Rhizosolenia sp. ?

Stephanogonia (*Mastogonia*) *actinoptychus* Ehr., rare.

Stephanopyxis appendiculata Ehr.

S. corona (Ehr.) Grun.

S. turris (Grev.) Ralfs, rare.

Stictodiscus Trunanii Witt. ?, very rare, 90 ft. This form differs from that figured by Truan and Witt. (Die Diat. der Polycyst. von Jeremie in Hayti, *pl. 4. figs. 23 & 24*), inasmuch as the rim is less definite and the outline slightly irregular. Only one imperfect specimen was found. It appears to form another link between the continental and insular deposits.

Triceratium condecorum Ehr., rare, 90 ft.

T. Kainii E. A. Schultze, rare, 120 ft.

T. semicirculare Brightw.=*Euodia Brightwellii* Ralfs.

T. spinosum (Ehr.) Bail.

New Species of Parasitic Fungi.

By S. M. Tracy and F. S. Earle.

[Type specimens in the herbaria of the authors, of the U. S. Department of Agriculture, of Rutgers, Harvard and Columbia Colleges.]

Puccinia notabilis n. sp. III. Amphigenous; sori black, confluent, forming small hemispherical or irregular masses on the bracts and petioles or involving the larger stems, forming fusiform black gall-like swellings two or three times their diameter and 3–4 cm. in length; teleutospores uniformly oval and obtusely rounded, slightly constricted, epispore smooth, thickened at the apex, 55–60 by 30–33 μ; pedicel hyaline or slightly tinted, very long and flexuous, 225–275 μ.

On Arrow-wood (*Pluchea borealis ?*) Rio Penasco, New Mexico, January, 1895.

Puccinia Paspali n. sp. II. Usually hypophyllous, sometimes amphigenous; sori linear, sometimes confluent, dark brown; uredospores globose or obovate, very abundantly and sharply echinulate, brown, 24 by 25–30 μ. III. Sori linear, darker than te uredo sori, usually on the leaf sheaths; teleutospores irregular, 35 by 27 to 30 by 35 μ, usually oval, much constricted, with the slender nearly hyaline pedicel attached obliquely to one side of the lower end, often orbicular with the septum vertical and the

pedicel attached either to the septum or near it, and the epispore of both cells distinctly thickened at the apex.

On *Paspalum virgatum*, New Orleans, La., November, 1894.

USTILAGO CRUS-GALLI n. sp. Involving the panicles and upper nodes, making the panicles abortive and forming pustules sometimes 1 cm. in diameter at the nodes; spore masses powdery, black, at first covered by a gray membrane; spores oval or subglobose, fuscous, sharply echinulate, 9–10 by 11–13 μ.

On *Panicum Crus-galli*, Salt Lake City, Utah, August, 1887.

This seems to approach *U. Maydis*, but the spores, though equally echinulate, are uniformly larger and more elongated.

USTILAGO TONGLINENSIS n. sp. Spore masses infesting the ovaries and causing the glumes to open widely at maturity, black; spores globose, dark brown, sharply and thickly echinulate, 9–11 μ.

On *Ischaemum ciliare*, Tonglin, Singapore. H. N. Ridley.

USTILAGO ORNATA n. sp. Infesting the ovaries. Spore masses black, pulverulent, 20–30 mm. in diameter; spores subglobose, very thickly beset with strong and prominent echinulations which give the spore a burr-like appearance, 12–12 by 15 μ. Panicles bearing affected ovaries always remain partially enclosed within the sheath of the upper leaf.

On *Leptochloa mucronata*, Starkville, Miss., November, 1894.

USTILAGO PERTUSA n. sp. Infesting the ovaries; spore masses hard and compact, black, finally pulvinate; spores small, globose, epispore covered with prominent irregular verrucose projections, 5–7 μ.

On *Setaria macrochaeta*, Queensland. F. M. Bailey, 1890.

USTILAGO PUSTULATA n. sp. Infesting the ovaries, or forming rounded bullate swellings which often surround the entire stem and branches of the panicle, or form irregular distortions on the leaves and sheaths; spore masses dark brown, long covered by a stramineous membrane which is a distortion of the tissues of the host, 25–75 mm. in diameter; spores dark brown or fuscous, subglobose or oval, cell-wall very thin, slightly echinulate, 7.5 to 9 μ., or 7 by 9 μ.

On *Panicum proliferum*, Starkville, Miss., October, 1894.

DIMEROSPORIUM MAGNOLIAE n. sp. Epiphyllous, on small indefinite areas; mycelium of dark brown irregular branching and septate hyphae; conidia clavate, dark colored, 4–5-septate, 7–8 by 45–55 μ; perithecia depressed-hemispherical, black, usually in clusters of 5 to 10, astomous, 50–100 μ; asci numerous, broadly oval or obovate, 8-spored, 35–40 by 45–50 μ, paraphysate; paraphyses thread-like, colored towards the tips; sporidia biseriate, at

first hyaline, dark fuliginous when mature, obovate, 1-septate, constricted, 9-10 by 20-23 μ.

On living leaves of *Magnolia Virginiana*, Ocean Springs, Miss., May, 1894.

ASTERIDIUM ILLICII n. sp. Hypophyllous; mycelium none; perithecia black, scattered, orbicular, aplanate, membranaceous, cellular, not radiant, fragile, wrinkled, 200–400 μ; asci numerous, suborbicular, 8-spored, 30–40 μ; sporidia subpyriform, often curved, granular, colorless, at first uniseptate, becoming 3-septate at maturity.

