QK177.G7c.2-Gratacep-FRESH WATER FLORA and FAUNA

QK
129
.G7
c.2

QK129

.G7

c.2

LIBRARY OF
THE NEW YORK BOTANICAL GARDEN

41
738
Compliments of
A. Woodward

THE FRESH WATER

FLORA AND FAUNA

OF

CENTRAL PARK.

PRELIMINARY PAPER, WITH BIBLIOGRAPHY.

BY

L. P. GRATACAP AND A. WOODWARD.

NEW YORK:
MAUGOWAN & SLIPPER, PRINTERS,
30 BEEKMAN STREET.

1884.

LIBRARY NEW YORK BOTANICAL GARDEN

THE FRESH WATER
FLORA AND FAUNA
OF
CENTRAL PARK.

PRELIMINARY PAPER, WITH BIBLIOGRAPHY.

/ BY
L. P. GRATACAP AND A. WOODWARD.

NEW YORK :
MACGOWAN & SLIPPER, PRINTERS,
30 BEEKMAN STREET.

1884.

Q1129

. G. 7

c. 2

THE FRESH WATER FLORA AND FAUNA OF CENTRAL PARK.

PRELIMINARY PAPER, WITH BIBLIOGRAPHY.

By L. P. GRATACAP and A. WOODWARD.

THE fauna and flora of fresh water ponds have become more generally studied as the limits of natural history widened, as the important influences exercised upon the character of water supply by organic life became known, and as the microscope extended its conquests and improved its powers. The publication of large and more or less exhaustive treatises upon microscopic life have made the task simpler of finding out the character and names and habits of the numerous strange objects which pass before the amateur upon the glass slide, though he finds identification even then difficult, and realizes that previous experience and a long series of observations are necessary for his progress in this bewildering field of natural study.

The monograph of Prof. Rabenhorst may be said to have first opened up the field of practical examination of fresh water algae to general students. His work entitled *Flora Europæum Algarum Aquæ Dulcis et Submarinæ* was a careful revision of the work of older authorities, and established a foundation upon which new discoveries could be established, especially as it arranged a confusing synonymy of species in previous disorder. For American students the publication in 1874 of Dr. Wood's "Contribution to the History of the Fresh Water Algae of North America," ("Smithsonian Contributions to Knowledge," vol. xix.) was a long wished for help, and gave a real impetus to this study among many to whom special papers and widely separated notices were inaccessible or unknown.

Dr. Schweinitz's early work on the desmids of America was continued by Dr. Francis Wille, and his lists, identifications, and descriptions are familiar to students in the Bulletin of the Torrey Botanical Club, followed only recently by his monograph on this subject, which must give the study an important impetus. The general student, in his attempts to identify the innumerable and somewhat monotonously varied species of diatoms, must depend upon the scattered publications of J. W. Briggs in the *American Journal of Science and Art*, and in the *Proc. Boston Soc. Nat. Hist.*, of Chas. Stoddard from the same source, and of S. A. Briggs of Chicago, now of New York, in the *Lens*. The large and

attractive work of Dr. Henri Van Heurck on the diatoms of Belgium forms a monograph on this subject, and the American student should possess this work or have access to it in his own researches, for the help it affords is very considerable. Assistance will be obtained in the Annual Geological Report of Indiana, 1882, in the paper and plates contributed by Rev. Geo. L. Curtiss.

The more inviting field of protozoan investigation is fortunately occupied by an exhaustive writer, and the young microscopist will rejoice in his first amazement over these extraordinary and prevalent forms, to turn to the sumptuous work of Dr. Leidy upon the Fresh Water Rhizopods of America.

Infusorial life has been treated upon with abundant elaboration and apparently* delightful literary skill and attractiveness by W. Saville Kent. These multitudinous objects, whose swarming numbers and eccentric motions early attracted the attention of observers, in old works are described as animalcula, a name which popularly still clings to them. Antony Van Leeuwenhoek in 1677 published the first account of these interesting forms, whose myriads pervade the waters about us, and his work was followed by Baker (1742), Muller (1773), and others. Veritable progress in the understanding of the real position of *infusoria* proper and in the separation of the heterogeneous group of objects included under the name of animalcula was made by Ehrenberg, Dujardin (1811), Von Siebold (1845), Stein (1854), Claparede and Lachmann (1858), Max Schultze (1860), Pritchard, and among modern authors by Haeckel, Englemann, and Butschli (*Nature*, vol. xxvii. p. 601).

