an hour more the sun, which shone dimly at times, was beginning to tell upon it. I cut it off, placed it in water in a dark room, where it remained with little change until 1:30 P. M., when it rapidly withered. Its companion was a little less ambitious in every respect, and was in its prime at 11:30 A. M., but being allowed to remain on the plant, proved more transient.

Other buds which reached maturity when the weather was warm opened in the usual manner.—BESSIE L. PUTNAM, *Harmonsburg, Penn.*

Ustilago Reiliana on corn.—*Ustilago Reiliana* Kühn was discovered several years ago at this place on sorghum and was first reported from here for America. Since then it has occurred in abundance in sorghum fields in other parts of the United States. Last year and this year it has been common in the experimental sorghum fields of this college; but up to this time has not been reported, to my knowledge, on *Zea Mays* from this continent, though found on that plant in Europe. The first stalk of corn affected by this smut was found in July of this year, and since then I have seen it quite frequent in fields about Manhattan. The smut usually appears first in the male inflorescence of the host plant, sometimes converting the whole upper part of the plant into a mass of smut, sometimes smutting only some of the flowers which are usually in this case enlarged and deformed. The whole plant is much dwarfed by the parasite, scarcely attaining more than half the normal size. The ears are small, and when not filled with the smut they are deformed, often very curiously, and scarcely ever develop any perfect grains. The rudimentary ears at each node from the base of the plant upward are nearly always affected. *Ustilago Reiliana* might be mistaken by the ordinary observer for *U. maydis*, the usual corn smut, and is perhaps more common than generally supposed; but they are easily distinguished when seen together. *U. Reiliana* has a more granular appearance, as if mixed with meal, due to the large colorless cells which accompany the spores. The fibers which remain in the smut mass are much larger than in *U. maydis*. The microscopic characters will of course distinguish the two species. A difference of greater economic importance lies in the fact that *U. Reiliana* attacks the whole plant, almost destroying it, while *U. maydis* is more local, and plants affected with it usually appear uninjured except at the point attacked by the parasite.—J. B. S. NORTON, *Kansas State Agricultural College, Manhattan.*

Note on buffalo grass.—I read with interest an article by Mr. Plank on "Buchloe dactyloides Englm., not a diœcious grass."[1] He asserts that the grass in question is not diœcious, as usually described, but monœcious, and in support records observations made in Kansas.

Wishing to satisfy myself experimentally as to the correctness of this assertion, a few seeds were germinated in the greenhouse in the spring of 1893. A single seedling was transferred to an outdoor plat. This grew vigorously through the season, sending out stolons and forming a compact mat. During 1894 the mat became larger and denser, but no flowers appeared.

However, the plant flowered this season (1895). Both staminate and pistillate flowers were present, the former preponderating. The flowers arose mostly from nodes that had taken root and thus become essentially independent plants. In no case did I find the two kinds of flowers from the same node, but from the interwoven state of the stolons I was unable to determine whether the two kinds of flowers were borne upon independent stolons.

The plant was first described by Nuttall (Gen. **1**: 65. 1818) from a staminate specimen, and named *Sesleria dactyloides*. He is evidently doubtful about the plant belonging to the genus Sesleria.

Rafinesque having occasion to review Nuttall's Genera (*Am. Monthly Mag.* **2**: 190. 1819) makes a note regarding this plant: "18. *Sesleria dactyloides* must form a peculiar genus by Mr. N.'s own account. It may be called *Bulbilis*." It is upon this basis that Dr. Otto Kuntze establishes *Bulbilis dactyloides* (Nutt.) Raf. (Rev. Gen. Pl. 763).

Nuttall remarks in his description: "Root, after flowering, resembling a bulb," from which, doubtless, Rafinesque derives *Bulbilis*. Upon the margin of the copy of the *American Monthly Magazine* above quoted (in the library of the Missouri Botanical Garden), some one has suggested another derivation, "bull's bile!"—A. S. Hitchcock, *Kansas Agricultural College, Manhattan.*

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[1] Bull. Torr. Bot. Club. **19**: 303. 1892.

EDITORIAL.

THE SPRINGFIELD meeting of the American Association for the Advancement of Science showed a marked decrease in the number of papers presented before it, and especially in the attendance. The proportional number of botanists was, however, somewhat larger than usual, although the actual number did not reach the point anticipated. During the last few years the botanical element at the annual meetings has been conspicuous both by reason of its numbers and its enthusiasm. It has also usually been one of the leading sections in the number and interesting character of its papers. In these particulars the recent meeting showed a decided falling off. Only twenty-seven botanical papers were placed on the program and quite a number of these were not read, mostly because the authors did not remain in Springfield until the papers were called. Altogether the meeting did not come up to the standard of its predecessors.

IT IS PERTINENT to enquire into the cause of so great a change. Is it due to a general decrease in botanical interest, to the lack of novelty which for awhile might have attracted members, to any interruption of good fellowship which may keep away a faction, to the establishment of other societies drawing off the papers and attendance, to any want of suitable provision for social entertainment, to internal friction or inconvenient arrangement of the program, to the development of the science so that it no longer needs the stimulus of such a gathering, or to some still unmentioned cause? The matter was considerably discussed at Springfield, and much diversity of opinion manifested. It was generally conceded that there was a variety of causes, and that the conditions in the botanical section were not materially different from those affecting the other sections of the Association. Without entering upon these arguments, although some profitable things might doubtless be said, we may state that in our opinion the main difficulties have been met in the proposed arrangements for the meeting next year at Buffalo. Two prominent innovations are to be tried: the meeting will begin on Monday and close on the following Saturday, giving Tuesday, Wednesday, Thursday and Friday to the uninterrupted consideration of papers and other legitimate work of the society, and a provisional program will be issued by the officers of the section at least a month before the time of the meeting. Both of these changes are important.

The two days' break of Saturday and Sunday, which has heretofore occurred, has always been detrimental. The present year the reading of papers began on Friday morning, and the program for this day was fully carried out as printed on the daily announcement, with a good audience present. When Monday morning arrived it was found that many of the members had not returned to Springfield after the excursions of Saturday, and the daily program was but partially carried out, with a very small audience present, and the continuance of the sessions for Tuesday and Wednesday was abandoned. It seems highly probable that such a collapse of the program will be out of the question with the change to uninterrupted sessions proposed for next year.

Issuing a printed program in advance of the meeting is the most important measure for increasing the interest and making the matters presented thoroughly available to the members in attendance that has yet been tried. If well carried out, it will be possible to know beforehand what subjects are to come up that may interest one, and at what time they can be heard. This arrangement can not fail to add great attractiveness to the meeting, and it is much to be desired that members lend their hearty cooperation to the efforts of the officers in securing a good program.

Some words might be said about the general usefulness of the Association. So far as the botanists are concerned, they owe much of their present prestige, both at home and abroad, and of their affiliations as a representative national body, to the opportunities created by the Association. The possibilities for gaining additional advantages through the same medium are by no means exhausted. The value of the Association to the individuals who attend its meetings does not admit of a doubt, in the majority of instances, and increases greatly with the increase in attendance.

CURRENT LITERATURE.

A guide to wild flowers.

That there is a deep popular interest in the flowers of the field must have impressed itself upon any person who was so fortunate as to be a part of the very large audience that saw the projections of the colored lantern slides of Mr. and Mrs. Van Brunt in Springfield during the recent meeting of the American Association for the Advancement of Science. The spontaneous and enthusiastic applause, especially when a favorite flower came upon the screen, made it manifest that it was not the beauty of the representations alone that attracted the audience, but an intelligent interest in the different species of plants. The success of Mrs. Dana's guide[1] to the wild flowers, which has now reached its twenty-seventh thousand, is another evidence of the same fact.

The work has been enlarged and improved in the present edition, but not changed in character from the earlier edition, which was noticed in these pages.[2] The volume will be of assistance to many persons who would not take the trouble to look up the names of plants in a technical work, and it will be read by some who are simply interested in the author's well written account of the different flowers. The illustrations are an attractive feature of the volume. They have a certain artistic merit, but possess little of the characteristic pose and texture of the individual plants, and are not likely to be of great aid to the novice in locating a plant in hand.

In short it seems to us that the volume is a very poor one with which to study the flora of a region, but a very good one to have at hand for occasional assistance and information. For the niche in which it belongs the book is an admirable one, and most welcome, but it is not to be expected that it will serve the purpose of a strict manual. The author intimates that it was written to meet the demand of those who wish to name flowers "without the trouble of analyzing them." Bearing this limitation in mind, we have little else but praise for the work. The volume is well written and attractively printed and bound.

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[1] DANA, MRS. WILLIAM STARR: How to know the wild flowers; a guide to the names, haunts, aud habits of our common wild flowers. Illustrated by Marion Satterlee. Revised and enlarged edition. 12mo. pp. xvii + 373. pl. 156. New York: Chas. Scribner's Sons. 1895. $1.75.

[2] **18:** 319. 1893.

OPEN LETTERS.

The nomenclature question: Some points to be emphasized in the discussion.

In very recent literature may be found a discussion by the geologists that descended to unpardonable personality and vindictiveness, to which the attention of botanists may yet have to be recalled. In fact, an article has already been distributed that belongs to this category, for refusing to publish which the editors of at least two journals will be commended by all who favor dignified and honorable discussion of the points in dispute.

It would be wholly superfluous to argue at length for the entire elimination of personalities and imputation of improper motives in the discussion of any topic, and a mere allusion to the subject is sufficient. Equal condemnation should be meted out to those who attempt to belittle the work of their opponents, and to decry the branch of science cultivated by them. Such expressions as the "virtual exhaustion of the field of North American botany," "botanical nomenclature is not a scientific matter anyway," may be cited as the milder examples.

That there should have been some misunderstandings we must expect where the subject is of such deep interest as this reform in nomenclature has proven to be. While we do not criticise the disputants, we must deplore the fact that there occurred even unintentional depreciation of the character or standing of any representative body of botanists, or an unwarranted interpretation that charged such depreciation. But the answer has been given and should be accepted as satisfactory and final. A remark that was likewise unfortunate, "lay aside personal prejudice and join the remaining nine-tenths," has given much offense, apparently, to the opponents of reform. But I doubt not that the sentence was penned in a jocose mood, and surely did not deserve the attention it received.

It must be insisted that, while it may or may not be "out of place" for certain ones now to raise objection to the entire system of reform, when, in fact, the reform is virtually accomplished, those who have been instrumental in bringing about this change have not, in the least degree, intimated that discussion is to come to an end. Touching the points settled or the points unsettled, discussion can go on, freely as before. In fact, minor points are not fully agreed upon, and demand farther consideration. The cardinal principles are, however, settled as really as the foundations of organic evolution were determined when Darwin published his Origin of Species, though a storm of acrimonious opposition immediately broke forth.

It avails nothing to say that the "majority," or "nine-tenths" or the "non-systematic botanists," or the readers of horticultural journals, etc., are opposed to the system. In science, as elsewhere, the right will prevail ultimately. That this reform will even be inconvenient to the great mass of non-systematic botanists and readers, can scarcely be claimed. It will, at most, be so to the few scores of botanists who have learned a few hundred names and have frequent occasion to use them, and to the teachers who "analyzed" flowers some years ago, and to whom would be annoying any changes in botany while they continue to have classes. This inconvenience will, however, disappear (except to those "teachers") in a brief time, and the trouble will be forgotten as soon as the Manuals give the correct names. Lists, catalogues, monographs, magazine articles, etc., that are now appearing, are fast supplying the names according to the new system, and the cry of "instability" while these changes are being accomplished, will likewise disappear shortly.

But even if this "inconvenience" were really great, and the mass of the people opposed to the reform, these facts would be no argument against the application of the main principles, which for some time have received recognition in the several departments of natural history. It may be added that foreign botanists—to wait for whom such earnest appeals have gone forth—quite generally accept the initial date for genera and species adopted by the Americans. That they really recognize the chief corner stone of the system, namely, the doctrine of priority, is shown by the fact that they wish others to join with them in excepting a greater or less number of genera from the effect of its application. Other and minor points receive recognition in part, so that on the whole the anxiety lest Americans may go too fast seems to be groundless.

Both publicly and privately it has been hinted and claimed that the List published has not yet been adopted nor officially sanctioned by the Botanical Club, as if that had something to do with the principles that were adopted, and according to which the committee was instructed to prepare the list. But, for a moment, suppose it were a matter of importance, how far is the claim really well founded? The committee was instructed not to consider and report on a subject, or to formulate a judgment or make recommendations, but merely to do a certain piece of work. The case is comparable to that of a committee to notify a person that has been nominated for a certain office or position, or to engross aud present a memorial, or some similar work. It is evident that a discharge of the duty is final and could not in the nature of the case call for "authoritative sanction." If one raises the question as to whether the work of the committee on nomenclature was done according to the instructions given, then the question of "sanction" can be thought of. But the point here to be emphasized again is that this has absolutely nothing to do with the main question in the reform movement.

One other matter deserves a further remark. The opponents of change and reform say that nothing should be done at present because very soon there will be an international congress of botanists. Several have said in substance, both privately and publicly, that they would agree to the dictates of such a body and fall in line with whatever might be done. In other words, they resent the idea of authority when exercised (supposedly) by the Botanical Club, but covet the same when exercised by a larger body. I think their statements are made without due consideration. For my part, I consider nothing "binding," and will not agree to subscribe to and act in accord with anything that my judgment condemns. I rather think the systematic botanists will do the same. The "non-systematic botanists" may join together and repeal the Rochester Code, and all the other codes that were ever enacted, and yet that will not bring a return to the unsatisfactory and fast decaying system that they are trying to save. Dr. Winter applied the principle of priority even in the polymorphic fungi, and his work was never rejected nor his system condemned. In phenogamic botany, the reform has been virtually accomplished, and those who have been using it for some years will hardly turn backward. As intimated above, we are assured of sufficient literature for the near future for the convenience of the botanists who are working in other lines than systematic botany; sufficient also to enable all the progressive teachers to teach and to put in the hands of their pupils and students a nomenclature that can not give them trouble in the future.—W. A. KELLERMAN, *Columbus, Ohio, Aug. 24th.*

NOTES AND NEWS.

LOUIS PASTEUR died at his home near St: Cloud, France, on Saturday, September 28th, in the seventy-third year of his age.

MR. GEO. MURRAY has been appointed custodian of the botanical department of the British Museum in place of Wm. Carruthers resigned.

PROF. L. M. UNDERWOOD has accepted the chair of biology in the Alabama Polytechnic Institute at Auburn. He has returned from his vacation in Europe, and has already entered upon his new duties.

THE DEATH OF C. C. BABINGTON, professor of botany in Cambridge University (Eng.) occurred July 22d. He was 86 years of age, and had not been botanically active for more than a score of years. By his death this important chair of botany is left vacant.

PROF. G. F. ATKINSON notes that *Podophyllum peltatum* is to be added to the list of plants having an open style canal leading into the cavity of the ovary. The canal is a very wide and shallow one appearing in cross section as a crescent-shaped or broadly V-shaped slit, which lies transversely to the placental line.

MEINSHAUSEN[1] has lately published a monograph of the genus *Sparganium*. He discusses the geographical distribution and gives several interesting instances of the local occurrence of various forms. Seventeen species are enumerated with diagnoses in Latin. The following are new to science: *S. splendens, simile, Glehnii, subvaginatum, flaccidum* and *pusillum*.—T. H.

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[1] K. F. Meinshausen: Genre *Sparganium* L. Déscription systématique des espèces et leur distribution géographique d'aprés les observations faites au Gouvernement de St. Pétersbourg. Bull. de l'Acad. imp. d. sc. de St. Pétersbourg. N. S. **4**: 21–41.

THE STRUCTURE of a gall upon the stem of *Chondrilla juncea* is described by Gain.[1] The insect which produces it is a new species of Aulax, for which the author proposes the name of *A. Chondrillæ.* The larvæ were found in cavities formed in the pith, and it would appear that the lignified cellulose of this tissue furnishes the only nourishment for the parasite. The development of these galls did not injure the growth of the host. On the contrary the plant developed an abundance of sound achenes, and the galls seemed merely to have modified the ramification, each gall giving rise to five or even six lateral branches.—T. H.

IT SEEMS quite like "old times" for descriptions of new species from the Gray Herbarium to appear in *Am. Jour. Sci.* This last contribution is by Dr. Robinson and Mr. Greenman, and is in four parts: 1. "On the flora of the Galapagos Islands, as shown by the collection of Dr. G. Baur," an interesting discussion of the peculiar harmonic and divergent characters of the plants, with descriptions of new species; 2. "New or noteworthy plants, chiefly from Oaxaca," being a description of the numerous novelties of the recent collections of Pringle, Smith, and Nelson, among which are two new genera, *Oaxacania* (Compositæ), and *Urostephanus* (Asclepiadaceæ); 3. "A synoptic revision of the genus Lamourouxia" (twenty-six species); 4. "Miscellaneous new species."

BOTANY AND ZOOLOGY are becoming badly entangled again with "microscopy." As something that deals with methods, the latter has an important place; as dealing with botanical and zoological results it is out of its domain. At the last meeting of the American Microscopical Society, among the papers presented, the following titles suggest botanical rather than microscopical results: "Corky outgrowth of roots and their connection with respiration," H. Schrenk; "The chlorophyll bodies of Chara coronata," W. W. Rowlee; "Secondary thickenings of the rootstalks of Spathyema," Mary A. Nichols; "Two cases of intercellular spaces in vegetable embryos," K. M. Wiegand; "The fruits of the order Umbelliferæ," E. J. Durand; "The flagella of motile bacteria," V. A. Moore; "The fruits of the order Compositæ." W. W. Rowlee and K. M. Wiegand.

GEOSIRIS APHYLLA is a new plant of the family *Iridaceæ,* which has been discovered on Madagascar, where it grows on sandy soil in woods. Baillon[2] describes it and supposes that it is a saprophyte, since the plant has no green leaves. The parts under ground are unknown, and the aërial stem is simple or slightly ramified, reaching a height of about one decimeter. The leaves are reduced to short, ovate bracts, and the inflorescence is like that of our common *Iris,* only in a smaller scale. The perianth is white and has a strongly infundibuliform tubers. The plant has several characters in common with the Burmanniaceæ of Madagascar. The form of the anthers and the position of the stamens in alternation with the inner perianth-lobes does not, however, agree with the Burmanniaceæ but with the Iridaceæ. We have, therefore, in this plant a representative of the *Iridaceæ* with no green leaves.—T. H.

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[1] E. Gain: Sur une galle du Chondrilla juncea L. Bull. de la soc. bot. de France. **41**: —. 1894.

[2] H. Baillon, Une Iridacée sans matière verte. Bull. mens. de la soc. Linnéenne de Paris. no. 145. 1894.

AT ITS RECENT meeting in Springfield, the Botanical Society of America decided to deposit donations to its library in the library of the Missouri Botanical Garden, St. Louis, where they will be accessible to members of the society and other botanists under the general rules of the garden library. Donations to the society's library should, therefore, be sent to the above address, plainly marked "for the Botanical Society of America."

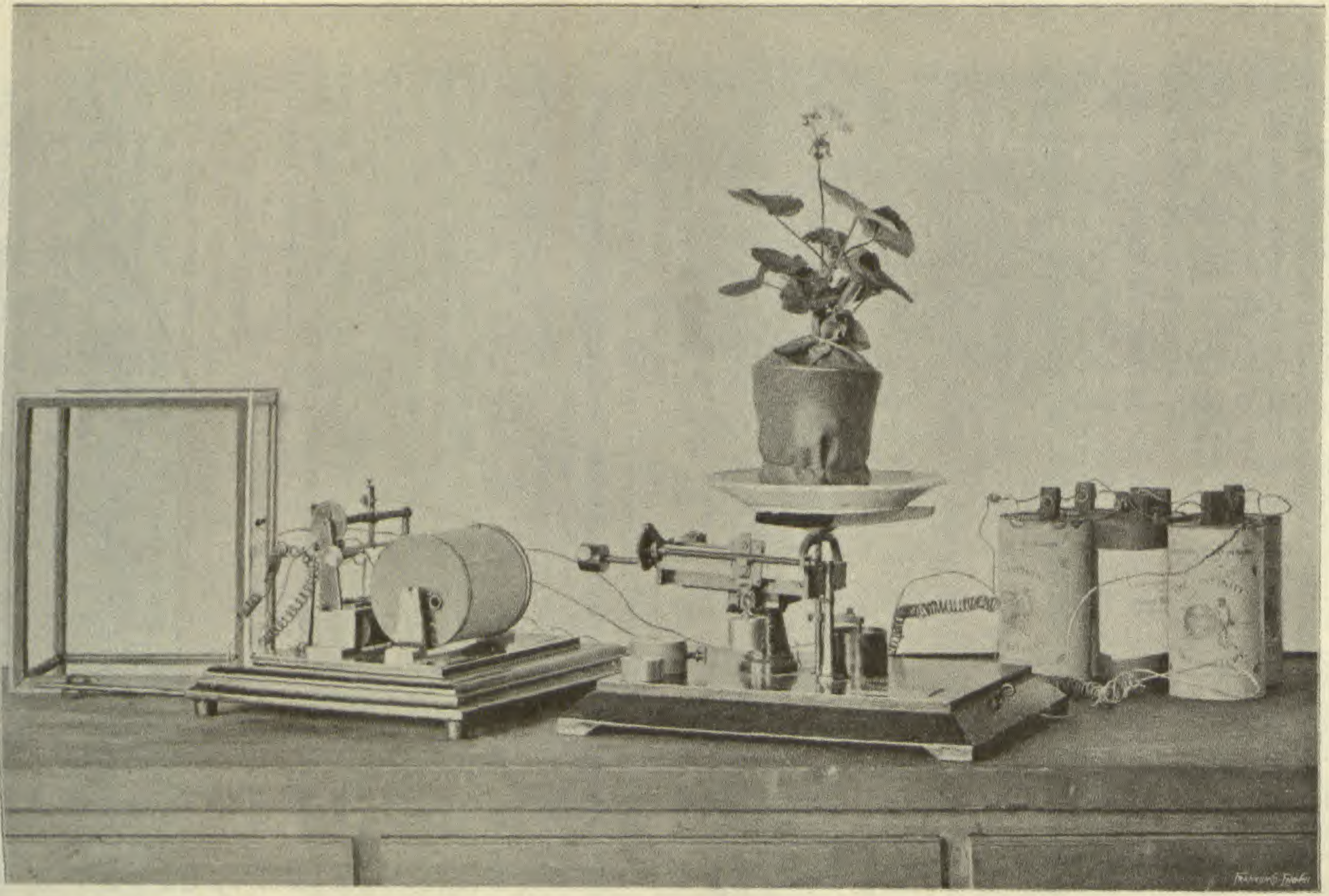
MR. F. BŒRGESEN gives an enumeration of fresh-water Algæ from East-Greenland,[1] which is the more welcome, since the flora of that part of Greenland is almost unknown to us. About 100 species of *Desmidieæ* are enumerated, of which forty-one belong to the genus *Cosmarium*, and twenty-nine to *Staurastrum*. The *Myxophyceæ* are represented by fifteen genera with about thirty species. The most frequent were *Stigonema* and *Gloeocapsa*, which formed the main part of the black stripes on the rocks, so frequently observed in the landscape.—T. H.

AMONG THE GRANTS made by the A. A. A. S. for 1895–6 were the following in aid of biological subjects: for printing a second edition of the "Rules for citation," $5.00, for a research table at Woods Hole, $100.00, for publication of an international bibliography of zoology, $250.00. The Association table at Woods Hole has so far been occupied by zoölogists, and it was the feeling of many of the members in attendance at Springfield that it should go to the botanists next year, if suitable application were made. The committee consists of the vice-presidents of Sections F and G and the director of the laboratory: viz. Messrs. Theodore N. Gill, Washington, D. C., N. L. Britton, New York, N. Y., and C. O. Whitman, University of Chicago.

THE PRESENCE of tendrils or clasping filaments in *Sepultaria Sumneriana* Cooke (*Peziza lanuginosa Sumneri* Berk. et Br.) has lately been observed by Boudier.[2] Filaments of this character have not been met with frequently among the fungi. Hyphæ or hairs more or less coiled have, however, been noticed in various genera. In the species of Sepultaria mentioned above, the author found that the mycelium or more properly the mycelium-like hairs, which cover the cupule like a woolly tomentum, bore small clumps which were formed by other filaments coiling around each other like the tendrils of the phanerogams. These were especially numerous when the fungus grew in a loose, gravelly soil, where the filaments had more space for their development, while they were scarcer when the fungus had grown in a stiff, compact soil. These peculiar tendrils develop from small tubercles and grow into small branches, simple or bifurcated, and which coil up as soon as they come in contact with other filaments. The filament which in this way becomes embraced by the cirrhus or tendril simply serves as a support, and no change was observed to take place in the protoplasm. In cases where the tendrils do not meet any of the neighboring filaments, they coil up around the same filament, from which they have developed. It is very likely that such tendrils may be met with in other species of Sepultaria, especially in those species, that grow in open, gravelly soil.—T. H.

[1] Færskvandsalger fra Ostgrœnland. Meddel. om Grœnland **17**: —. 1894.

[2] E. Boudier: Sur une nouvelle observation de présence de vrilles ou filaments cirroides préhenseurs chez les Champignons. Bull. de la soc. bot. de France **41**: —. 1894.



WOODS on APPARATUS for RECORDING TRANSPIRATION.

BOTANICAL GAZETTE

NOVEMBER, 1895.

Recording apparatus for the study of transpiration of plants.[1]

ALBERT F. WOODS.

WITH PLATE XXX.

Of the various methods devised for determining the amount of water evaporated by plants, none is so satisfactory as the direct one of weighing the plant at given periods. Weighings, however, as ordinarily carried on, are more or less unsatisfactory, for unless the operation is repeated at short intervals, a broken record is the result. To obviate this difficulty, various devices have been used. Some of these weigh the loss from the plant direct, while others operate by the indirect method of weighing the water absorbed by calcium chloride, sulphuric acid, etc. Of the last mentioned class the Anderson registering balance[2] is an admirable device which with some slight modifications might be made to record directly loss in weight. At the suggestion of Mr. B. T. Galloway, the writer has recently made some changes in Marvin's recording rain and snow gauge which fits it for very satisfactory work in measuring continuously the loss of water from transpiring plants. Prof. Marvin, of the United States Weather Bureau, very kindly assisted us in making the changes. The apparatus consists essentially of two parts, a balance and a register. (PLATE XXX.) The two parts are in an electrical circuit which is opened or closed whenever the equilibrium of the balance is disturbed. When the circuit is closed, the movement of the armature of the magnet mounted on the left arm of the balance engages a notched wheel which turns a long screw set parallel to the beam. This screw works in a half nut attached to the carriage of the

[1]Read before section G, A. A. A. S., Springfield meeting, August, 1895.
[2]Bull. Geol. and Nat. Hist. Surv. Minn. 9: 117–180. 27 S. 1894.

counterweight and is adjustable, so that the weight may be set at any point along the beam. For recording evaporation, a left hand screw is used, moving the weight from left to right. As evaporation from the plants goes on, the right arm of the scale rises, thus closing the circuit above the beam. The armature of the magnet is then attracted and turns the screw carrying the counterweight; at the same time the pen on the register is carried along by a similar mechanism. This is continued until the balance is brought to equilibrium and the circuit broken. Further evaporation causes a repetition of the process. The beam is protected from objectionable up and down swing by a dasher attached to the vertical stem supporting the scale pan and working in a cup of glycerin.

The register is shown on the right of the plate. It is exactly the same as that used for recording rainfall. Prof. Marvin describes it as follows:[3] "The record cylinder is mounted upon a horizontal axis with the clock movement inside. The cylinder makes one revolution in twelve hours. The mechanism giving motion to the pen consists of an electro-magnet and armature similar to those on the weighing gauge, and of a notched wheel fixed upon the end of a screw having cut upon it both a right and left hand thread of coarse pitch, viz., three threads to the inch. A cylindrical sleeve slides upon this screw, being guided by a slender rod below and parallel to the screw. A slender spring, with the recording pen attached to its point, is connected adjustably to the sleeve by a double friction joint which enables the pen to be set with great facility, the friction holding it accurately and firmly where placed.