On living leaves of *Illicium Floridanum*, Ocean Springs and Biloxi, Miss., March, 1889.

LAESTADIA ILLICIICOLA n. sp. Amphigenous, occupying large irregular brownish subarid definitely limited areas, usually involving the apical half of the leaf; perithecia very numerous, scattered, erumpent, more abundant on the upper surface, black, membranaceous, suborbicular or lenticular, obscurely ostiolate, finally collapsing; asci without paraphyses, clavate, stipitate, thickened at the apex, 40–50 by 10–12 μ; sporidia ovoid or fusiform, continuous, hyaline, granular, about 15 by 5 μ.

On living leaves of *Illicium Floridanum*, Ocean Springs, Miss., March, 1892.

SPHAERELLA ANDROMEDAE n. sp. Hypophyllous; spots none; perithecia abundant, scattered, often covering the entire lower surface of the leaf, black, erumpent, ostiolate, at length collapsing; asci obovate, somewhat thickened at the apex; sporidia oval, hyaline, uniseptate, cells about equal; 7–8 by 2.5–3 μ.

On living leaves of *Pieris nitida*, Ocean Springs, Miss., March, 1888.

LEMBOSIA ANGUSTIFORMIS n. sp. Epiphyllous, on raised brown irregularly stellate blisters; mycelium scant; perithecia black, long and narrow, often flexuous, seldom branched, 60–80 by 175–300 μ; subiculum reduced to a few short flexuous slightly fuscous branching threads; asci broadly oval, about 15 by 18 μ; sporidia obovate, somewhat unequally uniseptate, constricted, at first hyaline, becoming light fuliginous, 8–10 by 4–5 μ.

On *Ilex coriacea*, Ocean Springs, Miss., May, 1894; Biloxi, Miss., July, 1894.

This differs widely from the following in gross appearance on the leaf, in the narrower perithecia, less conspicuous subiculum and smaller asci and sporidia.

LEMBOSIA PRINOIDES n. sp. Epiphyllous, on orbicular pallid

spots; mycelium scant, brown; perithecia scattered, black, subcarbonaceous, fimbriate-margined, elliptical, subacute, often forking, 200–350 by 120–150 μ; subiculum of dark brown irregular nodular usually continuous and branching brittle threads; asci ovate, 8-spored, 30–35 by 15–18 μ; sporidia elliptical, unequally uniseptate, somewhat constricted, subhyaline, becoming fuliginous, 10–15 by 4–5 μ.

On *Ilex coriacea*, Biloxi, Miss., July, 1893.

LEMBOSIA ILLICIICOLA n. sp. Epiphyllous, on large light brown orbicular or irregular areas; perithecia numerous, superficial, carbonaceous, usually linear and strict, occasionally triangularly stellate, 100 by 300–400 μ; subiculum of light brown flexuous transparent continuous variously branching and anastomosing threads; asci very numerous, oval or ovate, 8-spored, 25–30 by 12 μ; sporidia oval, uniseptate, slightly constricted, ends obtusely rounded, hyaline, at length slightly colored, 8–10 by by 3–4 μ.

On *Illicium Floridanum* with *Asteridium Illicii*, Ocean Springs, Miss., March, 1889.

VERMICULARIA STACHYDIS n. sp. Perithecia scattered, subsuperficial; setae somewhat floccose and nodular, septate, olivaceous, paler towards the tips, which are obtuse and slightly enlarged; conidia falcate, attenuate at each end but without evident basidia, guttate, at length faintly 4–5-septate, 35–40 by 3–4 μ.

On dead stems of *Stachys affinis*, Starkville, Miss., October, 1893.

This differs from other described species in the larger, at length several-septate conidia, and the weak rather light colored setae with swollen tips.

DIPLODIA MINUTA n. sp. Scattered over indeterminate whitened areas; perithecia erumpent, small, 90–120 μ, membranaceous, smooth, ostiolate; sporules minute, oval, uniseptate, not constricted, light yellow, 6–8 by 3–4 μ.

On living stems of *Tecoma radicans*, with *Pestalozzia breviaristata*, Starkville, Miss., March, 1895.

DIPLODIA SASSAFRAS n. sp. Perithecia very numerous over large areas, black, hemispherical, erumpent, finally opening by an irregular fissure; sporules numerous, ovate, fuscous or nearly black, with a very distinct hyaline septum near the smaller end, 13–14 by 5–6 μ.

On living twigs and branches of *Sassafras*, Starkville, Miss., April, 1894.

HENDERSONIA TAPHRINICOLA n. sp. Epiphyllous, on white bordered spots. Perithecia scattered, black, erumpent, at length collapsing; conidia truncate, cylindrical, fuliginous, 2–septate, constricted at the septa, 12–14 by 4–5 μ.

On old whitened blisters of *Taphrina* on *Quercus Virginiana*, Ocean Springs, Miss., February, 1887.

PESTALOZZIA CLIFTONIAE n. sp. Epiphyllous, on orbicular arid brown-bordered spots. Acervuli scattered, bursting through the dried epidermis; conidia obovate, sometimes curved, 4-septate, septa often oblique, three medial cells fuliginous, the upper two dark and opaque, the lower one paler, basal cell colorless, small, short, acute, abruptly contracted to the short stipe; apical cell reduced to a short colorless apiculus bearing the three widely divirgent setae, 16–18 by 8 μ; setae 12–14 μ.