The work of Mr. Kent is comprehensive to the last degree, and though his views as to the generation of infusoria and their affinities have encountered adverse criticism, his lists and descriptions of species and his figures are simply unexcelled and invaluable.

The bibliography of rotifers is quite large, and is not confined to any special work; Carpenter, Gosse, Ehrenberg, Dujardin, Pritchard, etc., having contributed to this section of microscopic study.

For the crustacea the student will find less convenient and complete works at his command. Two notable contributions, monographic in character, to this subject, have been published by Prof. A. S. Packard and C. L. Herrick. Prof. Packard's work is contained in the Annual Report of Hayden's Survey of the Territories, for 1878, part i. and treats of the subdivision of phyllopods whose forms prevail in the West and are sparingly represented in our Eastern regions. Mr. Herrick's work represents the results of careful research

* The writers do not possess as yet a copy of this expensive work, though they will soon doubtless have access to it.

in the fresh water basins of his own State, Minnesota, to which he has chiefly confined his attention, principally in the groups of Cladocera and Copepoda. He has surveyed the distribution of species in the United States and has prepared generic tables for determinative study.

The "Micrographic Dictionary" is indispensable, and its descriptions, references, and plates replace to some extent the possession of the other special treatises.

In the spring of this year (1884) the writers were requested by Mr. W. A. Concklin, Superintendent of the Central Park Zoological Gardens, to make an examination of the microscopic and other life contained in the lakes of Central Park, N. Y. The request was accompanied by a permit to dredge the lakes and enjoy the use of the park boat. The examination made has been to some extent experimental and provisional. Neither of us felt fully justified in undertaking the labor, as want of time, and more seriously want of experience, would interfere with its thoroughness, and the variety of topics embraced in the research was thought of with apprehension. The temptation proved, however, stronger than, as the result may show, our prudence, and the task was undertaken. Imperfect as it is, and possibly not in every instance satisfactorily authenticated, the list so far as we know is the first of its kind in connection with the Central Park, and can be at least regarded as a contribution to the natural history of New York Island. At any rate, however incomplete the list may appear, the catalogue of papers appended to it will prove valuable, and may help to justify the paper's publication.

The two lakes whose waters were examined during this past summer are situated at opposite extremities of the park, the larger embracing an area of 20 acres, between 74th and 77th Street; the smaller, at the northern end of the park, on 5th Avenue, representing a square surface of about 12 acres. The greatest depth in either does not exceed 13 ft. The water supply of these ponds is derived from the Croton and from the surface drainage of the neighboring slopes; the roadways, drives, and foot-paths which arrest a great part of the rainfall in the vicinity of the lakes are drained into underground pipes, which again empty in the lake. The lakes are stagnant ponds, and the water is foul and impotable. The larger and more southern lake is tenanted with aquatic fowl belonging to the park gardens, and they must to some extent arrest the multiplication of crustaceous, molluscos, and fish life. The various inlets, sinuosities, and bays along the shores were found to be good hunting places, and we adopted the use of a surface net, which brought us many species not discovered along the margins of the pond. This net was a shallow sieve of coarse linen attached to an iron hoop; the whole suspended from the stern of the

row boat, and pulled through the water at a distance of 16 or 20 feet from the boat itself, filtered the intruding tide, which also kept it inflated and gathered a film of algæ (oscillatoria) in its pores, which in turn entrapped and retained associated forms. This film was washed off into a saucepan, and the washings poured into settling bottles, from whose sediment the material for microscopic examination was obtained. Dredging was resorted to upon Harlem Lake (the upper lake), but it did not reveal any molluscos life, though the silt drawn up contained numerous diatoms.

Our examination has not revealed as many varied forms of life as we had expected, and among the algæ we have failed to detect forms considered as more or less prevalent in the Croton water. A noticeable absence of desmids and rhizopods was something of a surprise, as also the deficient representation of algæ. One form of oscillatoria (*Ochlo-rina*), however, filled the waters of the lower lake at every point, and its waving and crowded filaments produced a turbid and flocculent appearance that is curiously deceptive, resembling clouds of some impalpable precipitate in the water. Among the threads of the oscillatoria were scattered chains of *anabaena* and *nostoc*. *Spirogyra* in limited and depauperate colonies were found near the shore, and braids and collections of a *stigeoclonium*-like algæ elsewhere.