"The armature of the electro-magnet engages directly the teeth of the notched wheel upon the right and left hand screw in such manner as to cause it to revolve tooth by tooth, always in one direction, with each vibration of the armature. The sleeve moving upon the screw is fitted with a crescent-shaped attachment which enters the thread of the screw. When the sleeve is set with the crescent in the thread at one end of the screw, the pen will, when the screw is revolved, be moved to the opposite end, the crescent-shaped piece being then guided into the other thread, and thus, upon continued rotation of the screw, causing the pen to return again to the

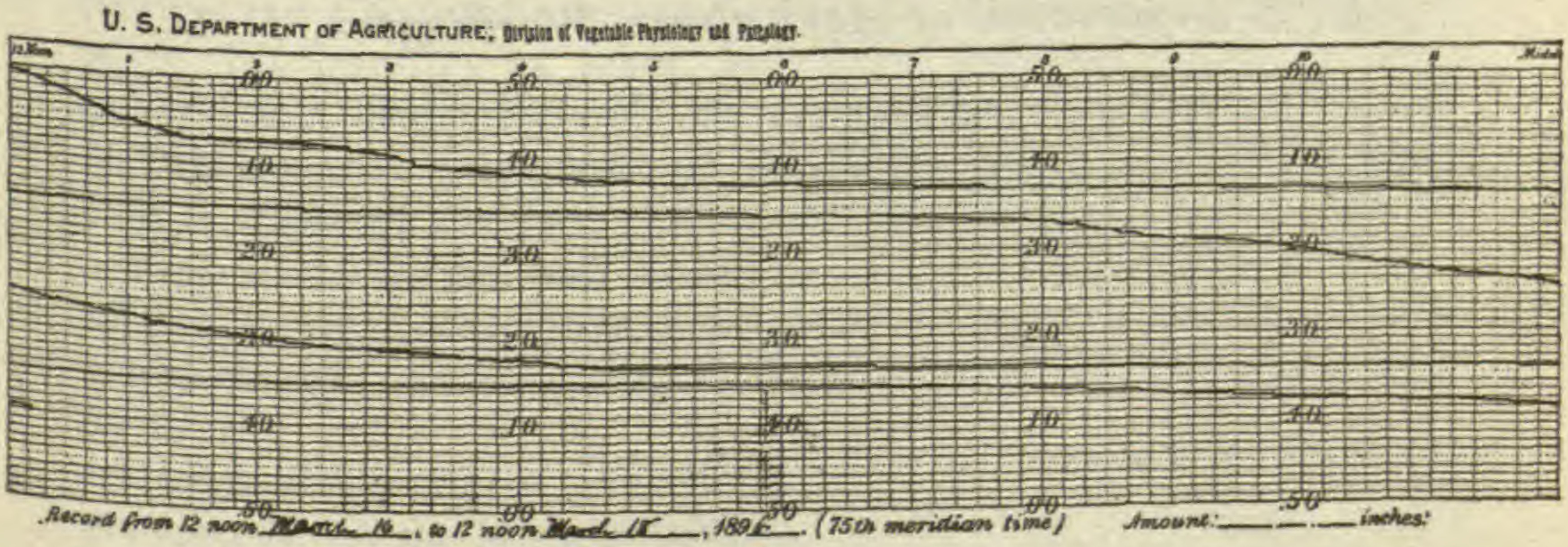
[3] U. S. Weather Bureau. Cir. E, Instrument Room.

starting point. Here the crescent nut will again pass into the thread first followed, and again carry the sleeve across the screw. The reciprocating motion of the pen thus secured is strictly in a straight line, and the subdivisions of the scale of the record sheet are equal throughout, conditions that are extremely desirable, especially in a recording rain gauge where rate of rainfall is to be obtained."

The equal subdivisions of the scale thus obtained also greatly facilitate the determination of the rate of evaporation.

The record sheet is divided into hours by lines running parallel to the axis of the cylinder; the hours are subdivided into spaces of ten minutes. Lines representing grams are drawn at right angles to the hour lines. The value of these spaces can be regulated by varying the weight of the counterpoise on the balance. Our instrument is set up so that each space equals one gram. One movement of the armature carries the counterpoise a distance equal to one-tenth of a gram and the pen at the same time moves across one-tenth of a gram space on the record sheet. Once across the sheet equals fifty grams. When the pen has recorded this amount it passes back, making the record in the other direction as before explained.

Below is shown a record of evaporation from a fuchsia from 12 M. March 16th to 12 M. March 18, 1895. It is one sheet of



a continuous record for the month of March. The pen was started at 12 M. March 16th at the top of the sheet. From 12 M. to 1:25 P. M. the loss was at the rate of one gram for each ten minutes. During this time the plant was exposed to direct sunlight. At 1:25 a screen was placed between the plant and the sun. The rate of evaporation was greatly checked, being only about one-tenth of a gram in ten minutes. At 2:30 P. M. the screen was removed. The intensity of the light was much lower than from 12 to 1:25, but greater than what the plant had been exposed to behind the screen. The increase in loss is proportional to the increased intensity of the light. The total loss from 12 M. to 6 P. M. is seen to be 12.1^{gm} from 6 P. M. to 12 midnight nine-tenths of a gram, 12 midnight to 6 A. M. 1^{gm}, 6 A. M. to 12 M. 9^{gm}, 12 M. to 6 P. M. 6.5^{gm}.

March 16th was clear, the 17th two-tenths cloudy, the 18th eight-tenths cloudy. The total amount lost for the whole period was 39^{gm}. This brief explanation in connection with the record will show how easily and accurately comparisons may be made for any period of time or the total evaporation determined at any time during the experiment. With automatic devices for recording temperature, humidity, intensity of light, and barometric pressure, it will be possible to obtain data on the much talked about but little understood problems of transpiration. The instrument can be very easily modified so that it will record either gain or loss in weight. With the help of Prof. Marvin we hope to simplify it and increase its range of usefulness in physiological work. Plate XXX is reproduced from a photograph of the complete apparatus as at present used.

Division of Vegetable Physiology and Pathology,
U. S. Department of Agriculture, Washington, D. C.

Contributions from the Cryptogamic Laboratory of Harvard University. XXVIII.

New or peculiar aquatic fungi. 2. Gonapodya *Fischer* and Myrioblepharis, *nov. gen.*

ROLAND THAXTER.

WITH PLATE XXXI.

GONAPODYA Fischer.

In the preceding note on Monoblepharis reference was made to the history of this genus which was erected by A. Fischer[1] to receive the single species formerly described by Reinsch[2] as *Saprolegnia siliquaeformis*. The form was subsequently referred by Cornu[3] to his *Monoblepharis prolifera*[4] but since this name had not been associated with any description or recognizable figure and since its relation to Monoblepharis must remain in doubt until more definite information is obtained concerning its sexual reproduction, it would seem proper to retain for the type the specific designation given by Reinsch. It is moreover quite uncertain from published data whether the forms referred to by Cornu and Reinsch are really identical, since a second species described below as *G. polymorpha* is, in this country at least, far more abundant than *G. siliquaeformis*, and may well be the species observed by Cornu. In this author's criticism[3] of Reinsch's paper incidental mention is made of the fact that since the publication of his monograph in 1872, he had observed the oospores, which he describes as oval, colorless, contained in oogonia similar to the zoosporangia and resulting from a fertilization of the oosphere by motile antherozoids. Beyond this mere statement, which, to the writer's regret, was overlooked in connection with the previous note on Monoblepharis, no further information and no figures of any kind have been published. Although, however, this statement must be accepted as it stands, from so

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[1] Rabh. Kryptogamenfl. **1**[4]: 382. 1892.

[2] Pringsheim's Jahrb. f. wiss. Bot. **11**: 293. 1876.

[3] Bull. Bot. Soc. de France **24**: 227. 1877.

[4] Idem **18**: 59. 1871.—Annales d. Sci. Nat. Bot. V. **15**: 16. 1872. Van Tieghem, Traite de Botanique 1029. *fig. 620,2.*

high an authority, it seems within the bounds of possibility that he may have been misled as to the presence of antherozoids by the extensive variations in size exhibited by the zoospores in certain instances (fig. 14), while the writer must confess that he has himself been several times misled as to the presence of oospores by the encystment of secondary sporangia within the empty primary sporangium, which sometimes occurs under unfavorable conditions. The presence of uniciliate zoospores (which are perhaps not invariably produced in this genus) can hardly be considered very significant in view of the fact that such zoospores are known to occur in other genera, even were it not true that in at least one species of Monoblepharis (*M. fasciculata*), if not in all, biciliate zoospores are normally produced.

In other respects the genus bears no resemblance to Monoblepharis in appearance or mode of growth, and is well defined through the correlation of successively proliferous sporangia with a habit corresponding essentially to that which distinguishes the order LEPTOMITACEÆ (APODYEÆ Fischer), namely the segmentation of its hyphæ through the presence of successive constrictions, each corresponding to a pseudoseptum formed by a deposit of cellulin (?) which nearly closes the passage from one segment to another except for a central perforation through which the protoplasm of adjacent segments may usually be seen to be continuous. This segmentation, however, although as a rule so conspicuous a feature in *G. siliquaeformis*, is sometimes almost wholly absent from, or at least greatly obscured in, the common and very variable species which I have called *G. polymorpha*. The "cellulin rings" in this species are sometimes unassociated with any marked constriction and are sparingly distributed, while in other instances the segmentation is as pronounced as in *G. siliquaeformis*, involving the entire vegetative body when the plant is short in habit, or often confined for the most part, as in fig. 11, to terminal groups of branchlets which are borne on more or less undifferentiated and sparingly pseudo-septate filaments.

The zoosporangia in both species are in general similarly shaped, though much shorter, stouter and smaller in *G. polymorpha*, tapering from a more or less inflated basal portion to the narrow tip which becomes terminally perforate for the emission of the zoospores. The sporangia may be once to several times proliferous and in *G. polymorpha* specimens are sometimes seen in which the hypha grows on through and beyond the empty sporangium eventually producing new sporangia at its top. The encystment of sporangia formed by proliferation within the empty primary sporangium has already been referred to and has been observed in a number of instances where the fungus was growing under unfavorable conditions surrounded by a mass of bacteria and other plants. The resemblance of such encysted sporangia to oospores is often misleading, but it must be admitted that the walls in such cases cannot be compared in thickness to mature spores of Rhipidium.[5]

The zoospores in both species are peculiar in appearance and though sometimes more or less evenly granular, are more commonly sufficiently transparent to show distinctly the large spherical nucleus just in front of which lies a coarsely granular mass characteristically disposed (fig. 10). Each zoospore makes its exit independently and after a short period, during which it undergoes rather rapid amoeboid changes of form, swims away. Zoospores when examined in a partly emptied sporangium may often be seen to creep over its inner surface with an amoeboid motion (fig. 9 below) sometimes disengaging themselves and swimming free in the cavity. In *G. polymorpha* the variations in size exhibited by the zoospores are very remarkable even in the same specimen which may show the extremes represented in fig. 14 produced side by side. The presence of antherozoids in the plant was at first suggested by this great discrepancy, but extended examination shows the occurrence of every degree of variation connecting these extremes.

Reinsch in the paper already mentioned figures[6] a sporangium in which sporangiola are supposed to have developed from the walls of an empty sporangium, but as such a development is a manifest impossibility, it seems probable that the objects figured are rather zoospores which having been unable to escape have germinated in the position indicated.

In several specimens of *G. polymorpha* oospores such as are represented in fig. 16, have been found associated with the zoosporic form, but in no instance was the material sufficiently good to show the hyphal connections of these spores. They are remarkable for their enormously thickened walls, and

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[5] Cornu l. c.

[6] l. c., *pl. 15. fig. 13.*

completely fill the oogonium. In almost every specimen examined the small rounded antheridium was present at the side recalling that of species of Rhipidium. It is quite uncertain, however, whether these spores are really connected with the zoosporic form which they accompany.

GONAPODYA SILIQUAEFORMIS (Reinsch). *Plate XXXI, figs. 6–10.*

Saprolegnia siliqaeformis Reinsch l. c.
Gonapodya prolifera Fischer l. c. Schroeter in Engler and Prantl Natürl. Pflanzenfam. 93: 107. 1893.

Hyphæ rather stout, more or less regularly divided into short elliptical to long clavate segments, copiously and successively sub-umbellately branched, the branches diverging in a dense tuft from a common base. Sporangia often once to three times proliferous, long pod shaped, inflated below, the sometimes very elongate distal portion tapering gradually to a blunt apex; borne sessile on the terminal cell of a branch or separated from it by a clearly defined constriction. Zoospores numerous (more than fifty), uniciliate, oval or elliptical with conspicuous nuclei. Oospores (*sec.* Cornu) oval in terminally perforate oogonia like the sporangia. Hyphæ 250–500μ long, the segments normally about $25 \times 14\mu$, but varying greatly. Sporangia, average $130 \times 22\mu$, sometimes 200–250μ long.

On decaying apples in water. Cambridge, Mass., and Kittery Point, Maine.

This species appears to be decidedly rare and has been collected by the writer on two occasions only, growing in dense tufts which formed small pustules on the surface of the substratum above mentioned, and there seems to be no record of its occurrence since it was found by Reinsch in a similar situation. It is distinguished by its very large tapering sporangia, the distal portion of which is sometimes very greatly elongated. Though its hyphæ are commonly rather regularly segmented, forms occur which present great irregularities in this respect, especially through the elongation of terminal branchlets into slender often unsegmented filaments, in a fashion frequently more pronounced than that which is represented in fig. 7. The secondary sporangia are often quite distinct from base to apex within the primary ones, though more commonly the distal portion only is distinct as is represented in fig. 6.

THAXTER on AQUATIC FUNGI.

HELIOTYPE PRINTING Co. BOSTON.

Gonapodya polymorpha, n. sp. *Plate XXXI, figs. 11–16.*—Hyphæ irregularly branched, more or less regularly divided into short oval or irregular segments, the segmented portion arising directly from the substratum or more often confined to tufts of branchlets borne sub-umbellately on the ends of slender elongate hyphæ in which the segmentation is indistinct or obsolete; the segmentation frequently ill-defined or obsolete throughout the whole vegetative body. Sporangia variable in size and form, long-oval, tapering rather abruptly to the blunt tip, terminal and solitary or sometimes several arising from a single segment, once to several times proliferous, the hypha sometimes traversing and growing beyond the empty sporangium. Zoospores very variable in size and number. Hyphæ 200–1000μ long. Sporangia 20–60 $\times$ 12–30μ.

On submerged twigs and other vegetable matter. Vicinity of Cambridge, Mass., and Kittery Point, Maine.

This species seems very common and may be obtained from almost any body of still water. Its variability is extraordinary and did not intermediate forms constantly occur one would not hesitate to separate specifically, if not generically, forms in which the segmentation of the hyphæ is most prominent and those in which it is nearly obsolete. Careful search, however, shows the presence of pseudo-septa unassociated with constrictions even in the unsegmented forms. When the segmentation is pronounced it is often even more clearly defined than in *G. siliquaeformis*, as in fig. 15, and in such instances the segmented portions are more often confined to tufts of branchlets borne on slender hyphæ as in figs. 11 and 12.

The oospores represented in fig. 16 have several times been found unassociated with any other zoosporic form, but, as has been already mentioned, a definite connection between the two has not been traced. They occur near the base of the ordinary filaments embedded in the mass of bacteria and foreign matter which is usually associated with this plant. These oospores, which recall those of Rhipidium in several respects, are about 54μ in diameter, the laminated refractive walls 18μ thick, with the rounded antheridium usually persistent.

The extremes of size exhibited by the zoospores are shown in fig. 14 in two sporangia which were borne side by side on the same filament. The general appearance of the zoospores also varies greatly, resembling in most cases those of *G. siliquaeformis*, but often densely granular throughout. In some instances the zoospores have seemed to be biciliate.

MYRIOBLEPHARIS.

In examining the material from which the species of Monoblepharis already described were derived, I encountered in one instance a singular fungus, remarkable alike for its energetic movements and the unusual character of its zoospores, to which I propose to give the above generic name. In a hasty examination of several preparations the form was at first passed over as an animal, perhaps a rotifer or some similar organism, which had attached itself, either by accident or as a parasite, upon the sporangium of a Pythium. Further investigation, however, made it clear that the surprisingly active mass of protoplasm which commonly terminates the plant was concerned in the production of its zoospores, the formation of which was watched from beginning to end in a number of specimens.

The vegetative body of the fungus consists of slender, continuous hyphæ which, arising for the most part singly from the substratùm and remaining simple or becoming sparingly branched, bear at their tips the peculiar sporangia represented in the illustrations (figs. 1–4). The primary sporangium is broadly oblong, or elliptic, terminally broadly papillate, and at maturity emits its contents very rapidly in the form of a single mass of protoplasm which at once commences a spasmodic irregularly rotary movement, the violence of which constantly increases. This mass remains adherent to the extremity of the empty sporangium which immediately begins to become proliferous, a new sporangium forming within it very rapidly and at maturity discharging its contents as in the first instance. As a result of this second discharge the first mass is carried up by the second (fig. 2), and each continues its rotating motion, while a third sporangium begins to form rapidly as before within the empty walls of the second. When this third sporangium is beginning to approach maturity, the mass first discharged divides rather rapidly into usually four parts (fig. 3), which undergo very violent movements, whirling around upon one another with great rapidity, but still retaining their position at the summit of the mass discharged from the second sporangium. The third sporangium then empties itself, carrying up the second mass, and, just as this occurs, the rotating bodies above the latter slowly separate from it and from one another, and almost immediately swim off as zoospores. The successive formation of sporangia and the discharge of new masses then continues, the series of sporangia remaining constantly surmounted by two rotating protoplasmic masses, the upper of which breaks up into free swimming zoospores just at the period when a third mass is being discharged. In this way more than a dozen empty sporangia are often superposed as in fig. 2, the series being traversed by the filament which bears them, from the tip of which new sporangia are successively produced. In rarer instances the filament may grow through the sporangium last emptied, and, after having attained a variable length, produces terminally a new series of sporangia as already described. Occasionally, when the successive formation of sporangia has been more than usually rapid, two successively discharged masses may unite with one another, as is shown in fig. 4, where the contents of the sporangium represented in fig. 3 has been discharged and united with the previously discharged mass above it, the two becoming quite indistinguishable from one another.

The successively discharged masses appear to be held in place by, and to go through their peculiar movements within, a perfectly hyaline gelatinous envelope in which each is discharged. The envelope of the first mass does not appear to be broken by the second discharge, and seems to be sufficiently elastic to withstand its pressure until the third discharge takes place, at which moment it is ruptured distally, and allows the escape of the zoospores, which are at this moment fully matured. In this way a series of gelatinous envelopes, corresponding to the series of empty sporangia, is formed, extending from the edges of the mouth of the first sporangium up around the whole series and beyond them to include the two lower masses last discharged. The figures given in the present connection do not show this envelope, being drawn from living material in which its character was not determined. Stained preparations show it very clearly, however, and serve to explain the otherwise inexplicable fixity in position of the three successively discharged masses.

At the time when the zoospores are ready to separate and make their escape, which usually is not less than half an hour after their discharge as an unsegmented mass, their surface in living material may be seen to be very conspicuously covered with innumerable cilia, as is represented in the illustrations; and, although this has not been made out satisfactorily in living material, stained preparations show that the masses within the gelatinous envelope are similarly ciliate when first discharged. The number of zoospores developed from a single mass is usually four, but is subject to occasional variation, two having been observed in small specimens while in the example represented in fig. 1, the number, originally four, has been increased to five by the division into two of one which was larger than the rest.

Although resembling some species of Pythium both in its slender hyphæ and proliferous sporangia, this genus seems to be clearly distinguished from all other Phycomycetes by its multiciliate zoospores and their peculiar process of formation. In fact no other zoospores, except those of Vaucheria among the algæ, are known to the writer to possess a similar disposition of cilia. The fate of the zoospores after their escape was not observed, and the sexual reproduction is as yet unknown.

Myrioblepharis, nov. gen. *Plate XXXI, figs. 1–5.*—Hyphæ slender, sparingly branched, bearing terminally zoosporangia becoming many times proliferous and forming an elongate series traversed by the hypha from the successive proliferations of which they arise. Zoospores very large, multiciliate over their whole surface, resulting from the division of the contents of the sporangia which make their exit as a single ciliated mass surrounded by a gelatinous membrane attached to the distal end of the sporangium, the successive envelopes, after rupturing distally, persistent around the series of empty sporangia.

Myrioblepharis paradoxa, nov. sp.—Characters of the genus. The contents of the sporangium dividing into two or four (rarely more) zoospores which are carried upward by the discharged contents of the two sporangia subsequently formed before making their escape from their inclosing envelope. Hyphæ slender, flexuous, seldom more than once or twice branched, about 1^{mm} long, $4–5\mu$ in diameter, sometimes growing through the terminal sporangium of a series and subsequently producing a new series in a similar fashion. Zoospores broadly oval or oblong, $20–30\mu \times 18–20\mu$.

On submerged sticks with Monoblepharis, etc. Weston, Mass.

Harvard University.

Explanation of Plate XXXI.

Myrioblepharis paradoxa Thaxter.

Fig. 1. Branched filament, showing a series of six sporangia, the sixth just ready to empty itself, its papillate tip hidden by the mass above it derived from the fifth sporangium; the contents of the fourth sporangium have divided into five zoospores which escaped immediately after the sixth sporangium discharged its contents.

Fig. 2. A hypha having a series of eleven sporangia, the eleventh half developed, the contents of the ninth borne on that of the tenth, and beginning to segment.

Fig. 3. A condition similar to that represented in fig. 1: the contents of the second sporangium having divided into four zoospores, the fourth sporangium just ready to discharge its contents.

Fig. 4. The same specimen, after the dehiscence of the fourth sporangium, the contents of which have united with those of the third while the zoospores derived from the contents of the second are separating to make their escape.

Fig. 5. Two zoospores showing the extremes of size observed.

Gonapodya siliquæformis (Reinsch) Thaxter.

Fig. 6. Portion of a plant showing elongate segments with two sporangia, one of them empty.

Fig. 7. Portion of a plant showing typical habit; seven of the sporangia are empty, and two of them are once proliferous.

Fig. 8. Sporangium, the contents of which have segmented to form zoospores, its base connected with a segment by a well defined constriction.

Fig. 9. A sporangium, partly emptied, sessile on its segment, the four lower zoospores creeping on the inner surface of the wall.

Fig. 10. Zoospores showing nucleus and anterior granular mass.

Gonapodya polymorpha Thaxter.

Figs. 11–12. Portion of two plants in which the segmented parts are borne sub-umbellately on slender hyphæ.

Fig. 13. Proliferous sporangia, borne on hypha, in which the segmentation is almost obsolete.

Fig. 14. Two sporangia on the same hyphæ, illustrating the extreme variation in the size of zoospores.

Fig. 15. Two segments very clearly distinguished, bearing terminally a sporangium from which the zoospores are escaping.

Fig. 16. Thick walled oospore with antheridium found associated with the zoosporic form, but not definitely connected with it.

⁂Note.—Figures 1–5, 8–10, 13–15, are drawn with Zeiss obj. D, oc. 4, the remainder with obj. D, oc. 2. All the figures reduced by photo-lithography.

Observations on the development of Uncinula spiralis.[1]

B. T. GALLOWAY.

WITH PLATES XXXII AND XXXIII.

At the meeting of this Association held in Indianapolis in 1890, the writer presented a note on *Uncinula spiralis* B. & C., calling attention to a number of experiments which established the connection between the forms on Vitis and those on Ampelopsis. Since presenting the note in question some additional studies on the life history of the fungus have been made, and while these are not as complete as they might be, it is thought desirable to present the results here, especially as it is doubtful when further opportunities for work will be afforded.

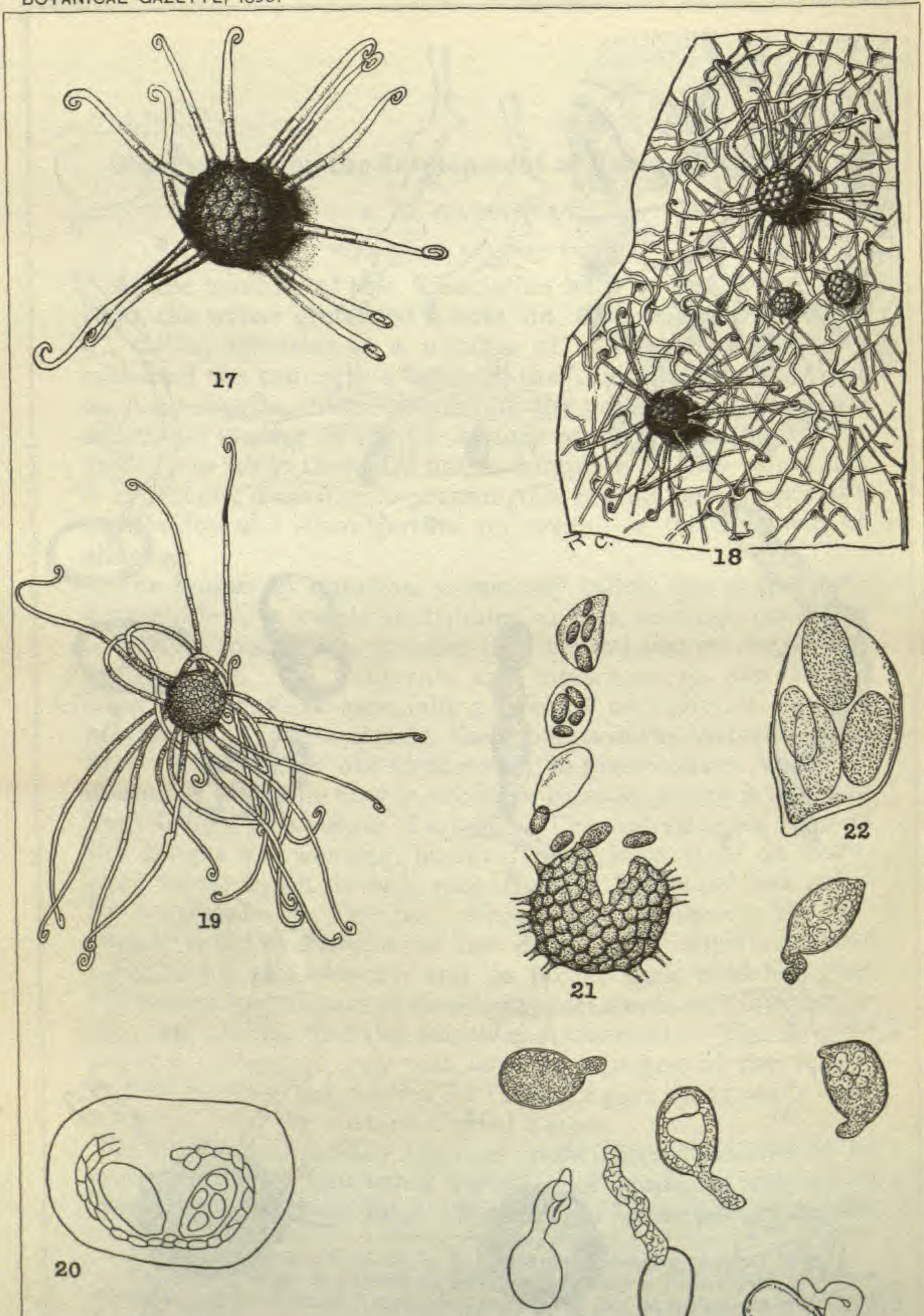
The fungus in question, commonly called the grape powdery mildew, is widely distributed in this country, occurring on various species and varieties of Vitis and also on *Ampelopsis quinquefolia.* In California and elsewhere on the Pacific coast the fungus is especially prevalent on varieties of *Vitis vinifera,* and it also attacks these plants in the eastern United States when grown out of doors and in greenhouses. What is doubtless the same fungus occurs in Europe, where it has long been known as *Oidium Tuckeri.* The native spore form of this fungus was wanting, however, for a long time on European vines, and it is only recently that Prillieux[2] has noted its occurrence in France. According to Prillieux, the perithecia found in Europe do not differ materially from those occurring in this country, and so far as such evidence goes there seems no reason to doubt the statements of Viala, Scribner, and others, that the forms are identical. The present paper is concerned only with the development of the fungus in this country, the studies for the most part being made upon material from the eastern United States.