On living leaves of *Cliftonia ligustrina*, Ocean Springs, Miss., November, 1893.

PESTALOZZIA BREVIARISTATA n. sp. Acervuli scattered over indefinite whitened areas, black, at length collapsing; conidia curved, elliptical, 5–septate, apical and basal cells colorless, medial cells fuscous, septa often diagonal, 25–27 by 7–8 μ; stipe hyaline, half the length of the conidium, somewhat swollen at the base, often deciduous; arista single, strongly oblique, thickened, scarcely one-fourth the length of the conidium.

On living stems of *Tecoma radicans* with *Diplodia minuta*, Starkville, Miss., March, 1895.

SCOLECOTRICHUM PUNCTULATUM n. sp. Amphigenous; spots indefinite; hyphae in small caespitose clusters, irregularly flexuous and nodular, olivaceous, 2–3-septate, 60–70 by 5–6 μ; conidia oval or oblong, ends obtusely rounded, fuscous, epispore distinctl granulose or punctulate, typically uniseptate but often continuous, and occasionally 3-septate, 15–20 by 6–8 μ.

On *Iris pabularia*, Starkville, Miss., January, 1894.

CERCOSPORA FLEXUOSA n. sp. Forming large indefinite effused patches on the under side of the leaf. Hyphae ferruginous, irregularly flexuous throughout, sometimes branched, many-septate, denticulate, 75–150 by 4–5 μ; conidia obclavate, fuscous, 2–6, 3–4-septate, not constricted, 20–30 by 4–5 μ.

On leaves of *Diospyros Virginiana*, Biloxi, Miss., July, 1892, and Ocean Springs, Miss., October, 1889.

This differs from *C. Diospyri* (Thum.) Cke. in its septate hyphae and much longer spores, and from other *Cercosporas* reported on the same host in the absence of definite spots.

CERCOSPORA GRAMINICOLA n. sp. Spots none; amphigenous and most abundant on the midvein; hyphae caespitose, straight or somewhat flexuous, fuscous, 2–3-septate, 75–100 by 4–5 μ; conidia clavate, continuous when young but finally becoming 1–3-septate, fuscous, 35–40 by 7.5–10 μ.

On languishing leaves of *Phleum pratense*, Starkville, Miss., November, 1894.

CERCOSPORA HIBISCI n. sp. Hypophyllous, on large indeterminate areas; hyphae fuliginous, clustered, somewhat irregular, once or twice septate near the base, 25–40 μ; conidia obclavate, somewhat curved, hyaline, guttulate, at length faintly 3–5-septate, 40–60 by 3–4 μ.

On living leaves of *Hibiscus esculentus*, New Orleans, La., November, 1894.

CERCOSPORA MARITIMA n. sp. Amphigenous; not forming definite spots, but densely effused over considerable dark-colored areas; hyphae fasciculate, mostly straight, olive brown, 5–6–septate, often swollen at the septa, 40–100 by 4–6 μ: conidia paler, elongated, straight or slightly curved, mostly uniseptate, the upper cell shorter and broader than the lower, 50–60 by 5–7 μ.

On *Croton maritimum*, Horn Island, Miss., March, 1892.

CERCOSPORA MISSISSIPPIENSIS n. sp. Amphigenous, but more abundant on the under side of the leaf. Spots small, brownish, irregular, usually bounded by the veins, surrounded by an irregular raised and darker border having a pallid outer margin; hyphae divergent, irregularly floccose, nodular, usually uniseptate above the somewhat bulbous base, 60–70 by 5 μ; conidia fuscous, narrowly clavate, tapering from the rather obtuse apex to the attenuated filiform nearly hyaline base, 4–8 or more septate, 75–150 by 4–5 μ.

On *Smilax glauca*, and *S. rotundifolia*, Starkville, Miss., November, 1893.

TETRAPLOA DIVERGENS n. sp. In black irregularly linear masses; conidia broadly oval, dark-fuliginous, 12-14 by 8-9 μ, quarternately divided, each division usually 2-septate, and terminated by an obtuse semi-transparent continuous divergent horn-like projection, 4-5 μ in length.

On living or languishing leaves of *Panicum agrostidiforme*, Starkville, Miss., October, 1894.

The Systematic Botany of North America.

The Board of Editors of the "Systematic Botany of North America" announce the following arrangements for the monographing of groups thus far decided on. Other assignments will be reported as made. 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.

MYXOMYCETES: Mr. O. F. Cook, Huntington, N. Y. (at present abroad).

SCHIZOMYCETES: Prof. H. L. Russell, University of Wisconsin, Madison, Wis.

CHLOROPHYCEAE: 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.

TAPHRINEAE: Prof. Atkinson.

HELVELLINEAE: Prof. Lucien M. Underwood, Greencastle, Ind.

PEZIZINEAE, PHACIDINEAE: Mr. Ellis J. Durand, Cornell University.

FUNGI IMPERFECTI: Prof. Byron D. Halsted, Rutgers College, and Mr. J. B. Ellis, Newfield, N. J.

USTILAGINEAE: Prof. Halsted.

UREDINEAE: Prof. J. C. Arthur, La Fayette, Ind.

POLYPORINEAE: Prof. Underwood.

BOLETINEAE, AGARICINEAE: 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, New York City; *Pleurocarpi:* Prof. C. R. Barnes, University of Wisconsin; *Sphagnaceae:* Mr. John K. Small, Columbia College, New York City.