Desmids are strikingly absent in our collections, but these may be discovered by later examinations. It seems probable that the stagnant, offensive state of the water may exercise an injurious influence on the multiplication of these objects, and the deficiency of fresh water hasten their death and decomposition when introduced. The diatoms are comparatively numerous, and found in numbers among the clusters and knots of algæ moving and disseminated through the surface waters, and entombed in the mud of the bottom. The infusoria in numbers exceeded all other objects, though the species enumerated are not many. These will be extended in future examinations. These puzzling creatures have given us great entertainment, and representing the nucleus of that ill-defined and chaotic assortment of objects known as *animalcula* will have in later and fuller lists more attention paid to them, as their identification has been rendered more possible by the extended treatise of Saville Kent.

The crustaceæ were strikingly few in species, though in some spots abundant in numbers; cyclops, cypris, daphnia, being prevalent and widespread.

Rotifers were frequent; vermes were found on sticks and through the algæ, and the species of larva indicated was seen associated with a new species (?) of *spongilla* to which in the list we have appended a note. Among micrococci,

Vibrio bacillus and *V. spiralis* abounded in certain places where there seemed unmistakable evidence of sewage contamination. These were seen in conjunction with whirling and infinitesimal objects, which in immense numbers were lashing themselves through the clustering masses of their neighbors, and which were believed to be *Bacterium termo*.

The species of mollusca have been almost entirely confined to Harlem Lake, *Physa heterostropha* and *Planorbis parvus* excepted. They were not numerous, but were encountered along the shores at various points, and all belong to shore feeding species. The anodontas were found mostly represented by dead shells, but one living specimen of *A. fluviatilis* was taken. Their habitat seemed to be near and under the wooded banks of the pond. We are indebted to Mr. Concklin for the lists of fishes, and we owe to Mr. Sanderson Smith acknowledgment for identifications among the mollusca.

FLORA AND FAUNA OF THE TWO LARGER FRESH WATER LAKES OF CENTRAL PARK, N. Y.

Provisional list made in 1884.

ALGÆ.

Conferoideæ.

Oscillatoria chlorina.	Sphaerium sulcatum.
“ nigra.	Botryococcus Braunii.
“ Fröhlichii.	Protococcus sp?
Conferva sp. (?) stigeoclonium (?).	Polyedrium spinosum.
Nostoc sphaericum.	Spirulina Jenneri.
Anabæna flos-aquæ.	Palmoglaea macrococca.
“ gigantea.	Palmella hyalina.
Spirogyra diluta.	Scytonema sp?
Batrachospermum moniliforme.	Chantransia expansa.
Cælosphaerium dubium.	Scenedesmus quadricauda.
	“ polymorphus.
	Volvox globator.

Desmidiæ.

Closterium Ehrenbergii.	Hyalotheca dissiliens.
“ griffithsii.	Pediastrum boryanum.
“ venus.	Staurostrum gracile.
Cosmarium margaritiferrum.	

Diatoms.

Amphipleura sp?	Navicula rhomboides.
Actinocyclus niagarae.	“ inflata.
Cocconeis sp?	“ cuspidata.
Cyclotella rotula.	Melosira crenulata.
“ astraea.	“ crotonensis.
Cymbella affinis.	Nitzschia longissima.
Bacillaria paradoxa.	“ sigmoida.
Fragillaria capucina.	Pleurosigma spenceri.
“ acuta.	Stephanodiscus niagarae.
Licmophora flabellata.	Synedra capitata.
Navicula sp?	“ ulna.
“ rhynchocephalus.	Gomphonema constrictum.
“ placentula.	“ acuminatum.

Protozoans, etc.

Schizomycetes.

Vibrio bacillus.	Bacterium termo?
“ spiralis.	

Rhizopoda.

Amoeba proteus.	Cochliopodium bilimbosum.
Actinophrys sol.	Diffugia urceolata.

Spongida.