The Uncinula usually becomes sufficiently abundant to be easily found on cultivated varieties of grape, as well as on Ampelopsis, early in July. Toward the latter part of August

[1] Read before section G. A. A. A. S., Springfield meeting, August, 1895.

[2] Sur les perithéces de l'Uncinula spiralis en France et l'identité de l'Oidium Americain et de l'Oidium Européen. Bull. de la Soc. Mycologique de France **9:** 253. 1893.

GALLOWAY on UNCINULA.



GALLOWAY on UNCINULA.

and during the months of September and October it may be found in an active stage on leaves, fruit, tendrils, and growing shoots, covering the same with a whitish, powdery, meal-like growth, which has caused it to receive its characteristic name. The powdery appearance is due largely to the presence of the mycelium and conidia of the fungus, which develop as described below.

Mycelium.—The mycelium consists of thin-walled, nearly hyaline, sparingly septate threads, which are very variable in thickness, but average from 6 to 7μ in diameter. The threads usually run in all directions, but show a tendency to converge at certain points (fig. 1), crossing and recrossing each other until a more or less thickened mat is formed. Although the mycelium does not become noticeably abundant until July, it may be found much earlier by carefully searching vines known to be susceptible to the attacks of the fungus. It occurs on such vines soon after the leaves put out, forming more or less rounded patches, which are difficult to see without the aid of a hand lens.

Haustoria.—At numerous points on the mycelial threads, more or less lobed swellings are formed (figs. 1 and 2). These are somewhat rounded on the upper side, but next to the leaf they are flat, clinging close to the surface. These swellings are the haustoria, and from their under side fine thread-like projections grow out and into the epidermal cells of the host. Once within the cell the end of the haustorial filament swells into a bladder-like body (figs. 3 and 4), which is filled with granular matter like that in the mycelium.

Conidia.—At numerous points the mycelial filaments send up short threads, which bear the conidial spores. These are formed by successive abjunction, from three to twelve being frequently found in one chain (figs. 5 and 6). When mature the conidia are oblong (the largest diameter being 20 to 30μ and the shortest 12 to 18μ), are filled with coarse granulated matter, and frequently contain two or more large vacuoles (figs. 7 and 8), which become more sharply defined as the conidium grows older. The conidia germinate readily in moist air or water, sending out one, and sometimes several, rather thick germ tubes (figs. 9 and 10), which seldom branch unless furnished nutrient material. The production of coniidia continues until late in autumn, when the growth of the fungus, as well as that of other vegetation, is checked by frosts.

Perithecia.—Perithecia, in all stages of development, may be found as early as the last of July, occurring in most cases rather evenly scattered over the parts covered by the mycelium. Owing to the close interweaving of the mycelial filaments, it is difficult to make out clearly the changes which take place in the formation of the perithecia.[3] As a rule their development begins at the intersection of two or more mycelial threads. There is little regularity, however, in the matter, and nothing that could be looked upon as a sexual act. Usually short branches, with frequent septa (figs. 11 and 12) grow out from the main hyphæ. These twist around each other, forming a more or less close weft, globose in shape (figs. 13 and 14). At first the bodies are hyaline, but they soon show a brown tint and at the same time become more globular in shape. With increasing age the evidence of the short branches originating from the main hyphæ disappears, and later the walls of the peritheciabe come clearly defined (figs. 15 and 16). Soon after this there is developed from the outer walls of the perithecium eight to thirty appendages (fig. 16), which are at first hyaline and without septa, but later become brown near the base and divided by several cross walls. In the mature perithecia (figs. 17 and 18) the tips of the appendages are hooked and not unfrequently they are branched. The length of the appendages varies greatly, the form on *Vitis vinifera* from the Pacific coast (fig. 19) having especially long ones. Within the perithecia are found the ovate asci containing the spores. There are four to eight, rarely ten, asci in each perithecium, and from four to eight spores in each ascus. From studies made of imbedded material it appears that the dark-colored wall of the perithecium is composed of one or possibly two layers of somewhat thick-walled brown cells. Within this there are one or more layers of colorless cells (fig. 20*a*), which in the early stages at least fit close around the asci, and in some cases seem to extend into the interstices between the latter. These cells take stains in the same manner as the asci. In all the material

[3] After many attempts to find satisfactory material for the study of the development of the perithecia, the best results were obtained by gently boiling for half a minute small fragments of leaves containing fertile hyphæ and young perithecia in a solution of potassic hydrate. After this treatment the mycelium and young and old perithecia easily separate from the leaf and the weft of filaments may be easily floated on a slide, stained, and studied. The most satisfactory stain found was ordinary red ink diluted with 10 to 25 per cent. of its volume of water.

studied the perithecia seemed to be flattened on one side, the flattening sometimes amounting to a concavity. In such cases the asci were compressed vertically and considerably distorted. Doubtless part of the flattening was due to the shrinkage of the tissues during imbedding, but some of it was normal.

One of the principal objects of these studies was to follow the development of the fungus during the winter and to determine if possible when and how the ascospores germinated and the manner in which the host was infected in spring. It was deemed especially desirable to germinate the ascospores, as the evidence as to how this takes place in the Erysipheæ is comparatively meager. Leaves of both ampelopsis and vitis containing the perithecia of the uncinula were collected in the autumn and stored in several ways. Some were placed on the ground and covered with stones and boards, while others were tied up in cheese cloth sacks and the sacks were then thrown on the ground out of doors and tied to stakes in order to prevent them from blowing away. This last method was found to be most satisfactory, as when the leaves were covered with boards they rotted so badly that most of the perithecia were lost. Frequent examinations were made of debris under vines which had been attacked by the uncinula the previous summer. No material of value, however, was obtained in this way, all traces of perithecia disappearing early in December.

The first change of importance in the perithecia was the disappearance of the appendages. After December 1st it was rare to find a perithecium with all of its appendages intact. The hooked ends are usually the first to break off and soon the entire appendage disappears. The asci and spores undergo little change until the last of December, when many of them are found dead or more or less collapsed. All attempts to germinate the ascospores before January failed, and it was only after repeated trials through the months of February and March that success was attained.

The perithecia were from time to time removed from the leaves which had been exposed to the weather and placed in Van Tieghem cells, in the bottom of which was a drop of sterile water. Under these conditions the perithecia were kept properly moistened and could be examined with the microscope at any time. Perithecia collected after January 1st and kept in Van Tieghem cells, as described, showed little or no change if allowed to remain perfectly quiet.[4]

After standing from a few days to a week or more, however, a slight jar was often sufficient to cause the perithecia to rupture and the asci and ascospores to escape. When this took place probably 8 per cent. of the ascospores collapsed, while the remainder either made no change or in the course of three or four hours began to send out germ tubes. The following case, which differs but little from others observed, illustrates the matter under consideration. Perithecia from the open ground were placed in Van Tieghem cells on January 7th. Twenty days later no change had taken place, the cell having been kept free from jars and other disturbances. The cell was then placed under the microscope and gently jarred with a needle, whereupon one of the perithecia suddenly burst and the asci began to escape into the drop of water surrounding the mass. The first ascus was violently ejected from the perithecium to a distance equal to about twice the length of the former. This was immediately followed by a second and a third ejected in the same way (fig. 21). The ruptured wall of the perithecium then closed and no more asci escaped. In coming through the ruptured walls of the perithecium the asci were more or less constricted, but they immediately assumed their normal shape as soon as they were entirely free. No sooner were the asci free than their spores began to escape or else to break up within the ascus. In the former case they escaped from the top, side, or bottom in much the same way as did the asci, but with less force. A large part of the spores burst as soon as they were free from the asci. In bursting the spores literally flew to pieces, the walls and contents being scattered in all directions. Nearly all the spores that failed to burst began to send out germ tubes in four or five hours, and at the end of twelve hours the tubes (fig. 22) had reached a length twice that of the spore or more. From a number of observations it appears that the sudden ejection of the asci is largely due to the abrupt contraction of the walls

[4]It was not uncommon to find perithecia which had been kept in water sending out long, hyaline filaments from the outer walls. At first it was believed that the spores within the asci had germinated and pushed their germ tubes through the perithecial walls. That this was not the case, however, was shown by the fact that when ruptured the asci and spores within were found in a normal condition. From the evidence at hand it seems more than likely that the mycelial filaments were direct outgrowths from the stroma-like wall of the perithecium. This matter, however, requires further study.

of the perithecium after being ruptured. The perithecium is doubtless filled to the point of bursting, pressure being greatest just over the apices of the asci. The least disturbance at this stage will cause a rupture at the point above noted and immediately the asci begin to go in the direction of the least resistance. During the passage of the thickest part of the ascus (*i. e.* the top), it moves quite slowly, and at this time the ruptured edges of the perithecium are pushed a little further apart. As soon, however, as the tapering portion of the ascus is reached there is a sudden contraction of the more or less elastic perithecial walls and in consequence the ascus is ejected with considerable force. After April 1st it was difficult to find perithecia containing spores and before the end of the month they had entirely disappeared. A number of attempts were made to infect grape and Ampelopsis leaves with ascospores, but the results of this work were in every case negative.

In conclusion I wish to express my thanks to Mr. D. G. Fairchild, my former assistant, who made a number of the sketches upon which the finished drawings accompanying this paper are based, and who also aided me in other ways.

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Explanation of Plates XXXII and XXXIII.

Fig. 1. Portion of upper surface of Ampelopsis leaf showing mycelium and haustoria.—Fig. 2. Isolated pieces of mycelium showing upper surface of haustoria.—Figs. 3 and 4. Haustoria within the epidermal cells of *Ampelopsis quinquefolia.*—Figs. 5 and 6. Chains of conidia.—Figs. 7 and 8. Isolated conidia.—Figs. 9 and 10. Germinating conidia.—Figs. 11–17. Development of perithecia on Ampelopsis.—Fig. 18. Portion of Ampelopsis leaf showing perithecia in different stages of growth.—Fig. 19. Perithecium from leaves of Vitis.—Fig. 20. Section of mature perithecium showing asci and colorless cells surrounding them.—Fig. 21. Perithecium which has just burst, showing relative position of ejected asci.—Fig. 22. Ascus containing four spores, drawn just before the escape of the latter.—Fig. 23. Germinating ascospores.

Notes from my herbarium. IV.

WALTER DEANE.

My baby flower press.

I always carry with me on my collecting trips a small press, consisting of two pieces of stiff card-board some six by five inches in size, filled with small blotters and pressing paper which I cut out from my large sheets used in the ordinary press. I use strong rubber elastics round the boards, and the little press can easily go into the pocket. The object of all this is to secure the flowers of many plants in a way almost impossible in the large press. It is most important for a well-furnished herbarium to be able to show the flower in all its details, that the student may have before him, spread out as in a printed diagram, the various parts of the flower, without resorting to boiling and dissection in order to find out the simplest facts as to number of stamens, position of petals, and the like. This my baby press enables me to do.

I am walking along the railroad track on a sunny morning, and I meet a fine specimen of *Lactuca leucophæa* Gray, a species of wild lettuce, its small purple heads of flowers broadly expanded to receive the warmth of the beautiful sun. How quickly those flower-heads will close and wither when the plant is picked! Even if put into the press on the spot, the flowers are apt to close and make a sorry show, for they are small and the stems of the plants prevent their receiving the needed pressure to keep them open. How many herbaria can show the open flowers of such species of the Ligulifloræ as *Lampsana communis* L., the nipple-wort, *Krigia Virginica* Willd., the dwarf dandelion, *Sonchus oleraceus* L., the common sow-thistle, and the like? This, however, can easily be done. When collecting the plant, pick off separate flowers and put them into the baby press, and, as you put the paper over them, hold them so that they will press wide open. Nothing is simpler. I find that there is no need of changing the blotters, since the flowers dry just as well without. In the case of such flowers as the fringed gentian, *Gentiana crinita* Froel., I section the corolla and press it open. This shows the appendages at the sinuses, so important a character in this genus.

A complete diagram of a flower is a most interesting feature to display, especially in the case of so curiously constructed a flower as *Sarracenia purpurea* L., the pitcher plant. Remove carefully all the parts, the three bracts, the sepals, the petals, the umbrella-shaped top of the style with its stigmatic rays, and then make a cross section of the ovary and keep the fringe of stamens on with it. Press all these and either mount them on the sheet or put them in a paper pocket. I use both of these methods in my own herbarium. If the separate flowers belong to the same plant on the sheet with them, I always signify the fact by writing on the pocket, "From this specimen." This lends greater value to the plant in question. Sometimes one is obliged to take flowers from adjoining plants. In *Sagina procumbens* L., the pearlwort, my little press enables me to show clearly the minute petals, while my finest specimens of the flowers of the exquisite little *Arenaria Groenlandica* Spreng., the mountain sandwort, are those clapped into the baby press in a rain storm on the summit of Mt. Monadnock, N. H. Their wetting seemed to give them additional freshness, and the plants were so small that I put them into the little press entire.

I spent part of the summer of 1887 at York Harbor, Maine. My attention was naturally attracted especially to the seaside plants, and none interested me more than the eel grass, *Zostera marina* L. The inlets at the mouth of the York river were full of it, and the surface of the water was covered with the long ribbon-like leaves. The inflorescence is most beautifully adapted to the environment of the plant in the water. It must be seen in the fresh state to be appreciated. The narrow spadix, some two inches in length, is enclosed tightly in a delicate spathe, and at the time of flowering the ovaries thrust their exquisitely beautiful two-forked styles between the clasping edges of the spathe into the water, to receive from some other plant the pollen which has worked its way out from its home to assist in the great work of propagation. My baby press came to my aid in showing this inflorescence to the best advantage. I cut off a large number of the inflorescences and pressed them in various ways, with the spathe enclosing the spadix or opened so as to show the flowers in their natural position; I also drew the spadix out from the spathe, leaving it attached and allowing the spathe to close again. So now I have the plant complete, from rootstock to seed. One pocket contains drawings of the inflorescence, others contain the specimens made in my little press, and others still, the fruit collected at various places. I was even induced in this case to put specimens of the inflorescence into a small bottle of alcohol, and, as I look at them now, the ovaries are still vainly extending their finely forked style, as when they left their briny home eight years ago, and the thread-like pollen is floating about, the whole telling the wonderful story of cross pollination in one of its thousand ways of adapting means to an end.

The most difficult task I ever gave my baby press was to prepare me a perfect diagram of the flower of a xyris. I think I may say that it is literally impossible to show the details of this flower in any other way. It is a poor withered blot in any pressed specimen of the plant. On August 9, 1888, I collected some fine specimens of *Xyris Caroliniana* Walt., the yellow-eyed grass, in Grassy Pond, Acton, Mass. The flowers were very beautiful as I gathered the plants. I had never realized that the xyris had a blossom with such exquisitely yellow petals. My herbarium showed nothing like it. Even when I put the specimen immediately into press, the hard scaly head allowed the blossom to wither. The operation of dissecting the flower was too delicate and too long a process to perform in the field, so I took home several flower heads in addition to my other specimens. I put them into a vase of water to get fresh blossoms in the morning. Sure enough when I visited them, a flower was slowly pushing its way up from behind its bract, and I saw, to my joy, that the flower was pushing ahead of it the anterior sepal which encloses the corolla, and falls as the blossom opens. How often had I read these words in the Gray Manual, "enwrapping the corolla in the bud and deciduous with it." Now I saw the performance for myself. As the flower opened, the sepal fell, and I caught it on the fly. Then, working under a lens, I dissected the flower and put into my baby press the three sepals, three petals with their inserted stamens, and the ovary with its three-cleft style. Attached to the base of the ovary are the three thread-like sterile filaments, beautifully cleft and bearded at the apex. I afterwards mounted them in diagrammatic form on a bit of white paper, and they are now in a pocket on one of my herbarium sheets, ready and anxious for inspection.

A pressed specimen of *Trapa natans* L., the water-chestnut, can hardly show the small white ephemeral flower in the center of the rosette of leaves. The press enabled me to do it, as I collected the plant on the Concord river in Concord, Mass. It is an introduction from Europe and has been in the river for years, thoroughly established and keeping company with *Marsilia quadrifolia* L., which is so abundant as to impede the oars as you row through it.

On a short visit to York Harbor, Maine, July 15, 1893, I took no press with me, for social duties made collecting out of the question. Walking along the cliffs with some friends, I noted the many plants about me, with the inward satisfaction that they were all duplicated in my herbarium. That feeling is always one of great gratification to me. Presently we reached a spot where we stopped to rest. It was close to the breaking waves and some ten feet above them, and as we sat down to enjoy the view, I noticed in the fine sand, which filled a shallow spot on the rock, some very small plants with purple flowers. The little fellows averaged an inch in height and covered the space of about a square yard. I confess that for a moment I was puzzled, for I did not expect to find such minute specimens of *Lythrum Hyssopifolia* L., the loosestrife. "Starve a plant," said Dr. Asa Gray to me once, "and it will flower immediately." This was when I showed him some seedling *Bidens cernua* L., the bur marigold, flowering half an inch above the cotyledons. I gathered them floating on a pond. Starved they were most certainly, and so was my loosestrife in the sand. An improvised baby press secured for me plenty of specimens. Contrary to the ordinary description of the species the flowers were very conspicuous. Indeed it was this that attracted my attention. The little roots had worked their way down an inch or two into the sand in search of the much needed moisture. On the following Aug. 13th, I received from my friend, who was spending the summer at York Harbor, perfect fruiting specimens of the plant from the same spot. The fruit was well developed, though the plants had not increased in size a bit. Fortunately the rains had given them moisure enough to sustain life. In fact for several days the little plants were entirely under water. My herbarium specimens of this species show the plant to vary in height from six to twenty inches.

I do not tell these little incidents, so interesting to me, to claim any credit. Far from it. Perhaps many others do the same things too. It is open to all who will take the trouble, and if the account of what I am doing will stimulate any collector to do the same, I know that it will give added zest to his work, and will enrich his herbarium with material which he cannot get in any other way.

Cambridge, Mass.

Noteworthy anatomical and physiological researches.

Root-tubercles on Ailanthus.[1]

The tumors upon roots of phanerogams have been studied extensively during the last decade. To the list of plants known to possess root-tubercles we can now add Ailanthus. Upon the roots of a tree of A. glandulosa cultivated in the botanical garden of Erlangen, Ernst Andreæ discovered numerous tubercles. These tubercles were outgrowths of very irregular shapes, varying from 5 to 40^{mm} in diameter and were most frequently grown together in clumps of three or more. The surface of the tubercles was scabrous, almost warty. One root showed a peculiar development of not only a number of these tubercles, but also an innumerable mass of lateral roots, all of which were of the same thickness and approximately of the same age. These roots were tangled up and more or less grown together, reminding one of some coarse fungus mycelium.

Two questions arise in regard to the origin of the tubercles: are they due to parasitic organisms, or merely to mechanical influences, disturbances in the functions of nutrition, etc.? The author bases his reply to these questions upon the results of a very careful anatomical study of the roots and the tubercles.

He describes minutely the structure of the various forms of tubercles. An old tubercle shows distinctly the original structure of the root, although the deformation is often so great that longitudinal and transverse sections are almost alike. This is seemingly due to the fact that the growing-points of new roots and root-shoots develop in almost any direction, and so the tubercle obtains its roundish shape. Most of these rudimentary roots and shoots do not develop any further. Sometimes, however, they grow so as to form lateral tubercles, but most often they constitute the warty mass which characterizes the surface of the tubercles.

Some fungi were observed by an examination of the structure of the tubercles. They were supposed to belong to the

[1] Ernst Andreæ: Ueber abnorme Wurzelanschwellungen bei *Ailanthus glandulosa.* Inaug. diss. Erlangen 1894.

Pyrenomycetes, but they were found in a very imperfect condition. Their occurrence was always merely local; they did not penetrate the entire tubercle, and the mycelium seemed constantly to decrease in size towards the center of the tubercle. Another fact observed was that the fungi only occurred in degenerated or decayed parts of the roots and tubercles. From this fact we might conclude that the fungi were saprophytic in nature, and had nothing to do with the malformation of the roots.

Comparing these tubercles with similiar ones on the roots of other plants, the author considers them to be nearly identical with those which Brunchorst described from *Cratægus prunifolia.*[2] The cause of their formation may be sought in purely external conditions, such as a sudden change in the nutrition of the plant or in some mechanical obstruction. In the present case it was found that the development of the tubercles was especially frequent whenever the roots struck sterile layers of sand, and they were thus at once deprived of their usual nourishment.—THEO. HOLM.

Studies upon galls.[3]

Pliny was the first to use the word gall (*galla*) as a name for these well-known outgrowths upon plants. The word has since been used for any pathological formation which appears as a thickening or swelling, and which is caused by insects, spiders, or fungi. The injury may, however, be of quite a varied character, and botanical terminology gives a large number of terms for distinguishing between the various forms, under which parasitism or pseudo-parasitism may occur.

Vuillemin[4] for instance has proposed the terms "antibiosis" and "symbiosis," according as the interference is or is not injurious to the host. But while this writer considers parasitism as intermediate between anti- and sym-biosis, Sarauw[5] uses parasitism as embracing all the various forms of anti- and sym-biosis.

The result of an antibiosis is probably always the develop-

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[2] Brunchorst: Ueber einige Wurzelanschwellungen insbesondere bei *Alnus* und den *Elæagnaceen.* Untersuch. im bot. Inst. Tübingen 1885–88.

[3] Küstenmacher, Max: Beiträge zur Kenntniss der Gallenbildungen mit Berücksichtigung des Gerbstoffes. Pringsheim's Jahrb. f. wiss. Bot. **26**: —. 1894.

[4] Vuillemin, Paul: Antibiose et symbiose. Assoc. française pour l'avanc. des sciences. **18**: —. 1889.

[5] Sarauw, Georg F. L.: Rodsymbiose og Mykorrhizer. Bot. Tidsskrift. **18**: —. 1893.

ment of a gall, which, however, may show a marked difference in its exterior aspect and internal structure.

The cynips-gall may be taken as a good example. It is often globular and the anatomical structure shows the differentiation of two or more (frequently of three) concentric layers as follows: 1. The parenchymatic outer layer with epidermis, which contains tannin, and may therefore be called the tannin-layer. The cells of this tissue are mostly arranged radially. 2. The protective layer, Frank's "Schutzschicht" and Lacaze-Duthier's "couche protectrice," which most often consists of sclereids. 3. The inner or nutritive layer, Lacaze-Duthier's "couche alimentaire," which is composed of thin-walled parenchyma, the cells of which are frequently provided with large pores. This tissue contains an emulsion of oil, sugar and albumen; it is often very loose and shows large intercellular spaces. These layers are, however, not observable in all forms of galls; they are, according to the author, especially characteristic of the cynips-gall.

But if we consider galls in general, the author makes the following statements: 1. Vegetable tissues become developed, which enclose the animal embryos or fungus spores; or else the existing tissues become utilized for the enclosure or covering of these embryos or spores. 2. These tissues develop a nutritive layer.

The nutritive layer develops from its inner epidermis roundish sacs or long papillose hairs, or the cells may possess only pores, through which the nutritive materials can pass and become utilized by the larva. It would appear that vegetable galls might be produced artificially with the same success as has been done with the common fresh water mussel, where the introduction of a mustard seed developed a pearl. This does not seem to be the case, however, according to numerous experiments made by the author. The following substances were tried on plants: formic acid, acetic acid, tincture of cantharides, croton oil, mustard oil, lactic acid, potassium iodide, iodine, lead acetate, suet, albumen, yeast, and sugar. The injections were made by means of a horn pin, with which the author punctured the midrib of leaves or young shoots, and subsequently introduced the solutions through capillary glass tubes. He finally introduced a small piece of black mustard seed and covered the opening with court plaster. The result was, however, negative in all instances. Similar experiments have also been made by Beyerinck,[6] who inoculated young leaves of *Salix purpurea* with the contents of the vesicle of *Nematus viminalis*, but without being able to produce the corresponding nematus-gall. One result was gained, however, which also confirms the correctness of Beyerinck's observations, viz., that neither the puncture itself nor the irritation which it causes to the plant is the real cause of the development of the gall, but that the larva of the animal or the fungus spore is the factor which produces the gall. It is, therefore, not difficult to prevent the development of a gall, and this can be done by killing the larva before the gall has reached its full size.

The author gives the history of the development of a number of galls from various species of wild roses, oaks, etc., and a systematic classification of the galls. This classification depends upon whether the galls are free or immersed in the plant; whether they contain one or more embryos; and according to the host, whether this belongs to the angiosperms, the conifers or the ferns. The occurrence of tannin in the galls is discussed at length, and there are many other points of interest in the work, so that it forms a welcome contribution to the study of vegetable galls in general.—THEO. HOLM.

The combined effects of geotropism and heliotropism.[7]

Dr. Czapek has recently obtained some valuable conclusions as to the interlocking effect of light and gravity stimuli. He finds that plants which are placed horizontally (for 60–70 minutes) until they have begun an upward geotropic curvature, when placed in an erect position and given a light stimulus on the previously lower side, will react to the light in exactly the same time as a control plant which has been standing upright meanwhile. On the other hand plants which were first given a heliotropic stimulus were greatly delayed in their reactions to a geotropic stimulus given later in an opposite direction. In the extension of the experiments plants were subjected to these two stimuli in every position from

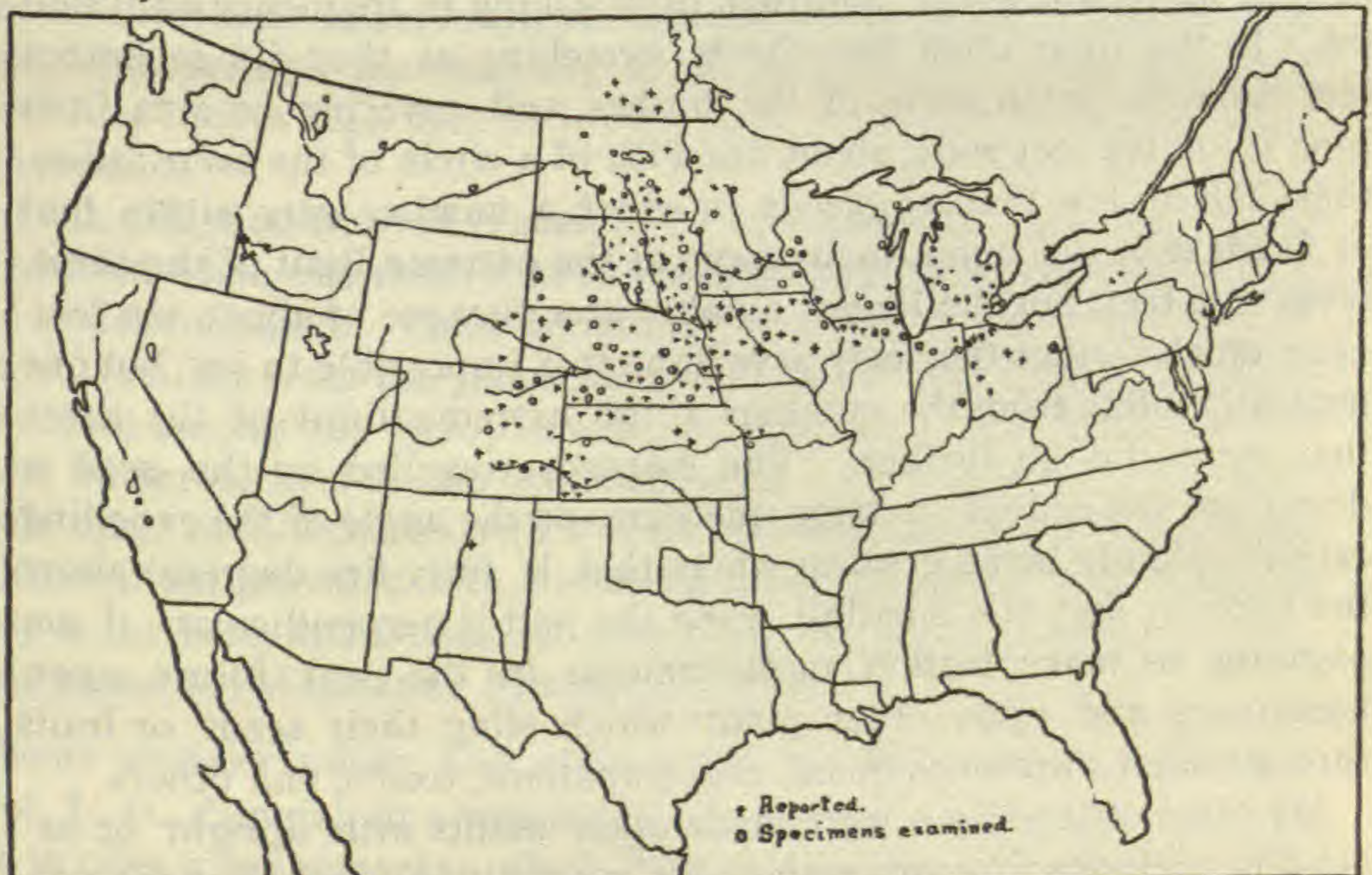
[6] Beyerinck, M. W.: Beobachtungen über die ersten Entwickelungsphasen einiger Cynipidengallen. Amsterdam 1882. Also: Ueber das Cecidium von *Nematus Capreæ* auf *Salix amygdalina*. Bot. Zeit. **46:** 1–11.17–28. 1888.