PTERIDOPHYTA: Prof. Underwood.

TYPHACEAE, SPARGANIACEAE, NAIDACEAE, JUNCAGINACEAE: Manuscript of the late Dr. Thos. Morong.

ALISMACEAE: Mr. Jared G. Smith, U. S. Department of Agriculture.

HYDROCHARITACEAE: Manuscript of Dr. Morong.

GRAMINEAE: In charge of Prof. F. Lamson-Scribner, U. S. Department of Agriculture.

CYPERACEAE: Prof. L. H. Bailey, Cornell University, and Prof. N. L. Britton, Columbia College.

ARACEAE: Manuscript of Dr. Morong.

LEMNACEAE: Mr. E. P. Sheldon, University of Minnesota, Minneapolis, Minn.

ERIOCAULACEAE: Manuscript of Dr. Morong.

COMMELINACEAE: Mr. J. N. Rose, U. S. Department of Agriculture.

JUNCACEAE: Mr. F. V. Coville, U. S. Department of Agriculture.

LILIACEAE: Mr J. N. Rose.

SMILACEAE: Manuscript of Dr. Morong.

DIOSCOREACEAE: Prof. A. S. Hitchcock, Kansas Agricultural College, Manhattan, Kansas.

SAURURACEAE, PIPERACEAE, CASUARINACEAE: Mr. T. H. Kearney, Jr., U. S. Department of Agriculture.

JUGLANDACEAE: Prof. N. L. 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, Columbia College.

CHENOPODIACEAE: Mr. Willis L. Jepson, University of California, Berkeley, Cal.

AMARANTHACEAE: Messrs. E. B. Uline and W. L. Bray, Lake Forest University, Lake Forest, Ill.

PHYTOLACCACEAE: Prof. A. S. Hitchcock, Kansas Agricultural College.

PORTULACACEAE: Mr. Jepson.

NYMPHEACEAE: Prof. Chas. A. Davis, Alma College, Alma, Mich.

RANUNCULACEAE: Prof. N. L. Britton.

MENISPERMACEAE: Prof. A. S. Hitchcock.

CALYCANTHACEAE: Mr. T. H. Kearney, Jr.

GERANIACEAE, OXALIDACEAE, LINACEAE: Prof. Wm. Trelease.

MALPIGHIACEAE, ZYGOPHYLLACEAE, RUTACEAE: Miss Anna M. Vail, Columbia College, New York City.

SIMARUBACEAE, BURSERACEAE, MELIACEAE: Mr. Geo. B. 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. Trelease.

RHAMNACEAE: Mr. Willis L. Jepson.

VITACEAE: Prof. L. H. Bailey.

LOASACEAE: Dr Wm. E. Wheelock.

CACTACEAE: President Coulter.

THYMELEACEAE, ELEAGNACEAE: Prof. Hitchcock.

HALORACEAE: 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, U. S. Department of Agriculture.

MYRSINACEAE, PRIMULACEAE, PLUMBAGINACEAE, SAPOTACEAE, EBENACEAE, SYMPLOCACEAE, STYRACACEAE, OLEACEAE, LOGANIACEAE: Mr. John K. Small, Columbia College.

GENTIANACEAE: Mr. Chas. L. Pollard, U. S. Department of Agriculture.

BORAGINACEAE: Prof. Edward L. Greene, University of California.

VERBENACEAE: Prof. A. S. Hitchcock.

SOLANACEAE, SCROPULARIACEAE: President Coulter.

CICHORIACEAE, COMPOSITAE: Prof. Greene (*Aster* and *Solidago* by Prof. Thos. C. Porter, Lafayette College, Easton, Penn.).

Botanical Notes.

A Redfield Memorial Herbarium Fund. It has been decided that no better monument to the memory of John H. Redfield could be erected than to arrange for completing and caring for the work he loved, and to which he gave freely so many years of his life—namely, the Herbarium of the Academy of Natural Sciences. Mainly through his disinterested labors, it stands to-day scarcely second to any in the United States, containing, besides many unnamed, over thirty-five thousand named species of flowering plants and ferns, the half of which have been verified and fastened down.

No one can probably be found to give the years of time he so freely gave. In order to carry on the work, and add to the collection, as exploring expeditions afford the opportunity, it has been proposed to establish a fund for its maintainance.

Mr. Redfield's will provides that his herbarium, minerals, shells and scientific works shall be sold to help the Herbarium—thus furnishing a nucleus for the proposed fund. It is in mind to raise $20,000, but the interest of any sum that may be contributed can at once be made available. Statements will be furnished from time to time to contributors, keeping them informed of the progress of the contributions. Checks may be made payable to the order of Thomas Meehan, Director, or Stewardson Brown, Treasurer, and mailed to either at the Academy of Natural Sciences, Nineteenth and Race streets, Philadelphia.

Announcement of the next Meeting of the American Microscopical Society. The next meeting of the American Microscopical Society will be held at Cornell University, in Ithaca, N. Y., August 21, 22 and 23, 1895, that is the week previous to the meeting of the

American Association for the Advancement of Science, which is to be held in Springfield, Mass.

The unsurpased beauty of the location of the University, and the richness of both its terrestrial and aquatic fauna and flora, make this an ideal place for holding the meeting. It is equally attractive to the student of natural history and to those who love beautiful scenery.

The University buildings, which will be at the disposal of the Society, are especially adapted for the formal presentation of papers, blackboard illustrations, hanging of diagrams, etc., as well as for any demonstration that authors may desire to make. The armory is very conveniently located, both for the University and for the city, and a soiree there can hardly fail to be a great success.