Spongilla fragilis? The specimen which was identified as this sponge was gathered upon the surface of rocks in a stream of artificially supplied water, tributary to the Harlem Lake. It was sent to Prof. E. Potts, of Philadelphia, who kindly acknowledged it, and said that the weight of evidence was in favor of *Spongilla fragilis*, but the absence of statoblasts prevented any entirely satisfactory identification.

Spongilla? sp? This specimen, which caused us considerable perplexity, and which may be quite wrongly classified, was found attached to sticks of *rubus*, floating in the water, in the form of low spine-like projections in groups, which under the microscope were seen to be composed of hollow needles irregularly blotched with brown patches, and quite densely hispid with hairs of various lengths, which seemed fascicled. These needles or tubes were irregularly lobose and swollen at points, and seemed striated. The slender ends were terminated by long flagellum-like hairs. Among these moved a vermiform larva with a mop-like head of recurved hooks at one extremity.

Infusoria

Cothurnia sp?	Monas umbra.
Coleps hirtus.	Paramæcium caudatum
Chilodon cucullus.	“ aurelia.
Euglena viridis.	Stylonichia histrio?
Halteria grandinella.	Trachelomonas sp?
Heteromita ovata = Bodo	Vorticella microstoma.
grandis.	“ sp? free swimming,
Kerona pustulata?	perhaps Trichoda.

Rotifera.

Anuræa stipitata.	Noteus quadricornis.
Chaetonotus squammatus.	Notommata centrura.
Colurus deflexus?	Rotifer vulgaris.
Euchlanis triquetra?	

Vermes.

Anguilula fluviatilis.	Hirudino—two species.
Nais sp?	

Crustacea.

Asellus vulgaris.	Daphnia pulex.
Bosmina longirostus.	“ sp?
Chydorus sphaericus.	“ reticulata.
Cyclops quadricornis.	Gammarus fasciatus.
Cypris fasciata.	Sida crystallina.

Probably Gammarus minus and G. limnaeus will be found.

Bryozoa.

Statoblasts of Plumatella have been indicated to us by Prof. E. Potts, but as yet no colonies of the mature organisms have been found.

Mollusca.

Anodonta fluviatilis.	Physa heterostropha.
“ implicata.	Planorbis deflectus.
Amnicola granum.	“ parvis.
Limnaea columella.	Succinea ovalis.
“ humilis.	Limax campestris.

Pisces.

This list was furnished by Supt. W. A. Concklin.

Catfish, *Amiurus melas*.
 Gold fish (carp), *Cyprinus auratus*.
 Sun fish, *Lepomis gibbosus*.
 White perch, *Rocco americanus*.
 Yellow perch *Perca americana*.
 Eels, *Anguilla*.
 Killifish, *Fundulus*.
 Common sucker, *Calostomus commersoni*.

The above have all come through the water pipes. The following have been placed in the ponds:

German carp, *Cyprinus carpio communis*.
 Black bass, *Micropterus salmoides*.
 Speckled trout, *Salvelinus hoodi*.
 Tench, *Tinea vulgaris*.

Chelonia.

Chrysemys picta. abundant. *Chelopus guttatus*.

CONTRIBUTION TO THE BIBLIOGRAPHY OF FRESH-WATER
 FLORA AND FAUNA OF THE UNITED STATES,
 MOSTLY MICROSCOPICAL.

- A. C. S.—Notes on *Vampyrella Lateritia*. Amer. Journ. Micr. and Pop. Sci., vol. v, pp. 105-108. New York, 1880.
- ANDERSON, C. R.—Spores, with a Spore Glossary. Amer. Quart. Micr. Journ., vol. i, pp. 260-268. New York, 1878-79.
- ANON.—Water Colored by Algæ. Amer. Month. Micr. Journ., vol. iii, p. 94. New York, 1882.
- ANON.—Unicellular Algæ. Amer. Month. Micr. Journ., vol. iv, pp. 21-24. New York, 1883.
- ANON.—Some Minute Plants. Amer. Month. Micr. Journ., vol. iv, pp. 26-28. New York, 1883.
- ANON.—*Urnatella Gracilis*, a Fresh-water Polyzoan. Science, vol. ii, pp. 789, 790, 2 woodcuts. Cambridge, 1883.
- ANON.—Sense of Color of *Dasphna*. Amer. Month. Micr. Journ., vol. v, p. 77. Washington, 1884.
- ANON.—Spring Collections. Amer. Month. Micr. Journ., vol. v, pp. 77-78. Washington, 1884.