[7] F. Czapek, Ueber Zusammenwirken von Heliotropismus und Geotropismus. Aus d. Sitzungsber, d. kaiserl. Akademie d. Wiss. i. Wien. math.-naturw. Classe 4[1]:—. Mr 1895.

vertically upright to a directly inverted, and it was found that the law of the "angle of incidence" of light does not hold when the light is given from below the horizontal. Further "that when an orthotropic organ is acted upon by two opposing stimuli, the resultant curvature will depend not only on the relative force of the stimuli but also on the position of the organ." The results of Dr. Czapek's work form an important addition to those which oppose the theory of "specific energy" of Johannes Müller which is upheld by Sachs and which forms the basis of Noll's speculations in his Heterogene Induktion. Incidentally, the prevalent views concerning plagiotropic organs are placed open to question.—D. T. MAC DOUGAL.

BRIEFER ARTICLES.

Distribution of the Russian thistle in North America.—During the past thirty years the Russian thistle, *Salsola kali tragus*, has been introduced over a wider range and has covered the infested territory more thoroughly than any other weed in America has ever done in the same length of time. Prickly lettuce, *Lactuca Scariola*, has a record for rapid distribution which approaches that of the Russian thistle but the prickly lettuce was introduced as early as 1863, while the Russian thistle was not here until ten years later. Even the Canada thistle which was abundant enough in Vermont a century ago to be proscribed by law as a noxious weed, has not in a hundred years covered much more ground than is now occupied by the Russian thistle. The data being collected regarding the rapid distribution of this weed will form an interesting chapter in the history of weeds in this country.



The accompanying map shows the distribution of the Russian thistle as indicated by the reports received at the Department of Agriculture during the past three years, corrected to October 30, 1895. If the plant has been discovered in any locality not indicated on the map, the undersigned would be glad to receive a report of it; and, if in any locality there indicated the plants have been exterminated, a report of the fact would be doubly acceptable.—Lyster H. Dewey, *Washington, D.C.*

Observations upon the dissemination of seeds.—In the fall of 1894 working as a student in Cornell University upon the dissemination of plants, I made a few rather interesting measurements, showing with some definiteness the effectiveness of certain adaptations.

My apparatus was very simple, two sheets of white cheese cloth, nine by twelve feet, to spread beside the plants and make the falling seeds more readily distinguishable, and a tape line for the measurements.

I worked first with two bushes of *Hamamelis Virginica* standing close together. They were about eight feet high, and had branches extending about four feet out from the main stem. Most of the capsules had been split across by previous frosts, and, on the clear October day of my observations, were opening as they dried. Apparently the inner woody layer of the capsule curves inward in drying, producing pressure upon the tapering ends of the polished seeds that is finally great enough to overcome resistance, when the seeds are shot away with considerable violence. In the case in question, shooting of the seeds began a little before one o'clock, continuing with increasing activity up to nearly five, and then diminishing in frequency until sunset. In this time upon the sheets, stretching as they did seventeen feet from the main stems of the bushes, and covering an area from nine to twelve feet wide, about one-fifth of a circle of the same radius, there fell no less than 153 seeds, of which a number were within four or five feet of the stems, many more at the extreme limit of the sheet, seventeen feet, but the largest number at a distance of about ten feet. How much farther they may have gone it is impossible to say, but one naturally infers from the numbers at the extreme limit of the sheet that some did go further. The distance travelled by the seed is doubtless dependent in large measure on the angle of the expelling capsule, plainly being greatest where that is forty-five degrees above the horizon, and the smallest when the pod is perpendicular. I am planning to make further measurements in the near future upon hamamelis and upon other plants which sling their seeds or fruits through their own mechanism; e. g., impatiens, oxalis, and others.

My other observations were made upon plants with upright or ascending pods opening only at the apex, a condition precluding the possibility of direct fall from the capsule to the ground, and rendering necessary a swaying motion of the plant and a consequent *throw* of the seed for its escape.

A plant of *Œnothera biennis*, twenty-one inches high with the lowest pods six inches from the ground, showed the following results in a light intermittent breeze of a late October day: At one observation sixteen seeds were scattered toward the wind, the nearest at two inches, and with twelve between thirty-five and forty-three inches; and thirty went with the wind from eight to forty-seven inches away. Later the nearest were a few at four inches and more than sixty were scattered between twenty-three and thirty-six inches. Other observations taken at the same time on seeds of verbascum, dipsacus, and polanisia while less definite were nevertheless of the same general significance. Later observations on a new œnothera plant thirty inches high and with lowest pods eleven inches from the ground, extending over a longer period and with stronger winds, showed at one time the nearest seed alone at twenty-two and one-half inches from the plant stem, and upwards of 160 scattered over the sheet, being very numerous at the extreme limit, thirteen feet. At another time they were found in large numbers from four feet to the extreme limit.

During the same period observations upon *Datura Stramonium* with its erect prickly capsules and large pitted seeds gave the following results: one seed at five feet, one at four, and one at four and one-half; later one at one foot, twenty-two from two and one-half to seven and one-half feet; still later, fourteen scattered from twenty inches to ten feet, with perhaps the majority at about six feet. This plant was forty-four inches high with its lowest pods twenty-seven inches from the ground.

Thus, this modification is seen to be very effective. Its importance is realized when one notes that in the Cayuga flora seventy-five genera are so disseminated. These genera are scattered through widely separated families from the Juncaceæ to the Lobeliaceæ being especially abundant among the Scrophulariaceæ and the Caryophyllaceæ and quite numerous also in the Ranunculaceæ and Ericaceæ. Furthermore other modifications with similar effects occur; upright heads, the achenes often provided with embracing chaff, drooping pods opening only at the base, and persistent ascending calyx and bracts opening only upward.—MARGARET FURSMAN BOYNTON.

Some western weeds, and alien weeds in the west.—A paper by Prof. L. H. Pammel, in a volume of the Proc. Iowa Acad. Sci., leads me to offer a few remarks. Prof. Pammel discusses in detail the distribution of certain weeds, and points out how little has been done to record the spread of introduced plants in this country. Two of the species thus discussed are *Solanum rostratum* and *S. Carolinense*. The latter species is not cited from Colorado or New Mexico, nor had I ever seen it in these regions, until this year I gathered it in an orchard at Albuquerque, N. M. The case of *S. rostratum* is widely different, since it is a native of the west. Yet the only New Mexico record is one of Fendler, 1847! Prof. E. O. Wooton has found it at Riley's Ranch, on the west side of the Organ Mts., N. M., and I have observed it at Santa Fé; thus in New Mexico we get a vertical range of 2,000[ft], viz., from 5,000 to 7,000. In Arizona Prof. Wooton found it at the Hardy water tank, eight miles east of Winslow; and this is actually the first specific locality in that territory, according to Mr. Pammel's account. This is also apparently the most western locality on record, as it is not reported from California, and was not found by the Death valley expedition. The first time I ever found *S. rostratum* was at Oxford, Furnas co., Nebraska, in July, 1887. In Colorado, while it is common on the plains at the eastern foot of the mountains, at least from Denver to La Junta (where I found it this year), it does not ascend into the mid-alpine zone. There is another *Solanum* which shares with *S. rostratum* the credit (or discredit) of being the original food of the Colorado potato-beetle, namely, *S. elæagnifolium.* This is in New Mexico a species of the upper and middle Sonoran zones, going up the Rio Grande valley, to my knowledge, from El Paso to Bernalillo, in great abundance. It does not occur in the Transition, at Santa Fé, except that this year I found there a single patch of it, growing vigorously. The characteristic species of *Solanum* at Santa Fé are *S. Jamesii* and *S. triflorum*, the former especially abundant. *S. Jamesii* I have never observed in Colorado, but *S. triflorum* is the common species of the mid-alpine zone, in Wet mountain valley.

At Santa Fé one finds many European weeds. It is probable that their presence is mainly due to the zeal with which the late Archbishop Lamy imported plants from France, the weeds coming accidentally with them. I found *Senecio vulgaris* quite abundant, also *Sonchus oleraceus* and *Plantago major*. *Erodium cicutarium* was found, and plenty of a dock which appears to be nothing but *Rumex obtusifolius.* There is also a large purple flowered Tragopogon in quantity; it can only be *T. porrifolius*, I assume. Finally, I was quite pleased to come across a good patch of *Convolvulus arvensis.*—T. D. A. COCKERELL, *Agric. Exper. Station, Las Cruces, New Mexico.*

CURRENT LITERATURE.

The Kew Index.

The completion of this great work deserves special recognition, although the previous parts have been already noticed in this journal. It is difficult to overestimate its value to all those who deal with the names of flowering plants, and associated as it is with the name of Darwin, it becomes another proof of his sagacity. Drs. Hooker and Jackson and the staff at Kew are to be congratulated upon its prompt appearance, as well as upon its contents. With its 1,300 large closely printed pages of three columns each, it suggests an amount of work that is fairly appalling, and that could only have been accomplished within reasonable time with such force and material as are to be had at Kew. First appearing in 1893 it is a completed work in 1895, and hence is one of the few large works that is practically synchronous throughout. Botanists have already consulted it too extensively to need information as to its plan and purpose. The title page suggests that it is an "index to the names and authorities of all known flowering plants and their countries," with 1885 as the most recent date. In so vast a work it is impossible to avoid oversights and mistakes. It is only a wonder that they are not more numerous. Monographers will occasionally find that the reference cited is not the original one, but it usually takes a monographer to discover that.

There is one feature that we could wish had been different, and that is the matter of synonymy. A work of such great extent can not pretend to have made a monographic study of its whole field, and, therefore, much of the synonymy must be uncertain. We do not doubt that there is great familiarity with all plant groups at Kew, but in such a tremendous bibliography as the Index indicates, many of the expressions of opinion must have been "off-hand." It has seemed to us that if the Index had been a simple list of plant names, with no indications of synonymy, it would have been a fairer representation of the real value of the work. All questions of identity and of nomenclature might as well have been avoided, and the book made a record of fact rather than opinion. As it is, one can not be sure of the synonymy without investigation; and, if investigation be needed, what is the special value of the synonymy except by way of suggestion? This, if rightly understood, however, does not interfere in the least with the usefulness of the book, and botanists are under large obligation, as they have ever been, to Kew and Mr. Darwin.

The Synoptical Flora of North America.

When in the year 1878 Dr. Asa Gray's *Synoptical Flora* began to appear, botanists the world over hoped that the distinguished author would be permitted to complete it in a few years. In this way his vast experience with North American plants could be brought to the aid of subsequent botanists. The gamopetalous orders after Compositæ were the first to appear; then in 1884 the remaining gamopetalous orders. In 1886 a revision of these two parts, representing all our Gamopetalæ, was issued by the Smithsonian Institution. Ever since this has been the only part of our flora presented with any completeness, although monographs here and there have helped us out. The polypetalous orders were next attacked, and at Dr. Gray's death he had the work fairly outlined to the Leguminosæ. Certain large groups had been deferred, and these Dr. Watson was working upon at his death, in 1892. Now, seventeen years after the appearance of volume II, part I, the first fascicle of volume I, part I, has appeared,[1] under the editorship of Dr. Robinson, the third editor.

Dr. Robinson's task was a difficult one, for not only was he called upon to continue the work of our greatest systematist with work of reasonably equal quality, but he was compelled also to adopt a style of presentation not his own. It can be said without reserve that he has succeeded admirably, and that the part before us is a worthy companion of those we have already had. Recent questions of nomenclature cut no figure in a work whose mould was cast twenty years ago, while its great body of facts comes to us as the really desirable thing after all. The reviewer cannot but remember that Dr. Gray was a very progressive man, and is inclined to think that his successors have been handicapped by a rigid tradition.

Among the seventeen orders presented, interest naturally centers about the two largest, Ranunculaceæ and Cruciferæ, the former being the work of Dr. Gray, the latter the joint work of Drs. Watson and Robinson. An excellent editorial feature is found in the numerous footnotes giving supplementary references and information. The greatest pains have been taken to properly credit everything, all the recent species interpolated in the original manuscripts of Drs. Gray and Watson being indicated. In fact the whole work gives abundant evidence of the most painstaking care, and if anything pertinent has escaped mention it is certainly because it has escaped notice. It is out of the question to comment upon the numerous new forms de-

[1] Gray, Asa; Watson, Sereno; and Robinson, Benjamin Lincoln: Synoptical Flora of North America, Vol. I, Part I, Fascicle 1. Polypetalæ from the Ranunculaceæ to the Frankeniaceæ. American Book Co., New York, Cincinnati, and Chicago. Issued October 10, 1895.

scribed and the numerous opinions expressed in such a work. It will soon be in the hands of all working botanists, and it is sufficient to say that it is worthy of its predecessors. The history of this work, as of all extensive works undertaken by a single man, emphasizes the fact that although there may be a gain in uniformity, there is certainly a great loss in timeliness, and that such works are usually abandoned before completion. It is generally too difficult an undertaking, when one considers the extremely rapid evolution of botanical science, to profitably complete in uniform style a work which has been begun in a preceding generation. Now that we have seen the quality of Dr. Robinson's work we wish, as we have done for seventeen years, that some plan could be devised by which its completion could be hastened.

Saccardo's Sylloge Fungorum.

Another massive volume has now been added to the monumental work by Professor Saccardo[1] enumerating all described species of fungi. Ten volumes have previously been published, embracing descriptions of 38,163 species, to which the present volume adds 4,220 species. Of these 1,165 are North American fungi, chiefly new species published since June, 1892, an average of nearly 400 per year. They comprise Hymenomycetes, 118; Gasteromycetes, 14; Uredineæ, 92; Ustilagineæ, 17; Phycomycetes, 11; Pyrenomycetes, 388; Discomycetes, 101; Laboulbeniaceæ, 88; Saccharomycetes, 5; Myxobacteriaceæ, 9; Myxomycetes, 24; Sphaeropsideæ, 233; Melanconieæ, 68; Hyphomycetes, 44; Fossil Fungi, 3. The very rapid increase in the number of known fungi makes such a publication as the Sylloge one of great value to every working mycologist. This list of more than four thousand species is almost entirely the product of the botanical activity of only the last three years, and there is no likelihood of diminution for some time to come. The diversity in the methods and places of publication is astonishingly wide, and the necessity of such a work to one who desires to keep abreast of the mycologic literature is evident at a glance. To mention but a single illustration: of the ninety-two species of Uredineæ cited from North America, the original descriptions are published in twelve different periodicals, four of which are foreign. Other orders and regions might furnish even more conspicuous evidences of the indispensable character of the work.

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[1] Saccardo, P. A.: Sylloge fungorum omnium hucusque cognitorum. Supplementum universale. Pars III. Adjectus est index operis universalis. Vol. XI. Patavii, July 1895. Roy. 8vo. 753 pp. 48 francs.

Handbook of British Fungi.

The modernization of Cooke's *Handbook* has reached the fourth volume. Although at first promised in three volumes, the enumeration has not yet been completed with a fourth one. The first two volumes have already been noticed.[1]

The two volumes[2] before us closely resemble the previous ones in their make up, with possibly some improvement in the execution of the illustrations.

The first two volumes with 268 pages of the third volume disposed of the Basidiomycetes. The remainder of the third volume treats of the Hyphomycetes; and the fourth volume takes up a portion of the Ascomycetes. There yet remain the Pyrenomycetes, Tuberaceæ (both in the table of contents of the fourth volume, but not otherwise appearing in it), Uredineæ, Ustilagineæ, Saccharomycetes, Myxomycetes, Phycomycetes, and some others, which together form about 38 per cent. of the contents of Cooke's *Handbook.* It looks very much as if two more volumes, at least, will be required to describe the remainder of the British fungus-flora. It is much to be hoped that the work will be continued until completed.

Much labor has been expended in the examination of type specimens, the augmentation and correction of the diagnoses, and the addition of spore measurements. Of the nomenclature it only need be said that about the expected number of changes occur, without any apparent attempt to adopt the radical methods which have recently come into vogue. A critical examination into the value of the new species and genera[3] and the shifting of the old ones would lead us too far.

The work is a welcome and valuable one as it stands, but it will be rendered far more useful if a general synopsis of the groups and a universal index are provided with the last volume.

Minor Notices.

A CAREFULLY PREPARED catalogue of varieties of wheat was issued in 1850 by the distinguished Louis L. de Vilmorin, based upon material which had been in process of collection for twenty years or more. This collection has continued to grow, and in 1889 a new catalogue was issued by the eminent Henry L. de Vilmorin, and now a

[1] **18:** 31, 240. 1893.

[2] Massee, George. British fungus-flora; a classified textbook of mycology. London, Geo. Bell & Sons. Vol. III, 1893. 512 pp. Vol. IV, 1895. 522 pp. 12mo.

[3] Cf. BOT. GAZ. **20:** 431. 1895.

second edition of the same is published.[1] It will prove of great service to students of wheat, both from the standpoint of the botanist and the cultivator. The finely engraved plates show heads of many varieties full size.

THE ANNUAL VOLUME from the U. S. Department of Agriculture[2] has taken on a new and greatly improved form. The report covering the year 1894 makes a volume of 608 pages well illustrated and printed, and attractively bound. The subject matter has also been put into a more pleasing form, and the quality carefully considered. It is a volume of information on important subjects, and probably the most valuable one ever issued by the Department. If this high standard is maintained (there is a promise that it will be raised), the questionable reputation of the annual volume must shortly give place to a well grounded esteem.

THOSE INTERESTED in the cultivation of greenhouse and window plants will find an excellent little book on the subject, just issued by Macmillan & Co. It is entitled "Greenhouse and window plants," by Charles Collins, and is sold for 40 cents. The excellent directions for the construction and management of greenhouses will be of great service also to departments of botany desiring such facilities.

A HANDBOOK OF GRASSES, by William Hutchinson, has been issued,[3] whose purpose is to popularize the study of that group. The British species are presented, with the aid of small woodcuts, preceding which there is a general discussion of structure of grasses. The groups are arranged for the convenience of field work, rather than in any natural order. There is the "agrarian group," the seashore group, the alpine group, etc. In the closing pages the subjects of geographical distribution and uses are rather fully presented.

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[1] VILMORIN, HENRY L. DE.—Catalogue méthodique et synonymique des froments qui composent la collection de Henry L. de Vilmorin. 2nd ed. 8vo. 88pp. 16 pl. Paris, Vilmorin-Andrieux & Cie. 1895.

[2] Yearbook of the United States Department of Agriculture for 1894. 8vo. 608pp. 6 pl. and other illustrations. Washington, Gov. Printing Office, 1895.

[3] HUTCHINSON, WILLIAM.—Handbook of grasses, treating of their structure, classification, geographical distribution, and uses, also describing the British species and their habitats. Small 8vo. pp. 92. illustrated. London: Swan Sonnenschein & Co., New York: Macmillan & Co. 1895. 75 cents.

OPEN LETTERS.

The nomenclature question: Concerning homonyms.

In the September number of the GAZETTE Mr. Coville remarks that "probably the greatest objections that can be urged against the Association principles of nomenclature are those which may be brought forward relative to this very rejection of homonyms." But his explanation and examples do not in any way lessen the force of the criticisms of Dr. Robinson in the preceding number. This seems to be because no one, so far as I am aware, has yet properly distinguished between the rejection of revertible names within the limits of a genus, and their rejection when due to the varying conception of the limits of a genus. And this leads me to propound the question, What is a homonym? Among genera a name applied to one genus is never thereafter applicable to any other, and if so applied it becomes a homonym. Why should it not be equally true that a binomial which has been applied to one species is never thereafter, under any circumstances, applicable to any other species? In disregard of this principle, the recently published Check-List adopts the name *Anychia Canadensis* B. S. P. (1888), whereas it is acknowledged on the same page that Elliott applied this identical name to another plant as early as 1817! And thus a homonym, in the strict sense of that word, is adopted merely on the ground that the specific name *Canadensis* is older as applied to the former species! I do not understand by what stretch of the imagination *Anychia Canadensis* Ell. can be considered a homonym of *Queria Canadensis* L. In the same Check-List *Lespedeza frutescens* is proposed as a new name, notwithstanding the fact that Elliott, in 1824, used the same combination for a different plant. This, it appears to me, is a wholly indefensible and extremely pernicious principle.

Let us take another case. Every one will acknowledge that the two genera Silene and Lychnis are very closely related, and that some botanist might at any time unite them. If this were done, *Lychnis alba* Mill. (1768) would, according to the Check-List principles, become *Silene alba*, and *Silene alba* Muhl. (1813) would be relegated to the synonymy—there to remain forever—*Silene nivea* being substituted for it. Now suppose that the next writer upon this group should consider the two genera distinct. Again we would have *Lychnis alba* Mill., and the nomenclature of the two genera would stand as it does in the Check-List to-day, save that *Silene alba* Muhl. (a name which is now unchallenged) would have become *Silene nivea*, and must forever remain so, unless by some "lumping" or other jugglery this name too should be rejected, when a new one would have to be concocted. To generalize: if, of two large and closely related genera, A and B, A has the older name, the mere act of temporarily uniting B with A and then separating it again, may change permanently the names of some species of A, although these names may be otherwise unobjectionable. Can a rule which will permit this condition of things be a sound one?

Both Dr. Robinson and Mr. Coville express their dislike for theoretical objections. But what other objections can be made to a theoretical rule? It must be remembered that the principle under discussion has never been put into practice by any botanist who is inclined to "lump" related genera. Such botanists have existed in the past, and are sure to arise in the near future, and should they ever write in accordance with this principle, the present theoretical objections will at once become actual and overwhelming ones, and the present supporters of this principle will wake up, rub their eyes, and wonder why their rules don't work. It is my claim that nomenclatural rules, to be permanent, should provide for all foreseen possibilities.

It may be claimed by some that the utter disregard of the right of priority of a binomial, as such, is a principle copied from the zoologists. If so (and I am not sufficiently acquainted with their usages either to deny or to affirm it) I feel constrained, as does Dr. Millspaugh in considering decapitalization, "to speak against the tendency of many botanists to follow a bad example set by zoologists."[1]

To sum up: it appears to me that the recognition of the *priority of binomials*, and, so long as it does not conflict with the former, of the *priority of specific names*, possesses all of the advantages, and none of the disadvantages, of the *rejection of revertible names.* It will thus be seen that I am a firm believer in priority law, only consistency requires me to recognize the right of priority for binomials; and further, I believe heartily in the rejection of homonyms, provided only the word "homonym" be taken in its proper sense. The suggestions here brought forward would settle the case of *Juncus megacephalus* and all other cases which Mr. Coville has presented, in the way in which he would like to see them settled, and at the same time would do away with Dr. Robinson's objections, as published in the August GAZETTE. I feel sure that the leaders of reform, with whom I am thoroughly in sympathy, will strengthen their cause by rejecting any weak principle, instead of clinging to it when it has been proven untenable.—JOHN HENDLEY BARNHART, *Tarrytown, N. Y.*

Decapitalization.

Opposed, as I am, to the spelling of names derived from persons without a capital letter, I should nevertheless like to ask Mr. C. F. Millspaugh a question or two. How can *nevadensis* ever mean *of the whiteness of snow?* Is there a Latin scholar in existence who would not understand that *bajaensis* means *coming from Baja?* Is it not the case that in nearly all languages, except English, the adjectival form of place names is written with a lower case initial, while only the substantival form is written with a capital? In short, should we not write *Scutella blaviensis*, but *Scutella Besanconi*, *Scutella calvimontana*, but *Scutella Morgani?* Mr. Millspaugh will observe that I write this entirely from the point of view of the classical scholar, and not from the point of view of the systematic biologist, who must, I fear, be left to his ineptitudes whether he be zoologist or botanist.—F. A. BATHER, *British Museum.*

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[1] Bot. Gaz. **20:** 429. 1895.

NOTES AND NEWS.

A FINE ILLUSTRATION of Yucca Whipplei, reproduced from a photograph, appears in *Garden and Forest* for October 16th.

MR. DRUERY, in *Gardener's Chronicle* (Sept. 28th), reports a "bi-generic" fern hybrid between Scolopendrium vulgare and Ceterach officinarum.

IN CONNECTION with Professor Huxley's death it is of interest to call attention to his single paper on systematic botany, entitled, "The Gentians: notes and queries." It was published in 1887 in *Jour. Linn. Soc.*

THE INFLUENCE of spray and rain on the forms of leaves is a topic written upon by Conway MacMillan in *Science* for October 11th. He takes several recent articles by foreign botanists as the basis of his discussion.

THE RARE *Rhus Michauxii*, of North Carolina and Georgia, is described and figured in *Garden and Forest* (October 9th). Dr. Sargent believes it to be the most poisonous of the North American species.

DR. HARVEY W. WILEY, Chief of the Division of Chemistry, Department of Agriculture, has just published a bulletin containing an account of his analyses of cereals collected at the World's Columbian Exposition.

A FEW COPIES of the *Uredineæ Americanæ Exsiccatæ* published by Mr. M. A. Carleton in 1894 can still be obtained of the author (Agric. Dep't, Washington, D. C.). Only one fascicle of fifty specimens was issued, and the publication has been discontinued. The price is $2.50, or $2.75 in foreign countries.

MOLISCH recently showed that the phycoerythrin of the Florideæ is a crystallizable proteid substance,[1] and in a still more recent paper[2] he demonstrates the same for phycocyanin. The solubility of its crystals in water, its loss of solubility (coagulation) after treatment with boiling water, alcohol, ether, and dilute acids, its capacity for swelling, taking stains and easy decomposition, together with its proteid reaction, leave no doubt of its proteid nature.