Besides the attraction of papers and demonstrations by members, nearly all the opticians have expressed not only a willingness but a desire to be present and make an exhibit of their microscopes and microscopical apparatus, thereby affording the members an opportunity to see all the new and standard apparatus.

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, Professor W. W. Rowlee, or the President, will be glad to receive requests from those who desire to have some specially difficult method or structure elucidated, and an effort will be made to get some member particularly expert in such subject to demonstrate it before the Society.

Proceedings of the Club.

TUESDAY EVENING, MARCH 12th, 1895.

Vice-President Lighthipe in the Chair and 24 persons present.

The following were elected active members: Mr. Claude Crittenden, Mrs. Wm. Starr Dana, Mr. Eugene H. Van Nest, Mr. James P. Gardner, Mr. S. Cook.

The Committee appointed to draw up resolutions on the death of Dr. J. Bernard Brinton presented a report which was accepted, and a copy of it placed on file.

The Instruction Committee reported progress, and submitted the prospectus of the summer class for 1895. The report was accepted.

The Chair appointed the following Field Committee for 1895: Chairman, Mr. Small; Mrs. Britton; Mr. Tyler; Mr. Van Sickle; Dr. Rusby.

The announced papers of the evening were then presented as follows:

George V. Nash, "Remarks on some new and little-known Plants of Central Florida." Illlustrated by specimens. (Published in this issue of the BULLETIN.)

Elizabeth G. Britton, "Some Notes on the Genus *Mnium*." (To be published in a subsequent issue of the BULLETIN.)

A. Cogniaux, "Descriptions of new Melastomaceae from Bolivia," communicated by Dr. Rusby. (To be published in a subsequent issue of the BULLETIN.)

WEDNESDAY EVENING, MARCH 27TH, 1895.

Dr. Britton in the Chair and 34 persons present.

Mr. Eugene Smith, Miss Bliss, Miss Augusta Bliss and Miss Edith Parish were elected active members.

Dr. Britton announced the death of Mr. John H. Redfield, and remarked upon his life and labors. The Secretary also spoke upon the subject. Mr. Small moved that the Chair appoint a committee of three to draft suitable resolutions. Upon the adoption of the motion, a committee was appointed, consisting of Mr. Small and Professors Porter and Rusby.

Dr. Albert Schneider read his announced paper on "The Biological Status of the Lichens," maintaining that they are entitled to recognition as an independent group, and not to be classed as a division of either Algae or Fungi. It will be published in a subsequent issue of the BULLETIN.

Index to recent Literature relating to American Botany.*

Alwood, W. B. Ripe Rot or Bitter Rot of Apples. Bull. Va. Agric. & Mech. Coll. (II.) 3 : 59–82. *pl. 2.* My. 1894.
Description of *Gloeosporium fructigenum* Berk. with a bibliography.

Bailey, L. H. Experimental Evolution amongst Plants. Am. Nat. 29 : 318–325. Ap. 1895.
Argument that species have repeatedly been evolved by cultivation.

Bastin, E. S. Structure of *Veratrum viride.* Am Journ. Pharm. 67 : 196–203. *f. 1–6.* Ap. 1895.

Brandegee, T. S. *Mimulus Clevelandii.* Gard. & For. 8 : 134. *f. 20.* 3 Ap. 1895.
A new species from Southern California.

Britton, N. L. Publication by Signatures. Erythea, 3 : 50–52. 1 Mr. 1895.
With notes on the subject by E. L. Greene.

Clinton, G. P. Relationship of *Caeoma nitens* and *Puccinia Peckiana.* Bot. Gaz. 20 : 116, 117. 16 Mr. 1895.

Cogniaux, A. Orchidaceae.—II. Flora Bras. 117 : 158–318. *pl. 35–75.* 15 Ja. 1895.

Durand, E. J. Sporangial Trichomes in certain Ferns. Bull. Torr. Bot. Club, 21 : 408. 1894.

Durand, E. J. The Development of *Olpidium,* one of the Chytridiaceae. Bull. Torr. Bot. Club, 21 : 410. 1894.
Describes briefly the development of *Olpidium entophytum,* A. Braun, in the cells of *Spirogyra.*

Gibson, W. H. Welcomes of the Flowers. Harper's Mag. 1894 : 551–556. *figs.* Mr. 1894.
Discusses relation of insects to flowers, wild and cultivated.

Golden, K. E. Movements of Gases in Rhizomes. Proc. Am. Assoc. Adv. Sci. 43 : [reprint, pp. 10]. 1894.

Graves, J. A., Chairman. The Pteridophyta of North America, north of Mexico. Linnaean Fern Bull. 9 : pp. 23. Binghampton, 1895.
A numbered list of species and varieties.

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* It is requested that omissions from this list be communicated to the editors.

Greene, E. L. *Ceanothus leucodermis*, n. sp. Kew Bulletin, 97: 15. Ja. 1895.

Description of a new species from California, found in Kew Herbarium; with discussion of *C. di aricatus.*

Greene, E. L. Corrections in Nomenclature.—VI. Erythea, 3: 36. 1 F. 1895.

Greene, E. L. Novitates occidentales.—XI. Erythea, 3: 44–49. 1 Mr. 1895.