- ARTHOR, J. C.—A Supposed Poisonous Seaweed in the Lakes of Minnesota. *Science*, vol. ii, p. 333. Cambridge, 1883.
- ATWOOD, H. F.—*Volvox Globator*. *Amer. Journ. Micr. and Pop. Science*, vol. iii, p. 117. New York, 1878.
- ATWOOD, H. F.—*Brachionus Conium*, a New Rotifer. *Amer. Month. Micr. Journ.*, vol. ii, p. 102. New York, 1881.
- ATWOOD, H. F.—A New Rotifer. *Science (Michel's)*, vol. ii, p. 235, 2 woodcuts. New York, 1881.
- BAILEY, J. W.—A Sketch of the Infusoria, of the Family Bacillaria, with Some Account of the Most Interesting Species which have been found in Recent or Fossil State in the United States. *Trans. Assoc. Amer. Geol. and Nat.*, 1840-42, pp. 112-164, 6 plates. 1843.
- BAILEY, J. W.—Infusoria of the Mississippi River. *Proc. Bos. Soc. Nat. Hist.*, vol. ii, pp. 33-35. Boston, 1845.
- BAILEY, L. W.—Desmids and Diatoms. *Amer. Nat.*, vol. i, pp. 505, 517, 587, 595. 1 plate. Salem, 1868.
- BARNETT, W. J.—The Organic Relations of Some of the Infusoria, including Investigations concerning the Structure and Nature of the Genus *Bodo* (Ehr.). *Bos. Journ. Nat. Hist.*, vol. vi, pp. 319-324. Boston, 1857.
- BARNARD, W. S.—New Rhizopods. *Amer. Quart. Micr. Journ.*, vol. i, pp. 83-85, 1 plate. New York, 1878-79.
- BIRGE, E. A.—Notes on Crustacea in Chicago Water Supply, with Remarks on the Formation of the Carapace. *Chicago Med. Journ. and Examiner*, vol. xiv, pp. 584-590, 2 plates. Chicago, 1881.
- BRECKENFELD, A. H.—An Infusorian in the Water of San Francisco. *Amer. Month. Micr. Journ.*, vol. v, pp. 4-5. Washington, 1884.
- BRIGGS, S. A.—Diatomaceæ of Lake Michigan. *The Lens*, vol. i, p. 41. Chicago, 1872.
- BRIGGS, S. A.—Some of the Diatomaceæ of Upper Lake Huron and the Sault. *The Lens*, vol. i, pp. 235-237. Chicago, 1872.
- BRIGGS, S. A.—A Contribution toward a List of Rhode Island Diatomaceæ. *The Lens*, vol. iii, pp. 161-163. Chicago, 1873.
- CALVIN, S.—Some Observations on Living Cells. *Bull. Minn. Acad. Sci.*, vol. ii, pp. 207-228. 1881.
- COX, J. D.—Multiplication by Fission in *Stentor Mulleri*. *Amer. Nat.*, vol. x, pp. 275-278. Salem, 1876.
- COX, J. D.—Motion of Diatoms. *Amer. Month. Micr. Journ.*, vol. ii, pp. 66-69. New York, 1881.
- COX, J. D.—Some Phenomena in the Conjugation of *Actinophrys Sol.* *Amer. Month. Micr. Journ.*, vol. pp. 183-189. New York, 1881.