MR. D. T. MACDOUGAL has been promoted as Assistant Professor of Botany in the University of Minnesota, in charge of graduate and undergraduate work in vegetable physiology. The department will shortly erect a range of plant houses, in anticipation of which, Prof. MacDougal was sent to Europe last summer by the university, with a view to inspecting the best practice in European botanical gardens. An article from his pen, with the title "Botanic Gardens," appears in the *Minnesota Magazine* for October, separates of which have been distributed.

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[1] Bot. Zeit. **52:** —. 1894.

[2] Bot. Zeit. **53:** 131. 1895.

THAXTER on DISPIRA.

HELIOTYPE PRINTING C°, BOSTON

BOTANICAL GAZETTE

DECEMBER, 1895.

Contributions from the Cryptogamic Laboratory of Harvard University. XXIX.

New or peculiar American Zygomycetes. I. Dispira.

ROLAND THAXTER.

WITH PLATE XXXIV.

Among the many interesting forms studied by Van Tieghem in his classic "Etudes sur les Mucorinées" [1] are several genera of doubtful affinities which this writer is inclined to consider hyphomycetous conditions of certain Ascomycetes. Of these, several named genera (Martensella, Coemansia, Kickxella) have been included in a family of Coemansiæ, clearly distinguished by their peculiarly differentiated sporophores and spores, and must still be considered *incertæ sedis*, although one of them has been not too definitely connected with an ascomycetous form. In addition to these, two nearly related genera are included in the same category, both parasitic on species of Mucor and distinguished by producing fertile heads which recall in some respects those occurring in Aspergillus or Sterigmatocystis: the one, *Dimargaris*, characterized by an erect solitary fertile hypha, terminated by a large spherical head from which arise compound sterigmata bearing spores in chains: the other, *Dispira*, producing also solitary erect fertile hyphæ which become distally several times dichotomous, the branches spirally twisted in a characteristic fashion and bearing numerous fertile heads associated with sterile horn-like branches.

Since the publication of Van Tieghem's paper the writer is not aware that this or any other species of Dispira has been observed. During the past spring, however, a package of rat dung was received by Mr. W. H. Rush, a student in the

[1] Annales des Sci. Nat. Bot. VI. 1: 153.

laboratory, who was the first to observe in cultures of this material a clear white fungus which on examination was found to be very similar to Van Tieghem's *Dispira cornuta* and was provisionally so named. The form was subsequently cultivated and studied more carefully by the writer and proved interesting not only from the fact that it appears to be quite distinct from Van Tieghem's species but was found in some instances to produce its sexual spores in abundance, thus determining beyond question its position in the system.

As described by Van Tieghem, *Dispira cornuta* is characterized by producing erect septate fertile hyphæ which become terminally symmetrically dichotomous, the same type of branching being several times repeated in planes successively at right angles to one another. Each successive branch is distinguished by a septum at its base and all become spirally twisted. The last formed are somewhat irregular, the ultimate divisions being either sporiferous or forming curved sterile horn-like branchlets. The fertile branchlet becomes terminally swollen into a spherical head from the surface of which bud out in all directions papillæ that subsequently develop into sterigmata. The sterigma consists of a single cell with a median constriction, or more commonly this constriction is replaced by a septum which divides it into two superposed cells, the upper of which bears terminally a single chain of six spores. The two main branches which are, in the younger condition, at first erect, and give to the fructification the appearance of a closed umbrella, gradually separate as they grow older, so that at maturity it becomes shaped like the letter **T**.

The American species, however, shows important differences in several essential points of structure, and although its general habit is similar, it is very evidently falsely dichotomous, one of the main divisions of the fertile hypha being a lateral outgrowth (fig. 2) below the base of the other, which is thus in reality a terminal modification of the primary axis. The same false dichotomy characterizes the secondary branching, although the resultant fructification, except for a certain asymmetry in its general habit, closely resembles its ally, showing the same characteristic spiral modifications and sterile horn-like ultimate branchlets. In addition to its usual asymmetry, the fructification differs in that it does not undergo the characteristic change of position above described. The sporiferous heads, moreover, though similarly formed at the tips of ultimate curved branchlets, are clearly distinguished from the fact that the sterigmata are invariably two celled, the upper budding from the lower and not a result of septation, each cell bearing terminally several spore chains, or sporangia, if we adopt the terminology of Van Tieghem, each spore chain consisting of but two spores instead of six.

The characters of the non-sexual form of reproduction are of secondary importance, however, as compared with those of the sexual, which was not observed in connection with *D. cornuta*, but appears to be common in the American species and are quite without parallel among the Mucorineæ. The vegetative mycelium is composed of rather irregular branching hyphæ, for the most part aseptate and much smaller in diameter than the fertile ones. From these vegetative hyphæ are produced lateral branches which, becoming slightly swollen terminally, attach themselves usually to the fertile hyphæ of mucors. This lateral branch fixes itself firmly to the host filament by a sucker-like tip which eventually penetrates the host by means of an irregular protrusion, usually not conspicuously developed though sometimes extending a short distance beyond its point of entrance along the inner surface of the wall of its host. These suckers are the only parasitic organs which were observed in the material examined, and it is uncertain whether they are characteristic of the ordinary hyphæ or invariably represent the first stages in the production of zygospores, since they were always found associated with the latter.

The successive stages in the formation of the zygospores are illlustrated by figs. 10–13. The lateral branch already mentioned after it has fastened upon the host, becomes divided into two parts by a septum, usually nearer the filament from which it arises, and these two parts proceed to conjugate with one another, the outer becoming eventually separated from the parent filament and receiving from the inner the material derived from its parasitic union with the mucor. The outer gamete soon becomes nearly spherical, enlarging greatly to form the zygospore itself, while the inner, which gradually assumes the appearance of a mere outgrowth from the mucor, sends out simple or once-branched finger-like processes which grow about half way round the mature spore and are at first more or less yellowish from the presence of the yellow oily material in the cell contents so often associated with zygosporic reproduction in mucors generally. As far as can be judged with a one-twelfth oil immersion there seems to be eventually a direct connection between the contents of the mucor hypha, and the supplying gamete. The finger-like outgrowths from this gamete become roughened by scattered and not very conspicuous prominences, and although they suggest the protective branches which surround the zygospores of *Absidia* or *Phycomyces*, do not seem to have any very definite function in the present instance, since they arise on one side only of the spore which they but half enclose. In general appearance they recall to some extent the characteristic parasitic attachments found in *Chaetocladium*, and might readily be mistaken for these organs, when, as sometimes occurs, a number of parasitic branches have attacked a mucor hypha in close proximity to one another, and the finger-like processes are developed in dense groups arising from what would at first sight be taken for a general distortion of the host, instead of a mass of partly coalescent supplying gametes.

The only case of conjugation among Zygomycetes, which seems in any way comparable to that which has just been described is found in the genus *Basidiobolus* Eidam, where the vegetative hyphæ become divided by septa into a series of cells which conjugate with one another as a result of the absorption of the septa separating adjacent cells, the contents of one such cell passing into the other and there forming the zygospore. In the present genus, as has been seen, the process is similar in that a parasitic branch divides into two cells which conjugate with one another, one being receptive, the other supplying; but apart from this circumstance the two types are not to be compared.

The close relationship which exists between the present genus and *Dimargaris* is evident from Van Tieghem's figures; in fact *Dispira Americana* corresponds far more closely in the details of its non-sexual fructification to the type of the first than it does to that of the last mentioned genus, and the discovery of additional species may necessitate the union of the two, their separation being at present based on a mere difference of habit. Among the Mucorineæ they may be provisionally included in the Cephalideæ, although perhaps sufficiently aberrant in their mode of sexual reproduction to form a group by themselves.

Van Tieghem has called attention to the septa of the fertile hyphæ in the present genus (which by an oversight were not inked in the accompanying illustrations before reproduction) and described the disc-like thickening for which they are remarkable. The same thickenings occur in *Dimargaris*, and, as was first noted by Van Tieghem, also in the second group of uncertain genera already referred to as constituting the family of Coemansiæ. It may be mentioned in this connection that the writer has cultivated certain of the latter forms *(Coemansia reversa*, *Kickxella alabastrina* and several others) on nutrient agar-agar in an absolutely pure condition some of them for a period of years, under various conditions, without ever having observed the production of any perithecia, and although Kickxella has been connected with an ascigerous condition, the evidence on which this connection is based is of the most unsatisfactory nature, and the reference of the group to the Hyphomycetes seems based on practically no reliable information. In the writer's opinion the peculiarities of the sporophores, the coherence of the gelatinous spore mass when ripe, together with the peculiarities of the septa just mentioned, as well as the general habit of these plants would indicate a connection with the Mucorineæ rather than with any other known fungi.

Dispira Americana, nov. sp.—Vegetative hyphæ slender branched, creeping on the substratum or running on species of *Mucor* to which they become parasitically attached, giving rise to single erect septate colorless fertile hyphæ which become terminally several times more or less regularly falsely dichotomously branched, the divisions spirally twisted, the curved ultimate branchlets either sterile or bearing terminally a white fertile head. Fertile heads spherical, producing numerous sterigmata which bud in all directions and consist of two superposed cells, the upper formed as a bud from the apex of the lower, each giving rise distally to several short spore chains of two spores each. Zygospores always formed in connection with a mucor filament, from one of two gametes without suspensors, nearly spherical, pale brownish, slightly roughened, partly surrounded by a rosette of slightly roughened finger-like processes from the supplying gamete. Fertile hyphæ about 1^{mm} high, 10–12μ in diameter. Fertile heads 35–45μ in diameter. Spores $3 \times 1\mu$. Zygospores 35–65μ in diameter.

On rat dung from Greenville, Ohio (W. H. Rush), parasitic on Mucor.

Harvard University.

EXPLANATION OF PLATE XXXIV.

Dispira Americana Thaxter.

Fig. 1. Terminal portion of a small fertile hypha.
Fig. 2. A young fertile hypha showing false dichotomy.
Fig. 3–4. Fertile heads from which sterigmata are budding.
Fig. 5. Fertile head from which the terminal cells of the sterigmata have been formed by budding from the basal cells.
Fig. 6. Optical section of a fertile head showing mature sterigmata from which the spore chains are in process of budding.
Fig. 7. The same with nearly mature spore chains.
Fig. 8. Sterigma with two mature spore chains *in situ.*
Fig. 9. Two spores still adherent to one another.
Fig. 10. Fertile hypha of *Mucor mucedo* attacked by parasitic branches of Dispira which are producing zygospores in various stages of development.
Fig. 11. The same showing younger parasitic branches and zygospores more highly magnified.
Fig. 12–13. Two mature zygospores.

*** NOTE.—The original figures have been reduced by photo-lithography ⅓ and were drawn with the following approximate magnifications in diameters: Figs. 1, 2, 10, ×240. Figs. 3–9, ×925. Figs. 11–13, ×420.

THOMAS COULTER'S ROUTE IN CALIFORNIA.

The botanical explorations of Thomas Coulter in Mexico and California.

FREDERICK V. COVILLE.

WITH PLATE XXXV.

Among the botanical explorers in North America during the first half of the present century was Dr. Thomas Coulter, an Irish botanist, whose collections were the basis of important contributions to the descriptive botany of Mexico and California, but the details of whose life and route of travel are known only from the most fragmentary records. As illustrating the haze of uncertainty that surrounds the collections of Coulter I may cite the case of *Berginia virgata*. This acanthaceous genus with its single species was founded on Coulter's no. 603[1], accredited in the original description as "Californiæ incola." Later Dr. Asa Gray said of the plant, "not since met with; more probably collected in Arizona or within the borders of Mexico;"[2] and still later "probably Arizona: not since found."[3] In our inability, therefore, to ascertain an original station, the location of one of our monotypic genera was unknown for fifty years after it was first collected and finally when found in Sonora in 1884 by Mr. C. G. Pringle it was re-described by Dr. Gray as a new genus and species, *Pringleophytum lanceolatum.*[4] Had Berginia not become an essentially lost genus, from a lack of knowledge of the type locality, all this difficulty would doubtless have been avoided.

Thomas Coulter was born in the year 1793 near Dundalk, County Louth, Ireland,[5] and showed an early liking for out-

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[1] Harv.; Benth. & Hook. Gen. Pl. **2:** 1096. 1876.

[2] Gray, Bot. Cal. **1:** 588. 1876.

[3] Gray, Syn. Fl. **2**[1]: 327. 1878.

[4] Gray, Proc. Amer. Acad. **20:** 292, 293. 1895.

[5] See Proc. Roy. Irish Acad. **2:** 553-57. 1844. A five-page biographical sketch of Coulter is here given by his most intimate friend, the astronomer and physicist, Dr. John Thomas Romney Robinson, who invented the common cup anemometer and for whom Professor Harvey named the papaveraceous genus Romneya. This sketch seems to have escaped the attention of botanists, for neither Wittstein (Etymologisch-botanisches Handwörterbuch 233. 1856, [ed. 2]), nor Pritzel (Thesaurus Literaturæ Botanicæ 70. 1872), nor Hemsley (Biologia Centrali-Americana, Botany **4:** 125. 1887), nor Britten and Boulger (Journal of Botany **26:** 244. 1888) give either the place or the date of Coulter's birth.

door sports and natural history. He was prepared for college by Dr. William Neilson, author of a formerly well known Irish grammar, through whom he acquired an interest in the antiquities of Ireland. His education was continued at Dublin University where he showed marked proficiency in the mechanical and physical sciences and attracted particular attention for his knowledge of entomology and botany. His local collections of insects and mosses even at this time were large and valuable. In 1817 he was graduated with the degree B. A., and continuing his graduate work he took the degrees M. A. and M. B. in 1820.[6] He had already spent one or two summers in Paris, making there extensive collections of the plants of the Jardin des Plantes. After leaving the University he went to Geneva, where under the direction of DeCandolle he continued his botanical studies. He made a large collection of continental plants, compared them critically with DeCandolle's collections, and afterward, beginning in the spring of 1823, devoted himself to the elaboration of a monographic essay on the Dipsaceæ. The results of his investigations were published later in the year in his Mémoire sur les Dipsacées, an excellent work which, together with additional manuscript notes prepared in part at least at the herbarium of Delessert in Paris and communicated to DeCandolle in 1824, formed the basis for the elaboration of the Dipsaceæ published in the Prodromus in 1830.[7] The memoir was republished in 1824 by the Société de Physique et d'Histoire Naturelle de Genève. At the time of publication of his Dipsaceæ Coulter was already a Doctor of Medicine and a member of the Royal Irish Academy. This membership, which began March 16, 1819, he retained, as may be seen from the lists of members occasionally published in the Academy's Transactions, until his death.

In the year 1823 the Brazilian genus Coulteria of the Leguminosæ, now treated as a section of Caesalpinia, was named in honor of Dr. Coulter,[8] and the statement made that he was about to undertake an exploration in Chile. Returning to Ireland in 1824, he made preliminary arrangements for a trip to Argentina, Chile, Bolivia, California, and Mexico. He subsequently decided, however, to begin his travels with the

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[6] These dates have been kindly furnished by Professor E. Percival Wright from the records of Dublin University.

[7] See A. P. DeCandolle, Prodr. **4:** 643. 1830.

[8] H.B.K. Nov. Gen. & Sp. **6:** 328. 1823.

last named country, accepting a position as medical attendant, or, as we should say, physician, of the Real del Monte Mining Company, under a three years' contract.

Coulter sailed from England in August, 1824, and doubtless reached Mexico in the same year, but the recorded details of his work there are very meager indeed. In a chronometric table given by Coulter in his Notes on Upper California are named certain localities in Mexico at which he took observations. The year unfortunately is not given, but the localities and partial dates are as follows:

Zimapan [state of Hidalgo] . . . . . April 8 to 15.
Mexico [city] . . . . April 22 to 29.
R. D. Monte [Real del Monte, an old mining town in the state of Hidalgo, situated in the mountains about fifty miles northeast of the city of Mexico]. . . . . May 1 to 14.

In a meteorological table in the same paper Coulter cites from his journal certain temperature observations made, presumably by himself, at Veta Grande, a mining pueblo not more than ten miles north of the city of Zacatecas, in the state of the same name, from December 2, 1825, through the month of January following. Coulter, by reason of the desertion of some of his company's employees, was compelled to act, for more than a year, as superintendent of this important, and in his hands productive, mine.

After the termination of his engagement with the mining company, Coulter was located for a time at Hermosillo, a large town in the state of Sonora, on the river of the same name. His reference to this place is as follows:

"It [sometimes] freezes even to the south of Pitis [Hermosillo],[9] in lat. N. 29°; and in the winter of 1829–30, it froze in Pitis every night for nearly two months. On the 12th of December, on arriving at San Jose, a few leagues from Pitis [probably San Jose de Pimas, an old mining pueblo on the Rio Matare about sixty miles southeastward from Hermosillo], I found the thermometer at 18° Fahr., at 8 h. P. M. On the 13th, it stood in the shade below 32° all the day, at night sinking even to 18°. This, however, appears to occur very rarely."[10]

[9]On the maps of Humboldt and others to as late a date as 1840 this town was given variously as Pitic, Petic, and Pitit, but from the decade following that year the name Hermosillo appears on all the maps, though in Lippincott's Gazetteer these two names are not identified as belonging to the same town.

[10]Thomas Cculter, Notes on Upper California 69. 1835.

It is probable that Coulter passed through Guaymas on his way to or from Hermosillo, for two rare plants known only from the coastal flora at Guaymas, *Acacia willardiana* (Prosopis heterophylla) and *Perityle leptoglossa*, were in Coulter's collections, and many other species first brought to light by him have since been collected at that point.[11] It is known also from localities given by Hemsley in the Biologia Centrali-Americana for various plants collected by Coulter that he visited Jalapa, Guadalajara, Bolaños, Tepic, San Blas, and Mazatlan, all of which are well known as old mining towns or as sea-ports.

The first recorded news from Coulter, after his departure for Mexico, is furnished by DeCandolle, who in the year 1828 received from him a collection of fifty-seven species of living Cactaceæ, forty-seven of which DeCandolle immediately published as new, with no reference, however, to Coulter's movements.[12] Additional new species from this collection and remarks on his former descriptions were published by DeCandolle as a memoir six years later.[13] A similar collection of Cactaceæ, consisting of seventy species and varieties, was sent by Coulter to Trinity College, Dublin, for the botanical garden there in charge of Mr. James T. Mackay.

Of Coulter's work in California, after the termination of his travels in Mexico, we have much more satisfactory records. His headquarters were at Monterey. He reached that port, undoubtedly by sea and probably from San Blas, Jalisco, on the Mexican coast,[14] apparently in November, 1831; for David Douglas, writing to Dr. Hooker from Monterey under date of November 23rd in that year, stated that Dr. Coulter had arrived since he began the letter. These two botanists evidently worked together, to the great delight of Douglas, during the winter of 1831-2 and the following spring, Douglas finally sailing from Monterey to the Sandwich Islands and Coulter setting out on his trip to Arizona.[15]

As Coulter's journey from Monterey to the mouth of the Gila is the one with which the botanists of our own country are mainly concerned, it has seemed desirable to record in

[11] See Wats. Proc. Amer. Acad. **24:** 36-82. 1889.

[12] See note on DeCandolle's Revue de la famille des Cactées, below.

[13] See note on DeCandolle's Mémoire sur quelques nouvelles espèces de Cactées, below.

[14] C. C. Parry, Early Botanical Explorers of the Pacific Coast 6. (Reprinted from the Overland Monthly for October, 1883.)

[15] W. J. Hooker, Comp. Bot. Mag. **2:** 151-153. 1836.

some accessible place the details of his route. I therefore append suitable extracts from his Notes on Upper California and present also a photolithographic reproduction of a portion of the map issued with his paper. (*Plate XXXV.*)

[p. 60] "It will not be necessary to enter, at present, into much detail of my journeys in the country, of which the principal was that from Monterey to the junction of the Rios Colorado and Gila.

. . . .

[p. 63] "It would occupy too much time to go at present into any great detail of my travelling inland. I am tempted, however, to say a few words of the journey of which the principal [geographical] observations are [p. 64] given above, as it was the most interesting, the longest, and by far the most laborious of those I made in California.

"The rainy season of 1832 ended late in February, which is rather after the usual time, and I started so soon as the country was passable, which it is not at all during the rains, nor for some time afterwards. The rivers, which in the dry season are mere beds of sand, are quite impassable when swollen; and even for some weeks after they have fallen low, the danger and difficulty of crossing some of them, on horseback, are very considerable. If these streams carried down only sand, they might be passed as soon as the rapidity of the current was so far abated that a horse could stand; but the sand comes down mixed with a vast quantity of mud, which settles together with it; so that even when the stream becomes so low that a small animal can walk across, a horse or a man cannot. It is not until the mud is gradually washed out of the surface of the deposit that this becomes possible. We have then a bed of hard sand resting upon one of semi-fluid mud and sand; and it is very difficult to say when and where it is safe to attempt the passage. On this occasion I had to pass the Guadalupe [now the Santa Maria river, between San Luis Obispo and Santa Barbara counties], in this state, between San Luis Obispo and La Purissima;[16] and it was only after long search that I found a place where a bear had passed, and trusting to his sagacity I followed his steps. The stream was broad, very shallow, and the bed of clear sand on the surface of the deposit must have been very thin, for it swagged under foot like the surface of a quagmire. A body of troops which passed this way some days before, though on a most urgent affair, was obliged to wait for ten days to allow the sand to settle.

"From Monterey southward the road runs through a series of narrow ravines, as far as San Luis Obispo; but about Santa Ynez, south of San Luis, and again in the neighborhood of Santa Barbara, it runs on, or close by the beach; whence, southward, it keeps chiefly along the west foot of the mountains, separated from the sea by low sand-hills, in some places of considerable breadth, as at San Gabriel, where they are almost twelve leagues broad. The best way to the Colorado, in the dry season, is to follow the coast road as far as San Luis Rey, and

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[16]The mission of La Purissima Concepcion, originally situated on the south bank of the Santa Inez river, about half way between Santa Inez and the sea, but in 1813–15 moved to a new site about two miles northeastward on the old wagon road between San Luis Obispo and Santa Inez.

thence ascend the Pala stream [San Luis Rey river], which runs in a very narrow ravine behind the maritime ridge, crossing the summit level between its head and that of the small stream of San Felipe [a stream heading in Warner pass, San Diego county], which runs southeastward till it reaches the border of the sand plain [the Colorado desert] at Carizal,[17] where it sinks; though its course across the plain, when swollen, which it rarely is, is marked by a dry channel, in many points of which a little water, usually very bad, is to be had by deep digging.

"There is not much difficulty in any part of the journey up to this point,—the Carizal; but from hence across the plain, which is here about one hundred miles broad, and totally destitute of [p. 65] pasture, cattle suffer extremely. It is always possible to carry water enough for a party of men; but horses and mules must pass the first two days absolutely without water or food,—and even then get only brine at the point called the Aqua Sola [probably the 'lagoons' at Alamo Mocho of the Pacific railroad reports and recent maps], from its being the only pond on the plain. When I passed, the water I found at this place was so strong that it purged both men and cattle. There is here some rush and reed which mules will eat, though horses usually refuse them.

"From hence there is still another day's journey to the Rio Colorado. After passing the river the same difficulties continue for seven days farther, on the Sonora road, as far as Alta; but this part of the journey, from its greater length, it is extremely imprudent to attempt without a proper guide.[18] The only water to be had is found in the ravines, frequently at some distance from the road, in excavations called Tinajas, made by the Indians, who were formerly much more numerous in this neighborhood than they are at present. . . .

[p. 68] "I shall not at present go into any examination of the vegetation of California, though this, as well as its fauna, is well worthy of the most attentive consideration. . . .

[p. 70] "I am sorry to be obliged to content myself with offering the Society so desultory and imperfect a sketch as this; but I have many claims on my time, the most urgent of which is the preparation of a work in some detail on the entire subject of California. Whatever is here defective will there, I hope, be found supplied."[19]

From certain chronometric tables, given by Coulter on page 61, in connection with his determinations of longitude, have been taken the following dates in his journey from Monterey to the mouth of the Gila in Arizona, all in the year 1832.

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[17] According to Coulter's narrative, the Carizal is the sink of San Felipe creek. According to his map, however, it is on Carrizo creek, the next stream to the south, thus corresponding to the place known as Carrizo in the Pacific railroad reports and on recent maps. *Carinal* on Coulter's map is a misprint.

[18] It is clear from the dates of his itinerary and from statements in his article that Coulter did not at this time go on to Sonora but that he is here merely describing the road which might be followed into that country.

[19] See page 525 regarding the subsequent loss of his manuscripts.

Monterey	January 22 to March 20.
Santa Barbara	April 6.
San Gabriel	April 23.
La Pala [Pala, San Diego county]	April 30.
Ford [of the Colorado river, at or near the site of the present town of Yuma]	May 8 to 17.
La Pala	May 27.
San Gabriel	June 15.
Santa Barbara	July 5 to 7.
Monterey	July 19 to Aug. 2.

After further collecting in California, apparently always in the vicinity of Monterey, Coulter returned to Europe by way of Mexico, in the year 1834, bringing with him his collection of over 50,000 specimens, probably representing between 1,500 and 2,000 species, besides a collection of nearly 1,000 woods, botanical manuscripts, journal, and additional materials for a personal narrative. All these manuscripts were in some unaccountable way lost in transport between London and Dublin. Suffering from this loss, and broken in health from the hardships of his travels, he devoted himself thereafter quietly and unremittingly to the arrangement of his herbarium, which, with its total of about 150,000 specimens, became the property of Trinity College, he himself being appointed keeper, or curator. At the time of his death, in 1843, he had completed the arrangement of the European plants and had begun on his American collections.

The collections of Cactaceæ sent to De Candolle seem to have contained the only ones of Coulter's plants that reached an avenue of publication previous to his death, with the exception of five new Californian pines described in the paper by David Don, and the *Cupressus coulteri* of Forbes.[20] But Professor W. H. Harvey, upon his appointment as Coulter's successor, in 1844,[21] proceeded with the arrangement of the Californian and Mexican plants,[22] issued three short papers[23] on them, and, apparently in the years 1846 to 1848, distributed the greater part of the duplicates, the first set going to Kew and others to Dr. Asa Gray and Dr. John Torrey in America. The specimens were sent out under more than 1,700 numbers, unfortunately arranged systematically instead of chronologically.

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[20]See bibliography and list of species below.
[21]Gray, Amer. Journ. Sci. II. **42:** 274. 1866.
[22][Anon.] Memoir of W. H. Harvey 147, 156. 1869.
[23]See bibliography, below.

I give herewith the titles of the special papers based on Coulter's collections, together with his own two publications, all chronologically arranged.

COULTER, THOMAS.

Memoire sur les Dipsacées. pp. 49. *pl. 2.* 4°. Genève, 1823.

Reprinted in Mém. Soc. Phys. de Genève **2**[2]: 13-60. *pl. 2.* 1824. The type pages in the two works are identical, with the exception of the page numbers and the signature marks. Page 44 of the original, immediately preceding the index, is blank, but in the reprint is filled by running the succeeding matter one page backward.

A revision of the family, preceded by a brief statement of the circumstances under which the work was undertaken and an elaborate morphological introduction.

DECANDOLLE, A. P.

Revue de la famille des Cactées. Mém. Mus. d'Hist. Nat. de Paris **17**: 1-119. 1828.

Pages 107 to 119 consist of a postscript, presented to the Société Helvetique des Sciences Naturelles at Lausanne July 22, 1828, based on a collection of fifty-seven species of living Mexican Cactaceæ received from Thomas Coulter while the paper was in press, and clearly the first lot of Coulter's Cactaceæ that came into De Candolle's hands. Forty-seven species were described as new, 25 Mamillariæ, 5 Echinocacti, 10 Cerei, and 7 Opuntiæ. Unfortunately no more specific locality than "Mexico" was given for any of the species, nor does the paper include any other reference to Coulter's collections, location, or movements.

DECANDOLLE, A. P.