New species of *Ranunculus, Roripa, Tissa, Trifolium, Raillardella, Crepis, Allocarya, Collinsia* and *Habenaria.*

Greene, E. L. Novitates occidentales.—X. Erythea, 3: 17–24. 1 F. 1895.

New species in *Vicia, Lupinus, Trifolium, Thermopsis, Ranunculus, Erigeron, Pyrrocoma, Senecio, Agoseris, Phacelia* and *Linanthus.*

Greene, E. L. Observations on the Compositae.—VIII. Erythea, 3: 6–15. 2 Jl. 1895.

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The Biological Status of Lichens.

By Albert Schneider.

For reasons to be enumerated, our present knowledge of lichens is very imperfect. Lack of attention is not the cause, as the voluminous literature on the subject will testify. The references, authentic and otherwise, number many thousands. It would be an endless task to bring together all the monographs, treatises, and especially the "fragments," referring to lichens. Lichenologists of ante-Schwendenerian time supposed that the question of the true nature of lichens and their position in the vegetable kingdom was permanently settled. Nothing was left for them to do but to issue "fragments" describing presumably new species and varieties. Collectors set to work in widely distributed and circumscribed areas to add their mite to the heap of confusion. We all know that the ultimate aim of science is to systematize; but no system can be formed from unknown material, whatever it may be. A scientist's first duty then is to study (*as far as possible*) his material before attempting to classify it. This careful studying of material is what the *mass* of lichenologists have heretofore failed to do. It is not my intention to enter into a historical review of lichenology, as that has already been thoroughly done by Krempelhuber and others. With the above introduction I shall now attempt to make somewhat clearer the present status of general lichenology.

The epoch-making researches of de Bary, Schwendener, Bornet and others have conclusively demonstrated the dual nature of the lichen structure; that is, it consists of a colorless hyphal portion homologous with certain filamentous fungi; and a green celled portion homologous with certain low forms of algae. The specific algal homologues have been pretty accurately studied out. Concerning the specific homologues of the fungal portion our knowledge is less accurate. But in regard to both symbionts we are certain of their originally independent ancestral forms. This theory of Bornet and Schwendener has from the very first met with strong opposition from nearly all lichenologists (taxonomists, so called). Even a considerable number of physiologists and morphologists misconstrued evident facts with unscientific perversity, notably Itzigsohn, Famintzin and Baranetzky. Even to this very day there are a number of lichenographers who persist in ignoring or directly opposing Schwendener's theory. This is simply additional evidence of the correctness of the statement "None are so blind as those who do not wish to see."

It would be useless to repeat the arguments based upon actual experimentation which conclusively prove the correctness of Schwendener's theory. There is, however, a question which Schwendener and his immediate followers have almost unanimously answered wrongly and that is the question of the true position of lichens in the vegetable kingdom. During the ante-Schwendenerian time, beginning with the earliest periods, most lichenologists looked upon lichens as autonomous structures, though this conclusion had no scientific basis founded on morphology and physiology. Their characteristic distribution and marked macroscopic appearance were thought sufficient to make them a distinct group. Schwendener assumed that lichens resembled certain groups of fungi, both in structure and in their manner of growth, and should therefore be classed under fungi as ascolichenes and basidiolichenes. It is much to be regretted that Schwendener did not see his mistake in time to avoid confusion and unnecessary and unwarranted opposition to his theory. I will frankly admit that I formerly thought it most expedient to classify lichens as modified fungi. But having since made a special study of lichen morphology, I now consider such a pro-

cedure both unscientific and impracticable. This idea is not original with me, nor do I stand as its only advocate. Many of the most recent scientific writers, notably Reinke, strongly uphold this view. I shall briefly consider lichens from the standpoints of morphology and physiology to show that they can only be treated as *autonomous structures having a phylogeny of their own.* I shall not consider it worth while to enter into word quibbling as to the meaning of "autonomy." If such were my desire I might well deduce good arguments to show that angiosperms are not autonomons, that they are simply modified gymnosperms, that gymnosperms are modified pteridophytes, pteridophytes modified mosses, etc., finally having it reduced to a primal cell; this cell could still be reduced to organic matter, and that to inorganic matter, etc. I shall consider as autonomous any comprehensive group of organisms having morphological and physiological characteristics differing from those of any other comprehensive group of organisms; meaning by comprehensive group any collection of allied individuals comprising natural species, genera and families. I will first show why lichens cannot be classed as fungi.

The method of reproduction in lichens is wholly different from that of fungi. It is true that lichen spores have a strong morphological resemblance to those of their probable homologues among the fungi. Functionally they differ widely. They cannot be considered specific reproductive organs of lichens as they formerly were of fungi, because they are not capable of developing into a complete mature lichen or even a fungus. They will indeed develop a mycelial network which will however not produce spores unless associated with its symbiotic alga. They can only be looked upon as *degenerate reproductive organs of their fungal ancestors.* This degeneracy is the more marked as we ascend the scale of lichen development. Taking one of the lower types, as exemplified in *Pyrenula*, we find spore organs having almost typical, fungal characters; that is, apothecia are prominent, paraphyses distinct and numerous, spore wall rather thick and colored, spores distinctly septate. These are the usual characters of fungal spore organs. Considering some of the higher types as exemplified in *Parmelia* and *Cladonia*, we find apothecia few or wholly wanting; when apothecia are present the asci are few in number, spore wall

comparatively delicate and colorless, spores non-septate. There is no doubt that lichen spores still play a *part* in lichen reproduction. *This can however only take place when the spore with the specific algal symbionts are placed in a suitable environment.* That is, spores and algae must fall upon a spot where the algae can maintain existence independently until such time as the spores shall develop a mycelial network with haustoria with which to surround the algae, thus forming the beginning of a new lichen thallus. Should, for example, the spores with the requisite algae fall upon a dry rock the algae would die, and if the spores should subsequently develop there would be no algae with which to form a lichen. From this it is evident that lichen spores must be very unreliable as *assistants* in lichen reproduction. From the very nature of things, lichen spores are not true reproductive organs of lichens, hence their tendency to degenerate.