- COX, J. D.—A New Daphnia. Amer. Month. Micr. Journ., vol. iv, pp. 88, 89. New York, 1883.
- COX, J. D.—Structure of the Diatom Shell. Amer. Micr. Journ., vol. v, pp. 45-49, 66-69, 85-89. Washington, 1884.
- CURTIS, G. L.—Diatoms of the Waters of Indiana. Twelfth Ann. Report State Geol., pp. 377-384. 1882.
- CUTTER, E.—On the Presence of the Forms of Life in the Central and Lateral Surface Waters. Amer. Month. Micr. Journ., vol. i, p. 186. New York, 1880.
- CHEESEMAN, E. L.—An Algæ in an Aquarium. Amer. Month. Micr. Journ., vol. vi, p. 41. New York, 1883.
- CONGDON, E. A.—List of Rhizopods in Ponds of Richmond Co. Proc. Nat. Sci. Ass. of St. Is., vol. i, Extra No. 2.
- CONGDON, E. A.—Note on Diffugia. Science Record, vol. ii, p. 164, 2 woodcuts. 1884.
- CONGDON, E. A.—A Queer Rhizopod. The Microscope, vol. iv, p. 217, 1 woodcut. Ann Arbor, 1884.
- EDWARDS, A. M.—What is a Desmid? Amer. Nat., vol. iii, pp. 311, 323, 1 plate. Salem, 1870.
- EDWARDS, A. M.—Natural History of the Diatomaceæ. Geol. of New Hampshire vol. i, pp. 416, 505.
- EVARTS, N. C.—A New Species of Ophrydium. Amer. Month. Micr. Journ., vol. i, p. 1. New York, 1880.
- EYFERTH, B.—The Simplest Forms of Life. Amer. Quart. Micr. Journ., vol. i, pp. 146, 155, 225, 234, 305, 311. New York, 1878-79.
- EYFERTH, B.—The Simplest Forms of Life. Amer. Month. Micr. Journ., vol. i, pp. 10, 12, 34, 36. *Rhizopods*; Infusoria, pp. 68, 70. Flagellata, pp. 93, 95. Astasiæa, pp. 115, 117. Cryptomonadina, 133, 134. Volvocina, pp. 154, 156. Hydromonua, pp. 196, 197. New York, 1880.
- FARLOW, W. G.—Remarks on Some Algæ found in the Water Supplies of the City of Boston. 1877.
- FARLOW, W. G.—Swarm-spores of Closterium. Amer. Month. Micr. Journ., vol. iii, p. 118. New York, 1882.
- FARLOW, W. G.—Relations of Certain Forms of Algæ to Disagreeable Tastes and Odors, Science, vol. ii, p. 333. 1883.
- FISHER, J. H.—Notes on the Structure, Development, and Position of an Undescribed Flagellate Infusorian. Proc. Amer. Soc. Micr., 1880, pp. 44, 49, 2 plates. Buffalo, 1881.
- FORBES, S. A.—On the Food of Young Fishes. Illinois State Laboratory of Nat. His., Bull. No. 3, pp. 66, 79. Normal. 1880.
- FORBES, S. A.—On the First Food of the Whitefish. American Field, vol. xvii, No. 2, p. 171. 1882.