Mémoire sur quelques espèces de Cactées nouvelles ou peu connues. pp. 27. *pl. 12.* 4°. Paris, 1834.

The half-title of his work is "Mémoire sur quelques nouvelles espèces de Cactées, et principalement sur celles envoyées du Mexique par le Docteur Coulter" It contains descriptions of three new species, two Mamillariæ and one Echinocactus, with critical notes on twenty-four others. Almost all this new matter is based on cultivated specimens from Coulter's first consignment in 1828.

COULTER, THOMAS.

Notes on Upper California. Journ. Roy. Geog. Soc. Lond. **5**: 59-70. 1835. With map.

A geographic account of California with a brief description and map of his route in 1832 from Monterey to the mouth of the Gila and return.

DON, DAVID.

Descriptions of five new species of the genus Pinus, discovered by Dr. Coulter in California. Trans. Linn. Soc. Lond. **17**: 439-444. 1836.

Describes *Pinus coulteri*, *P. muricata*, *P. radiata*, *P. tuberculata* and *P.* [*Abies*] *bracteata*, and gives a brief reference to Coulter's work in California.

HARVEY, W. H.

Description of a new genus of Papäveraceæ, detected by the late Dr. Coulter, in California. Lond. Journ. Bot. **4**: 73-76. *pl. 3.* 1845.

A description of the genus Romneya and its single species, *R. coulteri.*

HARVEY, W. H.

Characters of two new genera of Cruciferæ, discovered by the late Dr. Coulter, in California. Lond. Journ. Bot. **4**: 76-78. *pl. 4, 5.* 1845.

Describes the genera Lyrocarpa Hook. & Harv. and Dithyrea Harv. with the species *L. coulteri* Hook. & Harv. and *D. californica* Harv. respectively.

HARVEY, W. H.

Description of a new genus of Hydrophyllaceæ, from California. Lond. Journ. Bot. **5**: 311-12. 1846.

The genus Whitlavia described, with its two species, *W. grandiflora* and *W. minor*, both collected by Thomas Coulter.

The descriptions of most of Coulter's new species have come into the literature of botany irregularly and incidentally in various reports and monographs prepared at the great herbaria which received his collections, so that the complete collation of them would be a matter of great difficulty and probably not worth the effort. As indicative, however, of some of the avenues of publication, I append a list, chronologically arranged, of most of the species that bear his name, together with a few critical notes on other species regarding which mistakes appear to have been made.

Pinus coulteri Don, Trans. Linn. Soc. Lond. **17:** 440. 1836.

"Habitat in California, in montibus Sanctæ Luciæ, alt. 3,000-4,000 ped. *Coulter.*"

Cupressus coulteri Forbes, Pinet. Woburn. 190. 1839.

Publication not seen.

Romneya coulteri Harv. Lond. Journ. Bot. **4:** 75. *pl. 3.* 1845.

"In California boreali legit *T. Coulter,* 1832." Known only from the coastward side of the San Jacinto mountains in San Diego county.

Lyrocarpa coulteri Hook. & Harv. Lond. Journ. Bot. **4:** 76. 1845.

"In California legit *T. Coulter,* 1832. (No. 40.)" Since collected only in Sonora and Lower California.

Prosopis heterophylla Benth. Lond Journ. Bot. **5:** 82. 1846.

"Sonora Alta, in Sonora, Mexico." Now called *Acacia willardiana,* and known only from Guaymas.

Prosopis pubescens Benth. Lond. Journ Bot. **5:** 82. 1846.

"California between San Miguel [in the northern part of San Luis Obispo county] and Monterey." The plant does not occur in the region named, but doubtless came from the Colorado Desert, where it is a common and characteristic tree. Coulter passed through San Miguel, although he did not give the place a name on his map, on his trip from Monterey to the mouth of the Gila.

Antirrhinum coulterianum Benth.; A. DC. Prodr. **10:** 592. 1846.

"In California (Coulter)." Now known from the coastal side of the San Bernardino-San Jacinto mountain system of southern California.

Linum coulterianum Planch. Lond. Journ. Bot. **7:** 498. 1848.

"In regni Mexicani ditione Zimapan, *Dr. Coulter,* no. 758, in herb. Hook. a cl. Harvey comm." Considered by Mr. Hemsley a variety of *Linum schiedeanum* Ch. & Schl.

Dalea mollis Benth. Pl. Hartw. 306. 1848.

"In vicinibus Monterey [California] legit Coulter." This plant has not been rediscovered at Monterey, and as it is now known to be a species characteristic of the California-Arizona desert region the locality given by Bentham should be treated, as intimated by Dr. Sereno Watson, in the Botany of California, as incorrect. It was undoubtedly collected by Coulter in the Colorado Desert on his trip from Monterey to the mouth of the Gila.

Astragalus coulteri Benth. Pl. Hartw. 307. 1848.

"Juxta Monterey [California] legit Coulter." A species of the Colorado Desert, California, not known in the coastal region and undoubtedly attributed to that district by mistake.

Eunanus coulteri Harv. & Gray; Benth. Pl. Hartw. 329. 1849.

"In valle Sacramento." The description was drawn by Bentham from a specimen collected by Hartweg as above, but the name was borrowed from unpublished manuscript of Harvey and Gray, based undoubtedly on one of Coulter's Californian plants.

Obione coulteri Moq. DC. Prodr. **13**²: 113. 1849.

"In California (Coulter! n. 687)." Supposed to be a plant of San Diego county, now referred to Atriplex, but not yet satisfactorily identified.

Pectis coulteri Harv. & Gray; Gray, Pl. Fendl. 62. 1849.

"California, *Coulter* (no. 330)." A desert species, undoubtedly collected on Coulter's trip to the mouth of the Gila.

Psilactis coulteri Gray, Pl. Fendl. 72. 1849.

"Mexico, *Coulter*, no. 295." Known now as a widely distributed desert species of southeastern California, Arizona, and northwestern Mexico.

Perityle leptoglossa Harv. & Gray; Gray. Pl. Fendl. 77. 1849.

From "Coulter's Californian collection." In Gray's Synoptical Flora **1**²: 321. 1884, the locality is given as "probably Arizona." It has been recollected at Guaymas by Dr. Edward Palmer, and Mr. Rose believes that the original specimens were collected in this region, not in California.

Cirsium coulteri Harv. & Gray; Gray, Pl. Fendl. 110. 1849.

"California, *Coulter*." Referred later by Dr. Gray to *Cnicus occidentalis* which is principally a coastal species.

Malacothrix coulteri Harv. & Gray; Gray, Pl. Fendl. 113. 1849.

"California, *Coulter*." A species principally confined to the desert region. In the original description the name of the species is cited from "Harv. & Gray, Pl. Coult. ined." indicating that a joint work on Coulter's collections was contemplated by Dr. Gray and Professor Harvey.

Oserya coulteriana Tulasne, Ann. Sci. Nat. Bot. III. **11**: 106. 1849.

"Nova Hispania.—(*Coulter*, no. 1,394.)"

Tauschia coulteri Gray & Harv.; Gray, Pl. Lindh. 2: 211. 1850.

No. 121 of Coulter's Mexican collection. Now *Arracacia coulteri* (Gray & Harv.) Coult. & Rose.

Menodora coulteri A. Gray, Amer. Journ. Sci. ser. II. **14**: 44. 1852.

"Mexico, Coulter (no. 938)."

Cleomella coulteri Harvey; Torr. in Gray, Pl. Wright. 1: 12. 1852.

Type locality not given. A *nomen nudum* for a plant now referred to *Wislizenia refracta* Engelm.

Kosteletzkya coulteri Gray, Pl. Wright. 1: 23. 1852.

"Sonora Alta, Northern Mexico, *Coulter* (no. 804)."

Hibiscus coulteri Harv.; Gray, Pl. Wright. 1: 23. 1852.

"Zimapan, Mexico, *Coulter* (809)." Description based also on the specimens of Wright and Gregg.

Acacia coulteri Benth.; Gray, Pl. Wright. 1: 66. 1852.

"(Zimapan, Mexico, *Coulter;* without any number.) Uplands of the Leona river, Western Texas [Wright]."

Bolanosa coulteri Gray, Pl. Wright. 1: 82. 1852.

"Bolanos, Northern Mexico, *Coulter*."

Brickellia coulteri Gray, Pl. Wright. 1: 86. 1852.

"California, *Coulter* (no. 293), in herb. Hook." From southern Arizona to adjacent arid portions of interior northern Mexico, probably collected by Coulter near Yuma where it has since been found.

Elaterium coulteri Gray, Pl. Wright. 2: 61. 1853.

"Zacatecas, Mexico, *Coulter*, no. 51." This is *Echinocystis coulteri* (Gray) Cogn.

Tetraclea coulteri Gray, Amer. Journ. Sci. II. **16**: 98. 1853.

"Mexico, *Dr. Coulter* (no. 1,172 in coll.).—Prairies of San Felipe and Live Oak creeks, Texas, *Wright*, 1849 (no. 462); also at Escondido Springs, in the same district, 1852. Azufrora, near Saltillo, Mexico, *Dr. Gregg* (no. 502). Saur de Cieñega, between Conde's Camp and the Chiricahui Mountains, on the borders of New Mexico and Sonora, *Wright*, 1851 (no. 1,513)." After the description of the genus the specific name is given, with citation of specimens as above but without a diagnosis of the species.

Guaiacum coulteri Gray, Pl. Thurb. 312. 1854.

"On hills between Rayon and Ures, Sonora; October, 1851 [Thurber's collection].—The specimens bear ripe fruit only. They are said by Sir William Hooker to accord with no. 779 of the Mexican collection of the late Dr. Coulter."

Salix coulteri Anders. Oefver. Kongl. Vet. Akad. Förh. **15:** 119. 1858.

"In California (*Coulter*) Hb. Hooker." Now united by Mr. M. S. Bebb with *S. sitchensis*, a species of the coastal region extending from Alaska at least to Santa Barbara, California.

Spigelia coulteriana Benth. Journ. Linn. Soc. Bot. **1:** 90. 1861.

"In Mexico ad Zimapan, *Coulter*, n. 962."

Decatropis coulteri Hook. f.; Benth. & Hook. Sp. Pl. **1:** 299. 1862.

"Mexicana." The name *D. coulteri* is cited without description, after the original description of the genus, as the only species.

Orthotrichum coulteri Mitten, Journ. Linn. Soc. **8:** 25. 1865.

"California, *Coulter*."

Conyza coulteri Gray, Proc. Amer. Acad. **7:** 355. 1868.

"This is Coulter's no. 285 and 286 and has recently been collected near Fort Mohave [Mohave Desert] by Dr. Cooper."

Berendtia coulteri Gray, Proc. Amer. Acad. **7:** 380. 1868.

"Mexico, no. 1334, 1335, coll. Coulter, ex herb. Trin. Coll. Dubl."

Peperomia coulteri C. DC. in DC. Prodr. **16¹:** 424. 1869.

"In Mexici prov. Zuinapa (?) [Zimapan] (Coulter n. 1400! in h. Kew)."

Nama coulteri Gray, Proc. Amer. Acad. **8:** 283. 1870.

" 'California' [perhaps Arizona], Coulter, 463. Nazas Valley, Bolson de Mapimi, Chihuahua, Mexico, Gregg." A desert species, not yet re-discovered within the borders of the United States. The brackets are in the original.

Caulanthus coulteri Wats. Bot. King Surv. 27. 1871.

"Southern California." A species not yet satisfactorily known.

Microsplenium coulteri Hook. f.; Benth & Hook. Gen. Pl. **2:** 4. 1873.

"In Mexici regione montana a Coultero et a Galeotti (n. 2704) lecta." As in the case of Decatropis the specific name is here cited without description.

Malvastrum coulteri Wats. Proc. Amer. Acad. **11:** 125. 1876.

"Collected probably in south-eastern California by Coulter (n. 96) and in the valley of the Gila by Schott, on the Mexican Boundary survey." A species of the desert region, now known as *Sphaeralcea coulteri* (Wats.) Gray.

Asclepias coulteri Gray, Proc. Amer. Acad. **12:** 71. 1876.

"Mexico, Coulter, coll. no. 983."

Leptoglossis coulteri Gray, Proc. Amer. Acad. **12:** 165. 1877.

"Mexico, coll. Coulter, no. 1346." Now *Nierembergia coulteri* (Gray) Hemsl.

Perezia coulteri Gray, Proc. Amer. Acad. **15:** 40. 1879.

"Gravelly slopes, near San Luis [Potosi?] flowering in spring and again in autumn. No. 547 [Parry and Palmer] in part. This is no. 234 of Coulter's Mexican collection, from Zimapan."

Sisymbrium coulteri Hemsl. Diag. Pl. Nov. 18. 1879.

"Mexico: in regione San Luis Potosi, alt. 6,000–8,000 ped., *Parry et Palmer*, 14; sine loco speciali, *Coulter*, 675."

Exostemma coulteri Hook. f.; Hemsl. Diag. Pl. Nov. 32. 1879.

"Mexico: Zimapan, *Coulter* 209."

Zaluzania coulteri Hemsl. Diag. Pl. Nov. 33. 1879.

"Mexico: Real del Monte, *Coulter*, 350."

Gutierrezia coulteri Hemsl. Diag. Pl. Nov. 33. 1879.

"Mexico: Zimapan, *Coulter*, 315."

Schoenocaulon coulteri Baker, Journ. Linn. Soc. **17**: 477. 1880.
"Mexico prope Zimapan, Coulter!"

Senkenbergia coulteri Hook. f.; Benth. & Hook. Gen. Pl. **3**: 6. 1880.
Original locality "North Mexico, Sonora Alta (*Coulter*, 1425). Hb. Kew", according to Hemsley, Biol. Cent.-Amer. Bot. **3**: 5. 1882. Referred by Dr. Watson to Boerhavia.

Helianthemum coulteri Wats. Proc. Amer. Acad. **17**: 323. 1882.
"At Zimapan (743 Coulter) and in the Morales Mountaines, San Luis Potosi (608 Schaffner)."

Calliandra coulteri Wats. Proc. Amer. Acad. **17**: 352. 1882.
"At Soledad (2129) [Palmer, 1879-80]; collected also by Coulter, without number or locality."

Marsdenia coulteri Hemsl. Biol. Centr.-Amer. Bot. **2**: 336. 1882.
South Mexico, Zimapan (Coulter, 970).

Echites coulteri Wats. Proc. Amer. Acad. **18**: 113. 1883.
"In the Sierra Madre, south of Saltillo (805) [Palmer, 1879-80]; 987 Coulter."

Verbesina coulteri Gray, Proc. Amer. Acad. **19**: 13. 1883.
"Zimapan, Mexico, *Coulter*, 341, 369."

Lasthenia glabrata coulteri Gray, Syn. Fl. **1**[2]: 324. 1884.
"Saline marshes, S. California *Coulter* (no. 338), *Brewer, Cleveland, Pringle*."

Carex coulteri Boott; Hemsl. Biol. Centr.-Amer. Bot. **3**: 473. 1885.
"South Mexico, Zimapan (*Coulter*, 1620), Santa Fé, valley of Mexico (Bourgeau, 671)."

Philadelphus coulteri Wats., Proc. Amer. Acad. **22**: 472. 1887.
"Zimapan (77 *Coulter*); foothills of the Sierra Madre near Monterey, Mexico (*C. S. Sargent*, April, 1887)."

It is evident from Coulter's published work and from references to him in the writings of his contemporaries that he was not merely a collector but a botanist, a man of general culture, and an enthusiastic field naturalist and geographer. Regarding his personal characteristics Dr. Romney Robinson[24] says: "He had every requisite for success among half civilized or savage races: a noble and commanding person; great stature, strength, and dexterity in the use of arms; good temper, courage, and presence of mind: a combination of qualities, which Bruce only, of modern travellers, possessed in the same degree." Coulter was the first botanist who penetrated the Colorado Desert,[25] remarkable for the aridity of its climate and the peculiarities of its flora. His collections were very large, and their enumeration, had it been published in a single report, would have formed probably the most valuable contribution to North American botany ever issued. It is hoped that this effort to record an outline of his work will serve to show to some extent the importance of his scientific explorations to the advancement of botany in America.

[24] Proc. Roy. Irish Acad. **2**: 555. 1844.
[25] See W. H. Brewer in Watson, Bot. Cal. **2**: 555. 1880.

I earnestly request that any known facts regarding Thomas Coulter not included in this paper be communicated to me. These together with other matter, including the letters of Coulter to Augustin Pyramus and Alphonse DeCandolle, to which through the courtesy of Dr. Casimir DeCandolle I have recently had access, may hereafter be incorporated into a more detailed account of Coulter's labors.

Washington, D. C.

Explanation of Plate XXXV.

The plate is a photolithographic reproduction, on the original scale, of the principal part of the map, which was itself a lithograph, published with Coulter's "Notes on Upper California." About an inch and a half was cut off the original at the top and bottom, neither portion containing any mark of Coulter's route.

Undescribed plants from western Mexico.

Collected principally by Frank H. Lamb in the winter of 1894–5.

MERRITT LYNDON FERNALD.

Kosteletzkya stellata, n. sp.—A slender much branched suberect plant, five to eight feet high, with the stems and branches densely stellate-pubescent: leaves one and one-half inches or less in length, lanceolate or ovate, on petioles a third or a fourth their length; the dark margins coarsely irregularly and bluntly serrate; pubescence of the leaves dense, finely stellate, with some coarser three-rayed hairs beneath, and some coarser simple or branched tuberculate hairs above: inflorescences axillary, not equalling the leaves; peduncles densely fine-stellate: involucral leaves five, subulate, a third as long as the calyx: calyx two to three lines high, five-parted two-thirds of the way to the base, the segments lanceolate, stellate-pubescent: corolla barely half an inch across, yellow or reddish, sparingly covered with coarse stellate hairs: stamineal column shorter than the corolla: capsule four lines broad, densely hispid, the sharp angles strongly ciliate.—Collected in waste places near Mazatlan by W. G. Wright, January, 1889 (no. 1,241); and near a pool on Isla Piedra, Mazatlan, by Mr. Lamb, January 2, 1895 (no. 374).

Triumfetta cucullata, n. sp.—A shrub, five to ten feet high: the terete branches sparingly cinereous-pubescent below, densely so above: petioles three-fourths inch or less in length, with four roundish black glands toward the apex; leaf-blade ovate-lanceolate, two to five inches long, three-fourths to two and one-half inches broad, tapering to a subcuneate base and an abruptly acuminate tip; pale, cinereous and stellate below, darker and less pubescent above; margin undulate and irregularly serrate, rarely with scattered dark glands toward the base: corymbs of four to six flowers either single or in fascicles in the axils of the upper leaves or leaf-like bracts: bracts mostly oblong, two to five lines in length, with pubescence and margins like the leaves, but with many round black glands on the margins: peduncles cinereous, one to nine lines long, the longer ones often bearing two or more corymbs; pedicels three lines or less in length, stellate-pubescent: sepals an inch long, linear, stellate-pubescent without, the tips incurved and cucullate: petals deep yellow, slightly exceeding the calyx, obovate, tapering to ciliate and densely-bearded claws: stamens fifteen to twenty, hirsute below: style exserted.—Collected in the mountains near Zopelote, Tepic, at 2,000 to 3,000 feet altitude, by Mr. Lamb, February 11, 1895 (no. 579).

Ilex Dugesii, n. sp.—Branches stout, covered with smooth minutely tomentulose gray bark; branchlets tomentose: leaves oblong, yellowish green, dull, one and one-half to two and one-half inches in length, eight to eleven lines broad, tapering about equally to the bluntish tip and the tomentose petiole (four lines long), margins strongly revolute, entire or obsoletely dentate; the upper surface puberulent, strongly rugose, with depressed veins; lower surface paler; the veins prominent and fuscous-tomentose: fruit red, axillary, solitary, globose, four lines in diameter; the tomentose pedicel three lines long: calyx with very shallow, strongly ciliated lobes: nutlets four, longitudinally grooved on the back.—Collected at Guanajuato by Prof. A. Dugès, 1891. The Mexican name is "Naranjillo." This species differs from *I. rubra* Wats., to which it is evidently related, in its more oblong relatively narrow entire leaves, which are strongly rugose and very pubescent beneath.

Gliricidia Lambii, n. sp.—A tree fifteen to twenty-five feet in height, the smooth trunk about eight inches through· branches minutely pubescent and warty or glabrate: leaves (at the time of flowering confined to the lowest branches) seven or eight inches long, 7-foliate, the rachis sparingly appressed-silky: the petiolule two to three lines long, fuscous-pubescent and hispid; leaflets two and one-half to three inches long, ovate-oblong, or the terminal nearly orbicular, tapering to an obtuse tip, glabrous on both sides, or minutely appressed-silky on the pale lower surface: racemes clustered on the naked branches giving the appearance of compound racemes two feet long; the true racemes two to four inches long, many-flowered; peduncle appressed-pubescent, viscid, fuscous toward the base; pedicels half inch in length, subtended by suborbicular fuscous-pubescent ciliate bracts (a line long): calyx subtruncate, dorsally saccate, appressed silky, three and one-half lines high, five lines broad; the teeth broad and ciliate: corolla pale blue fading with age;

the standard yellow below, suborbicular with a cordate base, and with two oblong callosities above the claw, retuse and ciliate above, an inch long, ten lines broad; wings broadly oblanceolate, eleven lines long by four and one-half lines wide, semihastate above the long claw; keel oblong, eleven lines long, two and three-fourths lines broad: vexillary stamen free, the other nine connate into a tube: style minutely granular below the stigmatic tip; ovary glabrous.—Collected in the valley of Rio Rosario, Rosario, Sinaloa, by Mr. Lamb, January 12, 1895 (no. 451), also observed at Acaponeta, Tepic, and often along the stage road between Rosario and Santiago. The tree is called "Cacaguananchi" by the Mexicans.

CÆSALPINIA CACALACO Humb. & Bonpl. Pl. Æquin. **2:** 173. *pl. 137.*

This species is described as having the leaves unarmed. Though Mr. Lamb's no. 363 from Ocean Beach, near Mazatlan, agrees well with the description and the plate, one of the leaves (in the specimen at hand) has stout recurved spines scattered along the rachis, the remaining leaves being unarmed.

Lagascea glandulosa, n. sp.—Slender, lax, branching from near the base, two to six feet high: the stems densely white-villous above, more sparingly so below: leaves apparently all opposite, ovate, acuminate, one to three inches long, pale beneath, finely soft-pubescent on both sides, entire, ciliate, on slender pubescent petioles three to eight lines in length: peduncles an inch or so long, lanate-villous, and often glandular: glomerule about 15-headed, subtended by two to five linear-lanceolate glandular-ciliate bracts: involucre three and one-half lines high, cylindrical and villous for half its length, then spreading into five narrowly deltoid glandular teeth: corolla yellow, viscid, twice the length of the involucre, the five lanceolate lobes acute: achene pubescent.—Collected at the head of Mazatlan River, by W. G. Wright, in January, 1889 (no. 1,305); and in thickets along the road from Rosario to Chile, Sinaloa, by Mr. Lamb, January 16 to 20, 1895 (no. 483). Resembling *L. decipiens*, Hemsl., but differing from that species in its more slender habit, thin, soft-pubescent leaves on very slender petioles, broader, more spreading and glandular involucral teeth, and pubescent achenes.

Calea submembranacea, n. sp.—Suffrutescent, five or six feet high, the many-grooved branches sparingly villous: leaves submembranaceous, on petioles a line or so long, oblong-lanceolate, subcordate at base, attenuated to a subapiculate tip, smooth and shining on both surfaces, or sparingly villous on the veins beneath, entire, or with a few scattered teeth; the largest three and one-half inches long: heads four to six in terminal or lateral corymbs; the peduncles and pedicels villous-lanate: involucral scales lanceolate, in four or five series; the outer short series villous, ciliate, and obtuse; the inner longer series becoming glabrate, or merely ciliate, acutish: flowers strongly pubescent below; rays about twenty, oblong, whitish, with about seven dark nerves, three-toothed at the tip; disk-flowers many: pappus scales fifteen to twenty, linear-subulate, ciliate-erose on the margins; achenes subtetragonal, hirsute.—Collected on a mountain side at Zopelote, Tepic, at 3,000 feet altitude, by Mr. Lamb, February 9, 1895 (no. 554). In habit closely resembling *C. scabrifolia* Benth. & Hook., but well distinguished by the thinner glabrous leaves, villous stem, and hirsute achenes.

Ipomœa amplexicaulis, n. sp.—A very slender vine, climbing over bushes to the height of ten or twelve feet: stems sparingly hispid or glabrate: leaves remote, an inch and a half long or less, glaucous, on very short petioles (two-thirds line), ovate, cordate, with rounded base and deep closed sinus, round or blunt at the tip; the veins conspicuous, especially below, and the mid-vein continued into a brown cusp: peduncles axillary, two or three inches long, bearing cymes of five to ten light yellow flowers; bracts of the inflorescence lance-subulate, a line long; pedicels two or three lines long: calyx two lines high; the teeth lanceolate, with whitish scarious margins, and covered with brown dots: corolla hardly an inch long, broadly cylindrical for two-thirds of its length and then gradually spreading to a limb half an inch or so across: stamens unequal, about half the length of the corolla-tube: style filiform; capsule obovate, three lines high.—Collected at 2,000 to 3,000 feet altitude in the mountains near Zopelote, Tepic, by Mr. Lamb, February 12, 1895 (no. 576).

Ipomœa Lambii, n. sp.—A slender vine, climbing fifteen feet over bushes and trees: the stem and branches covered with strongly reflexed tuberculate hairs: leaves broadly ovate, acuminate, varying in length from three to seven inches, two-thirds as broad as long; somewhat 3-lobed, or subhastate, strongly pubescent beneath, and sparingly above, with ascending tuberculate hairs; petiole two-thirds as long as the blade, densely covered with reflexed hairs: peduncles two to four inches long, sparingly appressed-pubescent, bearing two to four large flowers: calyx about an inch long; sepals ovate-lanceolate, the outer much larger than the inner: corolla rose-purple, three to three and one-half inches high, three to four inches broad when expanded: style exceeding the unequal stamens and reaching nearly to the throat of the corolla.—Collected near Zopelote, Tepic, at 2,000 feet altitude, by Mr. Lamb, February 10, 1895 (no. 556).

Solanum (Polymeris) Lambii, n. sp.—A stiff vine climbing ten feet over bushes: branches subterete, geniculate, densely stellate-pubescent above: leaves solitary or geminate and unequal above, an inch or two long, broadly ovate or reniform with blunt or rounded tips and cordate bases, densely white-stellate beneath, fuscous-stellate above, especially on the veins; petioles two to seven lines long, stellate-pubescent: peduncles stellate-pubescent, two to four, axillary, unequal, none exceeding the leaves, bearing single flowers: calyx subglobose, stellate-pubescent, with ten linear teeth one and one-half to two and one-half lines in length: corolla blue and white, eight lines high, plicate, angulately 5-lobed, externally cinereous-puberulent in bands, the narrow lobes somewhat incurved: anthers oblong, yellow, two and one-half to three lines long, one of them raised on a filament to twice the height of the other four.—Collected at Villa Union, Sinaloa, by Mr. Lamb, January 10, 1895 (no. 446).

Two specimens, one collected at Wartenberg, Huasteca by Ervendberg (no. 126), August–September, 1858; the other by Mr. Hahn in 1865–66 (no station given), may belong here, but they have their leaves tapering at the base.