The question whether lichen spores are sexual or asexual products is still unsettled. The observations of Stahl in the case of *Collema microphyllum* have not yet been verified. If his observations prove to be correct, then we may assume that lichen spores are sexual products. I am, however, strongly inclined to believe that Stahl's observations were probably erroneous. From numerous examinations of so-called "spermagonia," I believe them to be parasitic fungi, of which the "spermatia" are the spores. From a rather hasty comparative study it seems probable that their homologues are to be found in *Septoria* or allied genera. For example, *Septoria Speculariae* presents the general morphological appearance of spermagonia. The fact that we readily recognize *Septoria* as parasitic fungi lies only in the nature of things. In case of *Septoria* the morphological and physiological contrast between host and parasite is great, while in the case of spermagonia this contrast is only slight. No one would ever think of recognizing *Septoria Speculariae* as the male reproductive organs of *Specularia perfoliata*, upon which it lives. Such a suggestion would certainly be highly ridiculous. Then why should spermagonia of lichens be recognized as male reproductive organs, especially since no one has demonstrated that they play such a function? According to Wiesner, spermatia do develop a mycelium which finally produces spermagonia. From this the true nature

of spermagonia may safely be conjectured. To say the least, it is certainly unreasonable to assume that spermatia will at one time function as non-sexual spores, and at another time as male sexual organs. Further investigations will reveal the true nature of things. The sooner this is accomplished the better, as many lichenologists have already made the deplorable mistake of considering spermagonia as important characters in lichen classification. To classify plants according to the characteristics of the parasites found upon them would certainly be a questionable procedure in modern taxonomy.

Other characteristics which distinguish lichens from fungi are the presence of various chemical compounds, notably lichenin, which is never found in fungi.

Characteristics which distinguish lichens from fungi also distinguish them from algae. There is certainly less similarity between an alga and a lichen than there is between a fungus and a lichen, though several attempts had been made to classify them as algae. In general it may be stated that lichens *resemble* algae only in so far as the algal symbiont resembles algae. The *differences* will be brought out in the discussion of those characters which separate lichens from both algae and fungi. For convenience sake I will separate these characters into morphological and physiological. These are the characters which fully establish the autonomy of lichens.

Morphological.

Lichens, macroscopically considered, have such a peculiar appearance that the most superficial observer is naturally led to suppose that they form a group by themselves. They are found in places where neither alga nor fungus can exist alone. Especially peculiar is their ability to resist low temperatures. Freezing only checks their growth. A temperature of —40 ° C. does not kill them. Such crude observations are however not sufficient to establish their individualism.

The lichen thallus is of special interest to the morphologist since this structure is typically lichenological. It always consists of the hyphal and algal symbionts. The algal symbiont is usually more centrally located, being surrounded by the hyphae of the

fungal symbiont. Three types of lichen thallus may be recognized, namely, the crustaceous, the foliaceous and the fruticulose. The crustaceous type is the most rudimentary and cannot be said to to have even a dorsiventral structure, though one would naturally expect this from the nature of things. The lower surface differs only in having more numerous extended hyphal filaments to enable it to adhere more firmly to the substratum as well as to take up soluble food materials. The second type already indicates a considerable advance in the evolution of the lichen thallus. It is typically dorsiventral. Dorsal and ventral layers are semi-cortical in structure; that is, the hyphal cells are closely united and have only few air passages. Between these two layers is a layer of loosely interwoven hyphal tissue in which are imbedded the algae. From the lower surface extend the rhizoids. On the upper are found the apothecia (with exceptions, example, *Nephromium*) and soredia, besides the so-called "spermagonia" and occasionally accidental fungal and algal parasites. The third type (as exemplified by the vertical thallus of *Cladonia* and *Thamnolia*) shows a typical radial structure. Numerous examples showing the gradual gradation from the dorsiventral to the radial type can be found. In the radial type there is an outer semi-cortical layer, which usually differs from that of the dorsiventral cortical layer in that it is more compact. The fungal cell walls have become somewhat gelatinized and adhere very closely. Next to this layer, on the inside, is the layer of loosely interwoven hyphae containing the algae. The third and innermost layer consists of longitudinal closely united hyphae. Sometimes this thallus is hollow in the center, sometimes solid, containing a central core of closely united longitudinal hyphae.

Soredia are also typical lichen structures. They are very numerous in the higher forms of lichens (example, *Parmelia sorediata*), and are found on the dorsal surface of the thallus, more frequently near the margin. Each soredium is in reality a miniature thallus. It is usually spherical in form, the outer layer consisting of closely united hyphal cells; the central portion consists of algal cells and loosely interwoven hyphal filaments. Soredia contain all the elements necessary for the development of a new lichen.

From what has been stated above, apothecia can not be looked

upon as typical lichen structures, yet their morphology is of great importance in the consideration of lichen evolution and classification. Some of the changes in apothecia indicating a probable higher or lower stage of development have already been referred to. As I intend to consider these changes more particularly in a future paper on lichen classification, I shall at present omit further discussions. I shall now briefly consider the physiological characters which distinguish lichens from both fungi and algae.