- FORBES, S. A.—A Remarkable New Rotifer. *Amer. Month. Micr. Journ.*, vol. iii, pp. 102, 103. New York, 1882.
- FORBES, S. A.—On Some Entomostracea of Lake Michigan and Adjacent Water. *Amer. Nat.*, vol. xvi, pp. 537, 542, 640, 649, 2 plates. 1882.
- FOULKE, S. G.—Some Phenomena in the Life-history of *Clathrulina elegans*. *Proc. Acad. Nat. Sci.*, 1884, pp. 17, 19. Philadelphia, 1884.
- FOULKE, S. G.—On a New Species of Rotifer, of the Genus *Apsilus*. *Proc. Acad. Nat. Sci.*, 1884, pp. 37, 41, 1 plate. Philadelphia, 1884.
- FOULKE, S. G.—Some Notes on *Manayunkia speciosa*. *Proc. Acad. Nat. Sci.*, 1884, pp. 48, 49. Philadelphia, 1884.
- FOULKE, S. G.—A New Species of *Trachelius*. *Proc. Acad. Nat. Sci.*, 1884, pp. 51, 52. 1884.
- GISSLER, C. F.—Contributions to the Fauna of the New York Croton Water. *Microscopical Observations during the Years 1870-71*. New York, 1872.
- GISSLER, C. F.—Variations in a Copepod Crustacean. *Amer. Nat.*, vol. xv, pp. 689, 698, woodcut. Philadelphia, 1881.
- GISSLER, C. F.—Evidences of the Effect of Chemic-Physical Influences in the Evolution of Branchipod Crustaceans. *Amer. Nat.*, vol. xv, pp. 280, 282. Philadelphia, 1881.
- GISSLER, C. F.—A Singular Parasitic Isopod Crustacean, and Some of its Developmental Stages. *Amer. Nat.*, vol. xv, pp. 6, 12, 2 plates and woodcuts. Philadelphia, 1882.
- GISSLER, C. F.—The Crab Parasite *Sacculina*. *Amer. Nat.*, vol. xviii, pp. 225, 229, woodcuts. Philadelphia, 1884.
- GLEASON, S. O.—The Study of Infusoria. *Amer. Month. Micr. Journ.*, vol. ii, pp. 109, 111. New York, 1881.
- HALSTED, B. D.—Reproduction in Fresh Water Algae. *Amer. Nat.*, vol. xi, pp. 513, 524, woodcuts. Philadelphia, 1877.
- HARVEY, A. B.—The Classification of the Algae. *Amer. Quart. Micr. Journ.*, vol. i, pp. 116, 122, 1 plate. New York, 1878-79.
- HERRICK, C. L.—Fresh Water Entomostraca. *Amer. Nat.*, vol. xiii, pp. 620, 624, 3 plates. Philadelphia, 1879.
- HERRICK, C. L.—A New Cyclops. *Geol. Nat. Hist. Sur. Minn.*, 5 Ann. Rept., pp. 238, 239, 2 woodcuts. 1877.
- HERRICK, C. L.—Papers on the Crustacea of the Fresh Waters of Minnesota. *Rept. Geol. Nat. Hist. Sur.* 1881.
- HERRICK, C. L.—Heterogenetic Development in *Diaptomus*. *Amer. Nat.*, vol. xvii, pp. 381, 389, 499, 505, 794, 3 plates. Philadelphia, 1883.

- HERRICK, C. L.—A Final Report on the Crustacea of Minnesota included in the Orders Cladocera and Copepoda. 12th. Ann. Repor. Geol. and Nat. Hist. Survey Minn., 1883, pp. 1-191, pls. a-v. 1884.
- HILGARD, T. C.—The Fresh Water Algae as the Spawns of Moses. Proc. Amer. Assoc. Adv. Sci., 1871, vol. xx, pp. 352, 384. 1872.
- HINE, F. B.—Observations on Several Forms of Saprolegniae. Amer. Quart. Micr. Journ., vol. i, pp 18, 28, 136, 146, 4 plates. New York, 1878-79.
- HITCHCOCK, R.—Notes on Fresh Water Algae. Amer. Month. Micr. Journ., vol. i, p. 7. New York, 1880.
- HITCHCOCK, R.—Croton Water in August. Amer. Month. Micr. Journ., vol. ii, pp. 153, 157, 172. New York, 1881.
- HITCHCOCK, R.—The Phenomena of Growth among Microscopic Forms of Life. Amer. Month. Micr. Jour., vol. iii, pp. 28, 34. New York, 1882.
- HITHCOCK, R.—The Development of Pleurococcus. Amer. Month. Micr. Journ., vol. iv, p. 171. New York, 1883.
- HOLLAND, F.—Reproduction of Closterium by Swarm-spores. Amer. Month. Micr. Journ., vol. iii, p. 42, 43. New York, 1882.
- HAY, P. R.—Deep Water Fauna of Lake Michigan. Tran. Wis. Aca. Sci. Arts, etc., 1870-72, pp. 89, 101. Madison, 1872.
- HYATT, A.—The Moss-animals, or Fresh Water Polyzoa. Amer. Nat., vol. i, pp. 57-64, 131-136, 180-186, 3 plates. Salem, 1868.
- HYATT, A.—The Boring Sponge. Does it Excavate the Burrows in which it is Found? Amer. Month. Micr. Journ., vol. iii, pp. 81-84. New York, 1882.
- HYATT, J. D.—Sporadic Growth of Certain Diatoms and the Relation thereof to Impurities in the Water-supply of Cities. Proc. Amer. Soc. Micr., pp. 197-199. 1882.
- KELLCOTT, D. S.—Notes on Microscopic Life in the Buffalo Water-supply. Amer. Journ. Micr. Pop. Sci., vol. iii, pp. 250-252. New York, 1878.
- KELLCOTT, D. S.—Some Observations on Pond Life. Amer. Journ. Micr. Pop. Sci., vol vi., pp. 169-172. New York, 1881.
- KELLCOTT, D. S.—Observations and Notes. (*Clathrulina elegans*, Polyzoa.) Bull. Buff. Soc. Nat. Sci., vol. iv, pp. 61, 62. Buffalo, 1882.
- KELLCOTT, D. S.—Polyzoa. Observations on Species detected near Buffalo, N. Y. Proc. Amer. Soc. Micr., pp. 217-229. Buffalo, 1882.
- KELLCOTT, D. S.—On Some Infusoria Found on the Cray-fish. Proc. Amer. Soc. Micr., pp. 105-111, wood-cuts. Buffalo, 1883.