Carlowrightia glabrata, n. sp.—The slender somewhat woody stem diffusely branched, a foot or two high, villous or glabrate or merely puberulent: leaves one and one-half to two and one-half inches long, tapering below to slender petioles three to four lines in length, and above to cuspidate tips, finely pubescent or glabrate on both surfaces: flowering branches almost naked, arising from the upper axils, somewhat dichotomous, elongated and forming very slender few-flowered spikes three to eight inches in length: calyx-teeth subulate, one and one-half to two lines long, viscid-pubescent, twice as long as the lance-subulate bracts: corolla white or purplish, four to five lines long, deeply cleft, and with a short tube (about a line in length): anther-cells narrowly oblong, slightly oblique, one extended a little above the other: capsule four to five lines long, the stipe equalling the ovate laterally compressed body; seed flat, tuberculate-roughened, irregularly cordiform with thickened margins, two lines long, scarcely as wide.—Collected at Manzanillo by Dr. Edward Palmer, December, 1890 (no. 892); and in dry soil under "Mango" trees at Villa Union, Sinaloa, by Mr. Lamb, January 8, 1895 (no. 420).

Henrya grandifolia, n. sp.—Slender, two to four feet high, the branches densely glandular-pubescent above, glabrate below: leaves lance-ovate, three to five inches long, twelve to sixteen costate, tapering above to an acuminate tip, and below to a petiole an inch or so long, appressed-pubescent on both surfaces, sparingly villous on the midrib above; the margin nearly entire, ciliate: the axillary or terminal spikes lax, with a few scattered flowers; the spike generally subtended below by a pair of ovate or orbicular glandular-pubescent leaf-like bracts: bractlets subtending the involucre oblanceolate, one and one-half to two lines long: involucres four and one-half to five lines long, oblanceolate, rounded and often corniculate at the tip: calyx a line high, with lance-subulate teeth: corolla white, three-fourths inch in length: anther-cells elongate-oblong.—Collected at Escuinapa, Sinaloa, by Mr. Lamb, January 29, 1895 (no. 505).

Tillandsia (Platystachys) exserta, n. sp.—Leaves about twenty, rosulate and strongly recurved, deeply canaliculate above, softly white-lepidote on both surfaces; the dilated base broadly lanceolate, an inch long; the blade lance-subulate three to six inches long: peduncle six inches in length: bracts ovate, appressed-imbricated, the lower with subulate leafy tips two to three inches long; the upper with very short tips; all densely white-lepidote: the simple distichous spike two to four inches long, half inch broad, rather densely flowered: flower-bracts lance-ovate, acute, eight to eleven lines long, straw-colored shading into rose at the margins, lepidote, becoming smooth: sepals lance-linear, exserted often half inch beyond the bracts: petals ovate-oblong, violet, half inch long, slightly exceeded by the stamens.—Common on the bushes and trees near Mazatlan, Sinaloa, occurring mostly upon the trees bordering the "esteros" or lagoons. Collected by Mr. Lamb, January 2, 1895 (no. 381).

Cambridge, Mass.

Undescribed plants from Guatemala and other Central American Republics. XVI.

JOHN DONNELL SMITH.

WITH PLATE XXXVI.

Passiflora porphyretica Mast.—(§ DECALOBA). Scandens cirrata, ramulis teretibus setis longiusculis patentibus fulvidis dense vestitis; foliis 5–6^{cm} long. × 3–4^{cm} lat., superioribus gradatim minoribus, crassiusculis superne scabriusculis, infra molliter setuloso-tomentosis, subrotundis palmatim trinerviis, basi breviter cordatis, lobis rotundatis divergentibus ultra medium trilobatis lobis obtusis integris, medio parum longiore; petiolis 25^{mm} long. eglandulosis; stipulis 8–10^{mm} long. oblique ovatis acutis violaceo-purpureis; floribus numerosis secus apices ramulorum racemoso-fasciculatis; pedicellis 2^{cm}; bracteis floribus approximatis circa 1^{cm} long. ovato-oblongis acutis petaloideis violaceo-purpureis; floribus diametro 2–3^{cm} tubo lato expanso; sepalis oblongis 3-nerviis, petalis conformibus paulo brevioribus; corona fauciali univel biseriali filis crassiusculis purpureo-maculatis petalis vix brevioribus; corona media membranacea dimidio breviore erecta tubulata plicata margine anguste inflexa; corona infra mediana annulari crassiuscula; gynandrophoro gracili glabro; ovario ovoideo setuloso; stylis gracilibus. —*Plate XXXVI.*

Species ob stipulas bracteasque coloratas, necnon ob inflorescentiam racemoso-fasciculatum commemorabilis.

Sunny places in forest near Jutiapa, Depart. Jutiapa, Guat., alt. 1,200^{ft}, Apr. 1894, Heyde & Lux, no. 6,334.

Begonia convallariodora C. DC.; erecta glabra foliis modice petiolatis ovato-acuminatis basi inaequali utrinque rotundatis margine subundulatis serrulatisque denticulis breviter subulatis, nervis secundariis utrinque 3–4 e petiolo divaricantibus et 4–5 e nervo centrali penninervatim adscendentibus, inflorescentia cum pedunculo folium fere aequante multiflora, fl. masc. sepalis 2 rotundatis integris petalis 0–1–2 quam sepala multo minoribus staminibus liberis numerosis antheris oblongis cum filamentis fere aequilongis, fl. fem. 2-lobi lobis rotundatis integris stilis 3 bifidis laciniis spiraliter papilliferis ovario globoso-elliptico 3-alato ala maxima semilunari.

Caulis in sicco inferne circiter 3^{mm} crassus, fasciculis intramedullaribus nullis. Folia alterna, limbi ad 9^{cm} longi et 5^{cm} lati in sicco membranacei stomatibus ellipticis glomerulatis cystolithis nullis. Petioli circiter 12^{mm} longi. Inflorescentiæ axillaris in vivo niveæ pedunculus circiter 4^{cm} longus ramique ut videtur 2–3-dichotomi, bracteolæ cito deciduæ, flores in vivo Convallariæ odorem fragrantes. Floris masculi sepala circiter 5^{mm} longa, antheræ rimis longitudinalibus dehiscentes. Flores feminei in specimine adhuc juveniles. Capsula ignota.

Species verisimiliter sectionis *Rossmanniæ* A. DC.

Pansamalá forest, Depart. Alta Verapaz, Guat., alt. $3,800^{ft}$, Jan. 1886, von Türckheim, no. 840.

Begonia Cooperi C. DC.; foliis breviter petiolatis oblongo-ellipticis uno latere paulo latioribus basi ima parum inaequali acutis subduplicato-serratis, dentibus apice subulatis, supra glabris subtus ad nervos pilosis nervis secundariis rectis utrinque fere 15, inflorescentiæ multifloræ cum pedunculo folium parum superantis ramulis pluries dichotomis cum pedunculo hirsutis, fl. masc. sepalis 2 rotundatis integris glabris antheris ellipticis quam filamenta parum brevioribus, fl. fem. lobis 2 rotundatis integris glabris ovario glabro stilis 3 caducis 2-fidis basi connatis lobis laciniosis spiraliter papilliferis, capsula glabra alis 2 marginiformibus aequalibus tertia multo majore transverse elongata obtusa.

Rami lignosi hirsuti in sicco rubiginosi ad 5^{mm} crassi fasciculis intramedullaribus nullis. Folia alterna penninervia, limbi ad 11^{cm} longi ad 5.5^{cm} lati in sicco firmo-membranacei nervis secundariis cum centrali angulum acutum superne formantibus stomatibus glomerulatis ellipticis cystolithis nullis. Petioli ad 1^{cm} longi. Inflorescentia axillaris pedunculo circiter 8^{cm} longo. Floris masculi petala 0, stamina numerosa libera, antheræ glabræ rimis longitudinalibus dehiscentes connectivo ultra loculos breviter producto. Capsula basi subacuta ad 7^{mm} longa, ala maxima 12^{mm} longa 6^{mm} lata in sicco membranacea pellucida, placentæ 2-fidæ lamellis utrinque ovuliferis.

Species sectionis *Ruizopavoniæ* A. DC. *B. carpinifoliæ* Lieb. proxima ramis hirsutis limbis basi acutis nervorum numero aliisque notis ab ea discrepans, foliorum forma *Corylum ferocem* referens.

Cartago, Prov. Cartago, Costa Rica, alt. $4,250^{ft}$, Mch. 1888, Juan J. Cooper, no. 5,778.

Begonia Estrellensis C. DC.; glabra foliis parvis breviter petiolatis ovato-ellipticis basi subæquali obtusis apice acute acuminatis apicem versus serratis penninerviis nervis lateralibus adscendentibus utrinque 3–4, inflorescentia folium parum superante multiflora pauciramosaque floribus parvis, fl. masc. sepalis 2 cum petalis 2 quam sepala multum brevioribus ovatis integrisque staminibus liberis numerosis antheris oblongis filamenta brevissima multum superantibus connectivo ultra loculos producto, fl. fem. 2–3-lobi lobis ovato-ellipticis integris quorum interno multo minore vel deficiente, stilis 3 basi breviter connatis 2-fidis laciniis tortis spiraliter papilliferis, capsulæ ala maxima transverse et subadscendente subarcuata apiceque subacuta.

Ramuli lignosi nodosi circiter 2^{mm} crassi fasciculis intramedullaribus nullis. Folia alterna, limbi in sicco rigiduli 6.5^{cm} longi 2.5^{cm} lati stomatibus ellipticis 2–5-glomeratis cystolithis nullis. Petioli 5^{mm} longi. Inflorescentia axillaris ex apice pedunculi circiter 2.5^{cm} longi axi unifloro terminati utroque latere circiter ter dichotoma, bracteis bracteolisque cito caducis ellipticis integris. Floris masculi sepala 5^{mm} longa, antheræ rimis longitudinalibus dehiscentes, connectivus apice in sicco rubescens. Capsulæ ad lobos circiter 4^{mm} longæ ala maxima vix 3^{mm} lata aliis marginiformibus.

Estrella, Prov. Cartago, Costa Rica, alt. $4,400^{ft}$, Apr. 1888, Cooper, no. 5,779.

BEGONIA GUYANENSIS A. DC., var. **glaberrima** C. DC.; foliis exceptis supra parcissime pilosulis glaberrima.

Jiménez, Llanos de Santa Clara, Comarca de Limón, Costa Rica, alt. 650^{ft}, Apr. 1894, J. D. S., no. 4,814.

Begonia Heydei C. DC.; erecta glabra foliis modice petiolatis ovato-lanceolatis basi valde inaequali uno latere auriculatis apice acute acuminatis margine remote et parce denticulatis nervis 7 e petiolo divaricantibus quorum centrali nervulos utrinque 2–3 emittente, inflorescentia pauciflora cum pedunculo quam folium breviore, fl. masc. sepalis 2 cum petalis 2 quam sepala angustioribus ellipticis integris staminibus numerosis antheris ellipticis quam filamenta brevioribus, fl. fem. 3-lobi lobis ellipticis integris stilis 2-fidis basi connatis infra lacinias membranaceo-dilatatis laciniis membranaceis spiraliter papilliferis ovario brevi supra alas acuminato inferne attenuato alis e basi lata lineari-oblongis quarum maxima quam aliæ obtusæ parum longiore apice arcuato-acuta, capsula matura rotundato-rhomboidali alis angustis.

Caulis in sicco ad 3^{mm} crassus fasciculis intramedullaribus nullis. Folia alterna, limbi 10^{cm} longi 32^{mm} lati in sicco membranacei subpellucidi, stomatibus sparsis ellipticis. Petioli 2.5^{cm} longi. Inflorescentiæ axillaris ut videtur trifloræ pedunculus ad 2^{cm} longus, flores apice pedicellorum bracteolis 2 ellipticis integris fulti. Floris masculi sepala 12^{mm} longa, stamina apice columnæ inserta, antheræ rimis longitudinalibus dehiscentes. Floris feminei petala vix 1^{cm} longa, stili caduci, ovarium 3-loculare, placentæ 2-fidæ lamellis utrinque ovuliferis. Capsula matura circiter 12^{mm} longa lataque.

San Miguel Uspantán, Depart. Quiché, Guat., alt. $8,000^{ft}$, Apr. 1892, Heyde & Lux, no. 3,094.

Begonia Luxii C. DC.; foliis mediocribus modice petiolatis transverse ovato-acuminatis basi inaequali cordatis margine serrulatis supra ad paginam subtusque ad nervos pilosulis palmati-6-nerviis, petiolo glabro apice imo subtus fimbriato, inflorescentia florente pauciflora cum pedunculo quam folium breviore fructifera eum paulo superante bracteis caducis ellipticis, fl. masc. sepalis 2 rotundatis cum petalis 2 obovatis integris glabris antheris ellipticis quam filamenta brevioribus, fl. fem. 3-lobi lobis exterioribus rotundatis cum interno ellipticis integris glabris, capsula oblongo-elliptica glabra 2-loculari 2–3-alata alis subaequalibus quarum maxima transverse parum elongata tertia minima vel nulla.

Suffrutex circiter 30^{cm} altus radice fibrosa caule lignoso adulto fistuloso ad nodos tumido inferne inter nodos 3^{mm} crasso. Caulis fasciculi intramedullares in nodis nonnulli. Folia alterna, limbi in sicco tenuiter membranacei pellucidi ad 11^{cm} longi ad 5^{cm} lati stomatibus ellipticis sparsis. Petioli ad 5^{cm} longi in sicco tenues. Inflorescentiæ fructiferæ pedunculus 5^{cm} longus. Floris masculi stamina libera numerosa antheris glabris rimis longitudinalibus dehiscentibus. Floris feminei bracteolæ ovatæ caducæ, stili 3 caduci liberi 2-fidi laciniis spiraliter papilliferis, ovarium 3-loculare, placentæ 2-partitæ lamellis utrinque ovuliferis. Capsula abortu 2-locularis.

San Miguel Uspantán, Depart. Quiché, Guat., alt. $6,000^{ft}$, Apr. 1892, Heyde & Lux, no. 3,095.—Volcan de Agua, Depart. Zacatepéquez, Guat., alt. $7,000^{ft}$, June 1892, Shannon, no. 3,627.

Begonia Thiemei C. DC.; glabra foliis modice petiolatis oblongis inaequilateris subobliquis margine remote denticulatis in sicco tenuissime membranaceis pellucidis penninerviis nervis lateralibus utrinque circiter 8 tenuissimis subadscendentibus, fl. masc. sepalis 2 obovatis integris petalis 0 antheris filamenta duplo superantibus spathulato-oblongis, fl. fem. 2-lobi lobis reniformi-rotundatis integris stilis 3 liberis 2-fidis laciniis spiraliter papilliferis tortisque ovario 3-loculari, capsula transverse longe alata ala maxima ovata obtusa.

Caulis herbaceus. Folia conferta alterna ad 16^{cm} longa ad 6^{cm} lata in sicco tenuissime membranacea stomatibus sparsis raris magnis ellipticis. Sepala 1^{cm} longa. Capsula elliptica alis membranaceis quarum maxima 16^{mm} intermedia 5^{mm} longa. Placentæ 2-partitæ lamellis utrinque ovuliferis.

San Pedro Sula, Depart. S. Bárbara, Honduras, alt. 800^{ft}, Mch. 1888, Dr. C. Thieme, no. 5,240.

Begonia trichosepala C. DC.; caule repente haud dense piloso e nodis radicante, foliis longe petiolatis ovato-acuminatis basi cordatis margine remote denticulatis supra glabris subtus ad nervos sparse pilosis penninerviis nervis secundariis alternis adscendentibus utrinque 5, inflorescentia pauciflora florente cum pedunculo quam folium breviore, fl. masc. sepalis 2 rotundatis extus in medio longe fimbriatis petalis 2 quam sepala multo minoribus ellipticis glab is integris antheris oblongis obtusis quam filamenta pluries longioribus, fl. fem. stilis caducis capsula glabra 3-alata ala maxima quam aliæ parum longiore transverse elongata obtusa.

Caulis in sicco subcoriaceus 3^{mm} crassus e nodis radicellas fibrosas emittens fasciculis intramedullaribus nullis. Folia alterna, limbi circiter 10^{cm} longi 5^{cm} lati, in sicco tenuiter membranacei subpellucidi stomatibus ellipticis sparsis. Petioli 6.5^{cm} longi. Inflorescentiæ axillaris fructiferæ pedunculus ad 9^{cm} longus pilosus, bracteæ ellipticæ glabræ caducæ, florum pedicelli adpresse et longe pilosi. Stamina numerosa libera toro convexo inserta, antheræ glabræ rimis longitudinalibus dehiscentes connectivo ultra loculos subproducto. Capsula 3-locularis circiter 1^{cm} longa, placentæ 2-fidæ lamellis utrinque ovuliferis.

Pansamalá, Depart. Alta Verapaz, Guat., alt. 3,800^{ft}, Jan. 1887, von Türckheim, no. 225.

Begonia Tuerckheimii C. DC.; foliis magnis longe petiolatis ample reniformibus margine undulatis palmati-9-nerviis utrinque cum petiolis fulvo-tomentosis dein supra glabratis, pedunculo petiolis longiore cum inflorescentiæ pluries dichotomæ ramulis fulvo-tomentosis, fl. masc. sepalis 2 ellipticis integris extus rufo-pilosis, antheris subobovato-ellipticis quam filamenta usque ad duplo brevioribus connectivo ultra loculos obtuse producto, fl. fem. lobis 4 obovato-ellipticis integris extus parce pilosis, capsula 3-alata alisque pilosis maxima transverse et recte producta caeteris subaequalibus parum latiore.

Folia alterna, limbi in sicco subcoriacei opaci 11^{cm} longi 20^{cm} lati. Petioli circiter 22^{cm} longi. Floris masculi petala 0, stamina toro subconvexo inserta antheris glabris rimis longitudinalibus apice subarcuatis dehiscentibus. Floris feminei lobi circiter 7^{mm} longi 3^{mm} lati. Stili 3 persistentes basi connati apice auriculato-bilobi lobis extus papilliferis, ovarium ellipticum dense pilosulum 3-loculare, placentæ 2-fidæ lamellis utrinque ovuliferis. Capsulæ maturæ ad 11^{mm} longæ ala maxima 6^{mm} lata.

Species *B. pinetorum* A. DC. proxima.

Sesisp, Depart. Alta Verapaz, Guat., alt. 3,500^{ft}, Febr. 1886, von Türckheim, no. 885.

Macroscepis pleistantha Donnell Smith.—Setis longis patentibus simul et setulis minimis brunneo-vestita. Foial obovata, sin minus rhomboidea, acuminata, basis cordatæ lobis incumbentibus. Pedicelli plurimi pedunculum aequantes, floribus ebracteatis in umbellas globosas densas petiolos vix superantes congestis. Sepala ovata acuminata corollæ fauces superantia, sinu unoquoque glandula instructo. Corollæ extrorsum glabræ et pallidæ tubus ovoideus, limbi supra papillosi et in sicco fusci lobis rotundis. Coronæ squamæ deltoideæ in apice incurvo truncatæ ad basim connatæ. Retinacula oblongo-ellipsoidea, caudiculis subnullis.

Stems stout, their diameters exceeded by the longer hairs, younger parts villose. Leaves 6–9 × 4–5^{in}, pale beneath, each surface with short, scattered hairs, nerves and margins pilose. Petioles $1\frac{1}{4}$–$1\frac{1}{2}^{in}$ long. Peduncles stout, ebracteate. Pedicels 4–6^{l} long, equaling linear-lanceolate bractlets. Umbels about $1\frac{1}{2}^{in}$ in diameter. Sepals nearly free, $4\frac{3}{4} \times 3\frac{1}{2}^{l}$, reticulately veined, smooth within; glands minute, cylindrical. Tube of corolla 3^{l} high; limb spreading, 9^{l} in diameter, lobed to the middle. Gynostegium a third shorter than tube of corolla, the staminal scales closing the throat, anthers nearly destitute of a terminal membrane. Pollinia obovate-ellipsoid, compressed, vertically pendulous. Ovaries smooth, ovoid, attenuately produced, carinate, stigma flat. Follicles not seen. Moist grounds along river near Mataquescuintla, Depart. S. Rosa, Guat., alt. 4,000^{ft}, Mch. 1894, Heyde & Lux, no. 6,350.

Acalypha Lotsii Donnell Smith.—(§ LEPTOPODÆ Muell. Arg.) Folia ovato-lanceolata in caudam linearem integram producta, basi cordata 5–7-nervia. Spicæ utriusque sexus in ramis non constanter sitæ; spicæ masculinæ inferne laxi-bracteatæ basi bracteis singulis femininis interdum praeditæ, floribus 4–8-nis; spicarum feminarum bracteæ 2–6 dissitæ nonnunquam oppositæ, florentes fere partitæ in segmenta singula terminalia reliquis majora productæ, fructiferæ auctæ laciniis 7–11 elongato-triangularibus usque ad medium inaequaliter incisæ. Calyx 5-partitus. Styli glabri laciniis filiformibus tum pinnato–tum furcato–multifidi.

Shrub 9–12^{ft} high, branches virgate, petioles, nerves and young twigs cano-velutinous, otherwise glabrate. Stipules setaceous, 3–5^{l} long, persistent. Petioles 4–10^{l} long. Leaves $2\frac{1}{2}$–$3\frac{1}{4}^{in}$ × 11–13^{l}, serrated, the interior pair of basal nerves nearly half as long as midrib. Male spikes slender, pubescent, with their one fourth as long peduncle added $1\frac{1}{2}$–$2\frac{1}{2}^{in}$ long; calyx 4-partite, stamens 8. Female spikes glabrous, chiefly twice exceeded by the capillary (1–2^{in} long) peduncle; bracts 1-flowered, in fruit 4–5^{l} in diameter; segments of calyx ovate, acute, ciliate, divisions of style 8–22; capsules cano-pilose, seeds scarcely punctulate.—Indicated as a new species by Dr. John Lotsy, but the time for its description failed him before leaving the Johns Hopkins University for his post as Subdirector of the Botanical Gardens at Buitenzorg, Java. Closely related to *A. leptopoda* Muell. Arg. *ex char.*

Pansamalá, Depart. Alta Verapaz, Guat., alt. 3,800^{ft}, May 1887, von Türckheim, no. 1,242.—Rio Ocosito, Depart. Quezaltenango, Guat., alt. 250^{ft}, Apr. 1892, J. D. S., no. 2,615.—Azagualpa, Depart. S. Rosa, Guat., alt. 2,000^{ft}, June 1892, Heyde & Lux, no, 3,475.—Jumaytepeque, Depart. S. Rosa, Guat., alt. 3,000^{ft}, Sept. 1892, Heyde & Lux, no. 3,839.

Asplenium Donnell-Smithii H. Christ; fronde valde elongata glabra obscure viridi 45^{cm} longa 8–10^{cm} lata, numerosis (30 quoque latere vel pluribus) pinnis alternis instructa; stipite obscure castaneo laevi; pinnis brevissime, ne vix quidem, petiolatis basi inferiori sensim truncatis, basi superiori angulo recto abruptis vel moderate auriculatis 6^{cm} longis basi 8^{mm} ad 1^{cm} latis falcatis horizontaliter patentibus, simpliciter, ad basin rarius furcato-serratis, serratura valde regulari et parallela, dentibus 2^{mm} longis obtusiusculis, pinnis a parte media versus apicem in caudam angustam profunde serratam sensim productis; soris circa 12 quoque latere nervi medii pinnæ, a nervo versus marginem angulo patente (nec valde obliquo) tendentibus, sed dentes marginis non intrantibus latis brunneis sese fere tangentibus parallelis; textura papyraceo-herbacea, nervulis occultis.

Habit of *A. bisectum* Sw., but pinnæ broader (more resembling those of *A. protensum* Schrad.) and not incised-pinnatifid but simply and regularly serrated. Very peculiar by the very close large sori, occupying the undivided part of the pinnæ. Differing from *A. falcatum* and *protensum* by the long cauda of the pinnæ.

Nebáj, Depart. Quiché, Guat., alt. $7{,}000^{ft}$, May 1891, Heyde & Lux, no. 4,678.

ASPLENIUM SHEPHERDI Spreng., var. **bipinnatum** H. Christ.—Differt magnitudine dupla vel tripla typi, pinnis 9^{cm} distantibus, perfecte bipinnatis nec bipinnatifidis, pinnulis pinnarum solutis 1.5 ad 2^{cm} distantibus, margine inferiori decurrentibus, sed interstitio libero. Infra apicem pinnatifidam pinnæ adsunt circiter 8 harum pinnulularum solutarum quoque latere.

Volcan Tecuamburro, Depart. S. Rosa, Guat., alt. $6{,}000^{ft}$, Febr. 1893, Heyde & Lux, no. 4,680.

Nephrodium nigrovenium H. Christ, (§ LASTRÆA); stipitibus pluribus ex apice caudicis oriundis (æque ac in *N. contermino* Desv.) 18^{cm} longis debilibus stramineis, cum rachi pilis subulatis nigris 2 ad 3^{mm} longis vestitis; fronde herbacea glabra obscure viridi infra vix pallidiore triangulari-deltoidea 30^{cm} longa basi 8^{cm} lata versus apicem decrescente, infra apicem pinnatifidam 12 pinnis oppositis quoque latere instructa; pinnis infimis 9^{cm} longis 3^{cm} latis sessilibus lanceolatis acuminatis, in apicem subcaudatam productis, infra proxime versus nervum nigrum, sed non ad nervum ipsum incisis, supra ala mediali 3^{mm} lata remanente; lobis ligulato-falcatis 5^{mm} latis sese fere tangentibus manifeste et regulariter serrato-dentatis acutiusculis, nervulis quoque latere circiter 8 ad 10 distinctis, nigris, simplicibus haud furcatis; soris circa 8 quoque latere exacte mediis inter nervum medialem et marginem lobi nervulis insidentibus, flavescentibus, minutis, 0.5^{mm} latis, indusio nimius fugaci.

A very peculiar species, well distinguished by its feeble size, deltoid shape, black venation and scales of the stipe, regularly denticulated large segments.

San Pedro Sula, Depart. S. Bárbara, Honduras, alt. $1,000^{ft}$, Sept. 1887, C. Thieme, no. 5,646.

Baltimore, Md.

Explanation of Plate XXXVI.

Passiflora porphyretica Mast.—Ramuli floriferi cacumen, et folium magnitudine naturali. Stipula, bractea, sepalum, petalum, necnon flos in sectione mediana verticali visus bis aucti.

W.G.S. del. B. Meisel, Lith. Boston.

PASSIFLORA PORPHYRETICA

BRIEFER ARTICLES.

Mimicry of fungi in insects.—It has long been known to botanists as well as entomologists that certain butterflies belonging to the genus Kallima, although the upper surface of their wings is brilliantly colored, have the under surface of a dull gray or grayish-brown color. A large species often seen in museums, *Kallima Inachis*, always excites admiration when mounted with the wings expanded, from the beautiful and intense blue color of the upper surface. When specimens of this species are mounted so as to show the insect resting on a twig with the wings closely overlapping, the resemblance to a dead leaf attached to the twig is something astonishing. The color is precisely that of a dead leaf and the outline is that of a leaf, for at the lower angle of the wings, they are suddenly narrowed so as to form, in the resting position, a remarkable resemblance to a petiole. Although this mimicry of a leaf is well known, I do not remember to have seen it stated that the mimicry is carried still farther. Recently I was shown some specimens of *Kallima Inachis* from India which had been mounted on plaster by Mr. W. D. Denton. To show how great is the resemblance to a leaf I may say that the first tablet shown was only a few feet from me and I innocently asked why a leaf was mounted with the butterfly; whether it was intended to show the plant it lived upon. To my mortification Mr. Denton said that there was no leaf there; that the tablet showed only the insect in its expanded and its resting postures. On examining the insect more closely, I noticed that the "leaf" appeared to be attacked by a species of *Meliola* and, on turning the specimen so that the light fell obliquely upon it, I noticed patches of a dull olive green color resembling closely the appearance of a leaf on which is growing the young stage of a *Strigula*. In short, the mimicry was carried so far that there was not only an admirable imitation of a leaf but also a mimicry of the parasites which infest leaves in a region like that of which the Kallima is a native. On comparing several specimens, one could see that the spots which mimicked parasites were not identical on different individuals but, while there was a general similarity in all, there was just such a diversity in the disposition and intensity of the spots as one would have expected if he had had before him real leaves attacked by parasites like *Meliola* and *Strigula*. Mr. Scudder informs me that entomologists had noticed the spots on the lower surface of the wings of Kallima and also the fact that their position varied with the individual.