Physiological.

In their method of growth lichens stand alone. The two symbionts form a microcosmos which is enabled to perform the necessary life functions which were originally inherent in both, and in addition they have acquired new characteristics during their phylogeny as lichens, which unmistakably stamp them as autonomous structures. As a unit they can now exist where neither symbiont could exist alone. In spite of this intimate mutualism, it is not at all likely that the fungal symbiont is *wholly* dependent upon the algal symbiont for its food supply. For example, a lichen spore may develop to a considerable extent as a saprophyte upon decaying wood, humus, and other dead organic matter; nor is it at all likely that a lichen can develop upon purely inorganic matter, as, for example, pure quartz crystals. Of course, the spore, with the requisite algae or a soredium, has bound up within itself a certain amount of extra food material, which enables development to begin in the absence of all organic matter. The mycelial network then forms a structure for collecting within its meshes organic substances, carried to it by air and water currents; this allows growth to continue. No amount of food supply will, however, allow the fungal symbiont to mature without its algal symbiont, excepting perhaps the lowest forms. Thus we see that mutualism of fungus and alga is necessary to form a lichen. The fungal symbiont, considered by itself, still retains its ancestral function as a saprophyte; in addition it has acquired the habits of a semi-obligative parasite upon its algal symbiont. The algal symbiont, which has the function of chlorophyll-bearing plants in general, that of assimilating carbon, must be looked upon as a facultative parasite, since it can exist and mature independently of

its fungal symbiont. This has been repeatedly demonstrated experimentally. Considered as a unit, the fungal portion of the lichen supplies the algal with water, the necessary mineral substances, N., O. and H., from the underlying substratum and air. The algal symbiont as a result of this unusual supply of food materials, forms an extra amount of carbon and nitrogenous compounds, which is assimilated by the fungal symbiont. Thus it is seen that the benefit derived from this association is mutual. The term "mutualism," proposed by Tubeuf, is very appropriate and may well supplant the equally correct but more complex expression "mutualistic symbiosis," proposed by Frank.

Reproduction by means of soredia stands without a parallel in the vegetable kingdom. They are of course asexual, and are formed in the algal zone of the lichen thallus by the symbiotic association of algae and hyphae. They may be designated as mutualistic brood buds. They are really vegetative reproductive organs, and on that account the objection may be raised that they are not true reproductive organs. I shall not here enter into a discussion on the ultimate difinition of reproductive organs. The fact remains that *soredia alone contain the necessary elements for forming a new lichen.* There is no doubt that the great majority of lichens are reproduced from soredia; in fact, this is the only means of reproduction in some species. The outer semi-cortical hyphal layer of soredia enclosing the algae maintains a sufficient degree of moisture to enable them to lie dormant for a long period of time, or until conditions are suitable for their development. They are certainly far more reliable than spores (associated with the necessary algae) as reproductive organs. In fact, as Reinke has indicated, lichen reproduction by the aid of spores is in most respects similar to reproduction by means of soredia. In *Endocarpon pusillum*, for example, some of the algae are ejected and with the spore adhere to the mucilaginous spore wall, thus forming a sort of soredium in which the spore represents the fungal element. If the algae are not ejected with the spores, the chances for developing a new lichen must indeed be slight, for reasons already given.

In my opinion sufficient reasons have been given why lichens cannot be classed with fungi, much less with algae, and must

therefore be considered as an independent group. Based upon morphological and physiological considerations this group would naturally belong midway between fungi and algae.

In conclusion I shall offer a few suggestions on the probable origin and phylogeny of lichens. There is little doubt that various subdivisions of lichens indicate a polyphyletic origin. Of this polyphylogeny either one or all of several forms may have occurred. For example, in ascolichenes, a certain fungal type may have (during its phylogenyas a lichen symbiont) become so modified by its symbiosis with a given algal type, as to enable it to associate with other algal species; or it may be that the same algal type became adapted to one or even several fungal types. As to what the conditions actually were we are at present scarcely able to say. Of one thing we are, however, certain and that is that a lichen is the result of the mutualistic association of a fungal and an algal type. Though in general I agree with Reinke as to the origin of lichens, yet I am not so ready to assume (theoretically) that *Collema* represents the oldest lichen type. *Collema* is the result of the symbiotic association of the alga *Nostoc* with some fungus whose ancestral type is not definitely known. The mass of the lichen structure consists of the alga. As compared with some other lichens the following are some of the reasons why *Collema* does not represent the lichen prototype: 1. The alga has undergone considerable change by way of adapting itself to new environments. Originally it was no doubt accustomed to a high degree of moisture (as is its present homologue, *Nostoc commune*), while in its present form as a lichen it is able to exist on tree trunks, rocks, etc., as most other lichens. 2. Its thallus shows a considerable degree of differentiation, as exemplified in the closely allied genera *Hydrothyrio*, *Polychidium*, *Leptogium* and *Mallotium*. 3. Spores have probably become considerably degenerated as indicated by their thin colorless walls, and in many cases indistinct septae. As a rule apothecia are few, though there are exceptions to this. 4. Soredia, though not numerous, are more frequently present than in many other lichen forms.

The above are the main reasons why Collema is perhaps not the prototype of lichens. In my opinion the true prototype of lichens is perhaps to be found in those structures which were for-