Naturally it would not occur to them as it would to a mycologist that, in this case, the spots represented a case of mimicry carried, one would suppose, to the highest degree of perfection; for, not only is the whole insect remarkably like a leaf, but, to complete the deception, it is spotted with parasites irregularly distributed precisely like those on real leaves. In the specimens I saw it required no exercise of the imagination to interpret the meaning of the spots, but any person accustomed to examine tropical foliicolous parasites would have been struck immediately with the resemblance.—W. G. FARLOW, *Cambridge, Mass.*

Notes on the sumacs.—Rhus Caroliniana, sp. nov. Low but erect, ten to eighteen inches high, with somewhat glaucous branches: petioles terete and smooth; leaflets thirteen to seventeen, oval to oblong-lanceolate, coarsely and irregularly serrate, green above, pale beneath but not glaucous, two to three inches long: flowers polygamous in a close terminal thyrsoid panicle which is broadly ovate in outline, four to six inches long, the lower branches soft villous, otherwise smooth: drupe discoid, clothed with short red hairs, with a smooth stone.—Flowers in the latter part of May and the acid berries ripen in September.—*Plate XXXVII.*

This species was found in the early part of the present summer in middle North Carolina, growing in old fields and low woods. It seems to be decidedly rare and local and in this state has a very limited distribution. It is most closely allied to *R. glabra*, from which it is at once distinguished by the larger leaflets, fewer in number, and the absence of the glaucous-like whitening beneath. The panicle is broad and spreading while that of *R. glabra* is more narrow. *R. Caroliniana* occurs with *R. glabra* and *R. copallina* but attains only a low growth.

It may be of interest to know that *Rhus pumila* Michx. was collected during the past summer in western North Carolina. Chapman's Flora of the Southern States gives the habitat of this species as "pine-barrens, from North Carolina to Georgia." I can find no record, however, of its having been collected in this section and, as I have failed to find it there after a careful examination, have concluded it was an error. The description as given by Dr. Chapman is very good, though the lower limit of the number of leaflets is probably nine instead of eleven. Pursh in his Flora of North America, correctly gives the plant as occurring in "upper Carolina." It was from this section that John Lyon collected the plants which grew in his garden and from which Pursh made his description. This description is similar to that in Chapman's Flora except that the number of the leaflets is not defin-

ASHE on RHUS.

itely limited, merely stated to be "foliis pinnatis multijugis." Lyon avers that he was severely poisoned by handling the plant but it must have been by another plant or he was hypersensitive to rhus poisons. Negro children where *R. pumila* grows eat its berries with the same avidity as those of *R. glabra* or *R. copallina* and experience no symptoms of poisoning.—WILLIAM WILLARD ASHE, *North Carolina Geological Survey.*

Note on Aster.—In the region round about Oberlin, Ohio, the descriptions of *Aster corymbosus* and *Aster macrophyllus*, as given by Dr. Gray, do not hold. They run into each other so decidedly as to make the separation of the two into species of no account. Specimens gathered here in abundance show all grades of combinations between the two, making no end of hybrids.

For instance, the distinction of "leaves thin," and "leaves thickish and rough" does not hold at all. We have specimens with the leaves thin and smooth which can be placed only as macrophyllus. Nor will the differences as to serration hold at all. And this is true of specimens from other regions than northern Ohio. Taper-pointed and abruptly pointed would seem to be good distinctions, but will not hold good. Moreover the times of blooming are such that the two can be seen together side by side, part fulfilling the descriptions of corymbosus and part answering to macrophyllus. No wonder Dr. Gray's diaries show that he was nearly distracted with his Asters.—F. D. KELSEY, *Oberlin, Ohio.*

EDITORIAL.

WITH THIS NUMBER the GAZETTE completes its second decade. Beginning in a very small way, with no assurance of success or special reason for it, it seemed to meet a current need and American botanists accepted it as a convenience. Its birth happened to be timely, for it was just before what may be styled the renascence of American botany, and it shared in the development of its subject. As a consequence, it has become not merely a convenience but a necessity to American botanists. Looking through its twenty volumes one sees that all our botanists have written for it, from Gray and Engelmann down through the lengthening and still living list. It therefore represents well the history of American botany for twenty years. At first finding it difficult to fill its few pages with worthy material, its recent large volumes have been kept within bounds only by careful selection. At first necessarily confined to the region of systematic botany, it seeks now to represent all the multiplying fields of work.

ONE UNFORTUNATE THING in the history of the GAZETTE has been the unavoidable changes in the office of publication. From Hanover to Crawfordsville, Bloomington, and now Madison, it represents the usual shiftings in the experience of western college men, and seems to deserve the characterization of "this migratory publication" given by Jackson in his "Guide," who, by the way, confused places of printing with offices of publication. But it has been fortunate enough in its long continued editorial service to offset the change in its local habitation, and to give it that consistent purpose which makes for development. It has sometimes been remarked that in this development the more formal papers have crowded out those small notes and scraps of information which made the older numbers interesting and useful to many. If this be true, it has come about through failure to receive such material even with constant urging. The departments of "Briefer Articles," "Open Letters," and "Notes and News," all have in view such items as once constituted the whole of the GAZETTE. We have heard that, as a rule, botanists read the GAZETTE in oriental fashion, beginning with the last pages and working through toward the first, and it is far from the intention of its editors to eliminate the more transient and more immediately interesting records of botanical activity.

THIS WRITING is more by way of reminiscence than of promise, but it is proper to refer to the future. In the present condition of botany, to continue in the same way is to retrograde. The GAZETTE proposes to continue its development with the growth of the science and to be a worthy reflex of botanical activity. This will doubtless involve changes in size, in presentation, perhaps in departments. To maintain a strictly scientific journal of high character as a private enterprise has always proved to be difficult, and the fact that the GAZETTE has maintained itself for twenty years and has developed so rapidly testifies both to the devotion of its editors and to the loyal support of botanists. The editors wish that they could do more for less money, but the botanists whom they serve must be asked to share the financial burden. This will explain the gradual increase in subscription price, an increase not at all commensurate with the increase in the scientific value of the journal.

IN CLOSING its twentieth volume, therefore, the GAZETTE assures its readers that still more vigorous effort to make the journal what it should be will testify to waxing rather than waning strength.

* * *

PAINFUL NEWS has just been received of the death of Mr. M. S. Bebb, our well-known authority on the willows. Mr. Bebb died in San Bernardino, California, whither he had gone only November 2d in hope of recovery. A biographical sketch and portrait will appear later.

CURRENT LITERATURE.

The Seaweeds.

So large a part of our courses in general morphology has to do with the algæ that any handy text concerning them is welcome. The ordinary list of "types" has become somewhat stereotyped in text and illustration, and information concerning a broader range of forms would be very useful to such teachers as are not specializing in the group. Mr. George Murray's new book[1] is designed to fill such a place and should be very helpful. A full introduction gives a historical sketch of our knowledge of the group, the division on the basis of color and the relation of colors to distribution in depth, the relation of light and temperature to distribution, agents of distribution, comparison of the floras of different oceans, littoral and pelagic floras and their relation to the sustenance of marine animals, distribution in time, directions for collection, etc. A rather full bibliography is also a very useful feature. Although this is an "introduction" to the study of algæ, it is evident that the student must bring to it a general knowledge of the morphology and terminology of the group. A curious sequence is used, which is said to be for convenience. The *Phaeophyceæ* are first considered; then the *Chlorophyceæ* and *Diatomaceæ;* then the *Rhodophyceæ;* and finally the *Cyanophyceæ.* The account of the *Rhodophyceæ* is based upon the papers of F. Schmitz, and differs from the ordinary classification. As a rule, the illustrations are clear, and many of them are new; while the eight colored plates give a fairly good idea of the coloration. The title "seaweeds" is to be taken literally, for marine forms are chiefly considered, those of the fresh water being referred to only incidentally. The work will prove useful as a reference book in our laboratories, furnishing collateral reading and new illustrations.

Sand Hills of Nebraska.

In changing the plan of its field work the Division of Botany has wisely selected for study certain peculiar regions which may yield definite results to a biological survey in comparatively brief time and at small expense. Mr. Rydberg's work[1] in the "sand hills" region of Nebraska is a good illustration. This region extends over a wide area

[1] MURRAY, GEORGE.—An introduction to the study of seaweeds. Small 8vo. pp. vii+271. col. pl. 8. figs. 88. London and New York: Macmillan & Co. 1895. $1.75.

in the western part of the state, in fact, its eastern limit reaches the center of the state. The "sand hills" change their configuration constantly, and where not held by roots the sand is gradually carried away by the wind, often transforming bared spots into "blowouts." There are four notable "blowout" grasses, which serve to give such stability as there is to the shifting sands, viz: *Calamovilfa longifolia*, *Redfieldia flexuosa*, *Eragrostis tenuis*, and *Muhlenbergia pungens*. In addition to these species, Mr. Rydberg gives a list of about twenty-five others most characteristic. The survey was practically confined to two counties in the heart of the sand hills. The catalogue of species collected is a long one, and contains many interesting notes and critical remarks. There are also descriptions of new varieties, and a new species of *Carduus* is illustrated by a plate.

The economic possibilities of the region are also considered, and in Mr. Rydberg's judgment the only agricultural hope for this region, as well as the neighboring regions which it helps keep dry, is a covering of forest vegetation, which he believes may be possible.

Minor Notices.

VOLUME II of the *Proceedings* of the Iowa Academy of Sciences covering the meeting in 1894 is the first to be published by the state, and it makes a most creditable showing. It contains 225 pages and 22 plates, well printed and in convenient form. The matter is interesting and valuable. It includes seven papers upon botanical subjects: Effects of heat on the germination of corn and smut, F. C. Stewart; Distribution of some weeds in the United States, L. H. Pammel; Structure of the seed-coats of Polygonaceæ, Emma Sirrine; Lichens collected by Dr. C. C. Parry in Wisconsin and Minnesota in 1848, B. Fink; Pollination of cucurbits, L. H. Pammel and Alice M. Beach; and Diseases of plants at Ames, 1894, L. H. Pammel.

[1] RYDBERG, P. A.—Flora of the sand hills of Nebraska. Contributions from the U. S. Nat. Herbarium. **3:** 133–203. 14 S. 1895.

OPEN LETTERS.

Botany at the A. A. A. S.

Every one, I think, will welcome the new movement to compress all the sessions of the American Association for the Advancement of Science into a single week, thus avoiding the Sunday hiatus; and every one should heed the GAZETTE's advice to attend the meetings, for the mutual good of American botany and of the Association. It will also be a good plan, no doubt, to publish a program of section G some time in advance. There is one feature of this program which should be carefully studied, and that is the nature of the papers which are admitted to it. I do not mean that the committee should exercise any censorship over papers, but simply that very many excellent papers are not of a nature to be read at a public gathering of botanists. Papers of mere technical interest should be published in some medium but should not be read. Surely, several of the papers which were read at Springfield were of no interest, save to the author, and yet they were valuable contributions to science and, as such, should have found their way into print without having been presented before section G. A technical article upon Carex, for example, would be intolerable in a general gathering of botanists, and yet it is conceivable that it might be worth putting into print for the delectation of the two or three, or fewer, persons in the country who care anything about the subject.

It should be true of every paper which comes before the section that at least half the members will be interested in the subject and be able to discuss it. Good writings upon any fundamental phenomena or structures of plants, upon philosophical questions, geographical matters, distribution, the latest advances and methods, and a score of other subjects, will always arouse interest and do good. Let the papers have breadth and life in them, and the meetings will abound in enthusiasm.—L. H. BAILEY, *Ithaca, N. Y.*

Botanical terminology.

In the October number of the *Bulletin* of the Torrey Botanical Club a new phase of its tendency to innovation appears, indicating that changes similar to those in botanical nomenclature are also to be made in botanical terminology.

Mr. Nash, in an article upon new or noteworthy American grasses, has changed the definite and well-known terms, "glume" and "palet," to the very loose and indefinite word "scale," and uses this freely in the diagnoses. Instead of the old terms, "empty glumes," "flowering glume" and "palet," Mr. Nash designates these organs as "outer or inner scales," or "scale 1, 2, 3, 4, etc."

We venture to ask whether there is really any reason for making such change, since these organs have always been known as the glumes and the palet. It seems very surprising indeed that Mr. Nash in describing grasses has not been aware of the morphological dissimilarity of these organs. The term "scale" is used to designate the flat imbricate bracts in inflorescences of various families, e. g., Cyperaceæ, Xyrideæ, Compositæ, etc., also the scale-like leaves of underground rhizomes in general, various nectaries, the lodiculi of grasses, etc.: but the carinate glumes and the bicarinate palet of the grasses have so far not been called scales, since their shape as a rule is too different, and the indiscriminate use of this term could lead only to confusion.

It would be highly desirable if the Torrey *Bulletin* would compel its contributors to conform to the well-known terminology of scientific botany. If not, the terminology of American botany will soon become as chaotic as its nomenclature.—THEO. HOLM, *Washington, D. C.*

NOTES AND NEWS.

DR. H. BAILLON died suddenly in Paris on the 18th of July in his 68th year.

THE LINNEAN SOCIETY'S gold medal has this year been awarded to Prof. Dr. Ferdinand Cohn of Breslau.

DR. J. VESQUE, the eminent French botanist, died at Vincennes near Paris on the 25th of July in his 47th year.

MR. JOHN DONNELL SMITH intends leaving Baltimore early in January for a visit to Nicaragua in order to continue his researches on the Central American flora.

IN HIS series of papers, in *Journal de Botanique*, on new plants of western China, M. A. Frauchet has just described twenty-one new species of *Rhododendron*.

KALMIA CUNEATA, lost after Michaux's original discovery, rediscovered by Mr. W. W. Ashe, of the Geological Survey of North Carolina, is fully described in *Garden and Forest* (Oct. 30).

DR. S. NAWASCHIN announces that *Juglans cinerea* affords a new instance of chalazal fertilization and must therefore, with Casuarineæ and Betulaceæ, be ranked among the Chalazogamæ.—Bot. Cent. 63: 353. 25 S. 1895.

DR. FELIX HOPPE-SEYLER, professor of physiological chemistry in the University of Strassburg, died on August 11th, at the age of 70 years. He did much to advance the knowledge of vegetable physiology upon the chemical side.

THE DIVISION OF FORESTRY has reprinted in pamphlet form, from the last Yearbook of the Department, Mr. Fernow's paper entitled "Forestry for farmers." It will be of great service to all those interested in the proper handling of forests.

THE SPECIAL APPARATUS for bacteriological sampling of well waters described by Prof. H. L. Bolley in a paper before the Botanical Club of the A. A. A. S., in August last, is illustrated, and the paper given in full in the *Amer. Micros. Journal* for October.

MR. N. M. GLATFELTER discusses *Salix Wardi* Bebb in *Science* (Nov. 1). He has had extensive field experience with it and gives additional information as to its relationships and range. A careful tabulated comparison with *S. nigra* and *S. amygdaloides* sets out the species strongly.

THE SIXTH, seventh and eighth issues of Lloyd's "Photogravures of American Fungi" comprise Coprinus comatus, showing young and old plants; Crucibulum vulgare, growing on a piece of rotten straw mat; and Urnula Craterium on fallen limb. The high quality of the former issues is maintained.

IN CONTINUING his studies of the African *Asclepiadaceæ*, appearing in the *Journal of Botany*, Mr. R. Schlechter has described (Nov.) two more new genera, *Symphytonema* and *Glossostelma*, both illustrated. He also describes seven new species, and follows Baillon in merging *Gomphocarpus* with *Asclepias.*

WEED BULLETINS have been issued by the Experiment Stations of Kansas (no. 52), giving a list and distribution over the state by counties; of Ohio (no. 59) giving methods for destruction of weeds along roadsides; and of Iowa (no. 28 in part) giving an account of prickly lettuce (Lactuca scariola) and buffalo-bur (Solanum rostratum).

THE CONTRIBUTIONS to the Queensland (Australian) flora, by F. M. Bailey, the colonial botanist, has now reached the eleventh number. The last issue (dated July, 1895), contains descriptions of the fresh-water algæ, about ninety species, and of the marine algæ, about twenty species, with very full notes, and seventeen plates of illustrations.

THE BOTANIC GARDEN at the Agricultural College of Michigan is pleasantly described by Professor Beal in *Garden and Forest* (8: 303 and 322). The garden covers three acres, and, although most of the work is done by one man, yet it contains many interesting features, and is one of the few notable botanic gardens of the United States.

THE SUGGESTION has been made that the University of Pennsylvania, in connection with the museum buildings which are contemplated, lay out an ethno-botanic garden which shall serve for the instruction of the public as to aboriginal American plants, and shall possess, also, scientific value by reason of its rarity.—*Phila. Evening Telegraph.*

PROFESSOR H. HELLRIEGEL, director of the Agricultural Experiment Station, died at Bernberg, Germany, on Sept. 4th, at the age of 64 years. His investigations upon the fixation of nitrogen by Leguminosæ, and allied subjects, are of the highest value. Probably his best known work is "Untersuchungen über die Stickstoffnahrung der Gramineen und Leguminoseen," published in connection with Dr. H. Wilfarth in 1888.

IN THE *Annuario del R. Instituo Botanico di Roma*, which is edited by Professor Pirotta, the sixth volume opens with the following papers: The formation of the starch grain, by C. Acqua; The germination and certain structures of *Keteleeria Fortunei* (a coniferous plant), by Pirotta; Some plants new to the Roman flora, E. Chiovenda; Contributions to the flora of eastern Africa, by C. Avetta, a list of 202 species, several of which are new.

IN *Flora* (80: 303) Herr H. Glück combats Bower's theory of the sporophyte being derived by the sterilization of sporogenous tissue. The point taken up is the foliage leaf of pteridophytes, which, Glück maintains, has nothing whatever in common with the sporogonium of mosses.

UNDER THE TITLE "Education and research in agriculture in the United States," the U. S. Department of Agriculture has published a pamphlet of thirty-six pages, prepared by Mr. A. C. True, giving a clear historical account of the beginnings, advancement and present status of the higher intellectual forms of agricultural knowledge.

DR. CHAPMAN'S HERBARIUM of southern plants, upon which is based his *Flora of the Southern States*, has been purchased by Mr. George W. Vanderbilt, and will serve as a nucleus of the scientific collections which he is establishing on his estate at Biltmore, in North Carolina, in connection with an arboretum and systematically managed forest. —*Garden and Forest.*

M. VUILLEMIN has described some very curious ovules of *Begonia erecta*. They "are transformed into organs, the upper part of which has the color and structure of petals, the lower part the essential structure of a carpel" (*Jour. Roy. Micr. Soc.*). He seems to think that such a monstrosity shows that there is no essential difference between an axial and an appendicular organ.

A EUROPEAN BOTANIST, whose plant preparations are known everywhere, is upon the point of losing his eyesight, this misfortune rendering him absolutely helpless. European journals have been interesting themselves in his case, and the BOTANICAL GAZETTE is glad to present this notice to its readers and to act as a channel of communication for American botanists who desire to help in this case.

THE ENERGY of the living protoplasm is treated in a series of most interesting and comprehensive articles by Dr. Oscar Loew, professor of agricultural chemistry in the Imperial University of Japan, which are now appearing in the *Bulletin* of the College of Agriculture. They are written in English. The same publication contains many other articles upon chemico-physiological subjects, for the most part the result of original investigations.

GRAPE DISEASES of the Pacific Coast are treated by Newton B. Pierce in Farmer's Bulletin no. 30 from the U. S. Department of Agriculture (pp. 8, figs. 3). The diseases described are "California vine disease," known since 1884, devastated 30,000 acres of vineyards and caused a loss of $20,000,000, the powdery mildew, known since 1860 and coulure. The last causes the flowers and fruit to fall from the bunches, and is due to a variety of causes.

IN *Bulletin de l' Herbier Boissier* (Oct.), J. Freyn discusses a group of oriental Hieraciums; Nicolas Alboff giyes the results of an extended study of the alpine flora of the limestones of the western Transcaucasus, a peculiar and uniform region fully deserving careful biological observation; R. Chodat describes twelve new species of South American Polygalaceæ, two of which form a new subgenus (*Monninopsis*) of *Monnina;* and Olga Tchouproff discusses the anatomy of *Acanthaceæ.*

THE BULLETIN of the botanical department of the Public Gardens of Jamaica, published at Kingston, contains much valuable information to tropical cultivators and others interested in tropical vegetation. The number for September discusses the essential oils of orange, cultivation of cocoa and cocoa-nut, and other economic topics. It also includes a continuation of the synoptical list of Jamaica ferns, four species of Aspidium being treated.

A BRONZE BUST of Robert Brown has been placed as a memorial "in a niche in front of the house in which he was born," at Montrose. The bust is the gift of Miss Paton, a kinswoman of Robert Brown. The reputation of this botanist was almost unique, the foundation for it being laid in his four years of exploration in Australia, and the wealth of strange types that fell to his lot to study. Several botanists made addresses at the unveiling, and all testified "to the great work of the greatest British botanist."—*Gardener's Chronicle* (Oct. 26).

BULLETINS HAVE BEEN ISSUED from the Experiment Stations upon the following subjects: Poisoning from cowbane, by L. H. Pammel (Iowa no. 29 in part), an excellent account of the effects upon man and the domestic animals of eating the fleshy roots of Cicuta maculata; Crimson clover and other topics, by A. A. Crozier (Mich. no. 125), largely treated from the cultivator's standpoint; Native trees and shrubs, by Thos. A. Williams (S. D. no. 43), enumerates 117 ligneous plants and gives a brief description and the distribution over the state.

DR. J. W. HARSHBERGER has in preparation an account of the botanists of Philadelphia and their work, to show that American botany owes much to Philadelphians for its full development. The book will be an impartial discussion of the work of Philadelphia botanists. It will consist of an historical introduction, describing the rise and progress of botany in and near Philadelphia, to be followed by biographical sketches of those botanists who have prominently molded botanical thought as collectors or investigators. Portraits of all botanists included will appear. Any who can contribute any information about Philadelphia botanists are requested to communicate with the author.

BY INCREASING THE AMOUNT of nourishment Kenjiro Fujii (*Tokyo Bot. Mag.* 9: 271–275) has been able to produce female and hermaphrodite[1] flowers in *Pinus densiflora* which would otherwise have been male flowers. The method is to cut away the end of the shoot, or to remove all side shoots, or both, and thus force most of the store of nourishment into the growth of the flowers. He is led to believe that the sex of the flower is undetermined up to a certain stage of growth, and that it is in part determined by the amount of nourishment. The article is printed in English.

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[1] We use the sex terms as in the article, though it must be remembered that they are not really applicable.

IN THE *Journal of Botany*, for October, Mr. A. B. Rendle continues his description of Elliot's tropical African Orchids; Mr. R. Schlechter begins an enumeration of the Asclepiadaceæ of the same collector, describing a new genus (*Pleurostelma*); and Mr. D. Prain continues his account of the genus Argemone.

THE LEMMON HERBARIUM has been removed to a commodious building belonging to Mr. J. G. Lemmon in North Temescal, a beautiful suburb of Oakland, California, on the electric line between that city and Berkeley. Mr. Lemmon's twenty years of familiarity with Pacific coast plants, his large collection, and the library facilities at Oakland, Berkeley, and San Francisco ought to make possible some valuable monographs of western spermaphytes.

IN THE ANNUAL REPORT of the Rhode Island Experiment Station for 1894, L. F. Kinney discusses the fungous parasites of the apple and pear (pp. 183–198), with nineteen well printed illustrations. In the report of the New Jersey Experiment Station for the same year, B. D. Halsted writes upon a variety of subjects (pp. 273–419). Fungicides were tried upon cabbages, tomatoes, potatoes and beans. A large part of the space is devoted to injurious fungi of cultivated plants. Weeds receive some attention, and the poisonous plants of New Jersey are reported upon. Several articles are reprinted from journals. There is abundant illustration, but the cuts are very indifferently printed. Like the former reports of this indefatigable observer and writer, this one contains a large amount of important matter from both the scientific and economic standpoints.

POISONING OF CATTLE by eating corn stalks, which contained an excessive amount of nitrate of potash, has been reported from Kansas (*Bull. Kans. Exper. Sta. no.* 49). The plants had taken up so much of this substance from the soil, that in the partly dry stalks examined, "beneath the leaf sheath which surrounds the stalk just above the joints the nitrate had crystallized in fine white crystals which resembled a white mold, but was easily recognized by tasting with the tongue. Around and in the cut ends of the stalks were solid masses of almost pure potassium nitrate. If a stalk was cut in two and tapped lightly upon a table, the crystals of potassium nitrate would be jarred loose and fall as a fine powder. Upon splitting a stalk, the crystals in the pith could easily be seen with the unaided eye. On lighting a bit of stalk, it would deflagrate, burning rapidly like the fuse of a fire cracker. A chemical examination gave 18.8 per cent. of the dry weight of the stalk as nitrate of potash." This corn was raised on about one-eighth of an acre, which had for some time previously been used as a hog pasture. The corn had not matured owing to dry weather.

PROFESSOR W. C. WILLIAMSON died in London on June 23d, at the age of 78 years. He is best known by his series of important memoirs upon paleobotanical subjects, published mostly in the Proceedings of the Royal Society. From 1851 to 1892 he was professor of natural history and geology in Owens College, Manchester. At the latter date he laid aside his collegiate duties and removed to London to devote himself exclusively to his special field of study. Professor

Williamson had a sympathetic and attractive personality, which endeared him to all who had the privilege of his acquaintance. It was while his guests, that the picture, so well known in this country as the Manchester group of botanists, was taken. Beside Professor Williamson, who is in the center of the picture, sits Dr. Asa Gray, and no two men in the group looked more alike, or had more endearing qualities of mind and heart. His home in Manchester looked out at the rear upon an enclosure in which were grown in great thriftiness quite a large number of flowering plants, both for beauty and for botanical interest. A small greenhouse was fairly packed with orchids and other plants. Although a good gardener was employed, the direction of the work and part of the actual labor was carried on by Professor Williamson, who gave much of his leisure time to its care, and obtained from it no small degree of enjoyment.

A notice of his life, and of his contributions to science, written by Prof. L. F. Ward, has been published in *Science* for August 9th.

WHILE MANY plants are known to owe their dissemination to animals, especially birds and insects, only a few have so far been observed to become distributed by snails and toads. Voglino has lately published a very interesting article[1] upon this subject, and he demonstrates the fact that certain fungi (*Agaricineæ*) become distributed by snails and toads. It seems even, according to his observations, as if there is a connection between the occurrence of such fungi in places where these animals abound. It was, at least, the case in some pine woods in Carara and Piedmont in Italy. An examination of the stomach-contents of the snails showed the presence of spores of various species of Tricholoma, Lactarius, Russula, Amanita and others. The spores were observed to have begun their germination while still inclosed in the animal, and a culture of the excrements of various snails produced a large number of germinating spores of these fungi. The same was also observed by examining the stomach-contents of toads, in which, especially, spores of *Russula* and *Lactarius* were abundant. The author supposes that the spores of these fungi obtain the most favorable conditions for their germination by passing through the digestive can alof a snail or a toad, thus their dissemination seems closely connected with the presence of these animals.—T. H.

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[1] Voglino, P. Richerche intorno all'azione delle lumacbe e dei rospi sviluppo di alcuni Agaricini. Nuovo Giornale bot. Ital. Nuova serie. **2:** 181–185. Ap. 1895.

GENERAL INDEX.

The more important classified entries will be found under the following heads: Diseases, Floras, Host Plants, Journals, Necrology, Nomenclature, Personals, Reviews.

Names of synonyms are printed in *Italics;* names of new species, etc., in **bold face.**

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