- KINGSLEY, J. D.—The Development of *Moina*. Amer. Nat., vol. xiv, pp. 115, 116, wood-cuts. Philadelphia, 1880.
- LEIDY, J.—*Amœba Proteus*. Amer. Journ. Micr. Pop. Sci., vol. iii, pp. 86, 87. New York, 1878. Amer. Nat., vol. xii, pp. 235-238. Philadelphia, 1878.
- LEIDY, J.—Fresh Water Rhizopods of North America. 324 pp., 46 plates. Washington, 1879.
- LEIDY, J.—Remarks on Pond Life. Proc. Acad. Nat. Sci., pp. 156-158. 1880.
- LEIDY, J.—Notice of Some Aquatic Worms of the Family Naidæ. Amer. Nat., vol. xiv, pp. 421. Philadelphia, 1880.
- LEIDY, J.—Rotifera with Rotary Organs. Proc. Acad. Nat. Sci., pp. 243-248, 1 ^{out} plate. Philadelphia, 1882.
- LEIDY, J.—On *Actinosphærium Eichhornii*. Proc. Acad. Nat. Sci., pp. 260-262. 1883.
- LEIDY, J.—A New Infusorian belonging to the Genus *Pyxicola*. Proc. Acad. Nat. Sci., pp. 252, 253. 1883.
- LEIDY, J.—*Dictyophora* as *Apsilus vorax*. Proc. Acad. Nat. Sci., pp. 50, 51. 1884.
- LEIDY, J.—On *Manayunkia*. Proc. Acad. Nat. Sci., pp. 302, 303. 1884.
- LEIDY, J.—*Urnatella Graciles*. A Fresh-water Polyzoan. Journ. Acad. Nat. Sci., vol. ix, pp. 1-16, 6 wood-cuts and 1 plate. Philadelphia, 1884.
- LEWIS, F.W.—On Some New and Singular Intermediate Forms of Diatomaceæ. Proc. Acad. Nat. Sci., vol. xv, pp. 337-346, 1 plate. Philadelphia, 1863.
- LEWIS, F. W.—On Extreme and Exceptional Variation of Diatoms in some White Mountain Localities. Proc. Acad. Nat. Sci., vol. xvii, pp. 7-18, 2 plates. Philadelphia, 1865.
- LEWIS, W. B.—Report on the Microscopical Examination of the Croton and Ridgewood Waters. 1870.
- MICHEL, A. J.—Cannibalism of the *Amœba*. Amer. Journ. Micr. Pop. Sci., vol. ii, pp. 87, 88. New York, 1877.
- MILLS, H.—Microscopic Organisms in the Niagara River. Amer. Journ. Micr. Pop. Sci., vol. iii, p. 139. New York, 1878.
- MILLS, H.—A Month Pond Hunting. Amer. Journ. Micr. Pop. Sci., vol. vi, pp. 173, 174. New York, 1881.
- MILLS, H.—*Vaginicola Valvata*. Amer. Journ. Micr. Pop. Sci., vol. vi, pp. 25, 26, 1 plate. New York, 1881.
- MILLS, H.—New Fresh Water Sponges. Amer. Journ. Micr. Pop. Sci., vol. vi, p. 30. New York, 1881.
- MILLS, H.—Motion of Diatoms. Amer. Month. Micr. Journ., vol. iii, p. 8. New York, 1882.
- MILLS, H.—Microscopic Organisms in the Buffalo Water Supply and in Niagara River. Proc. Amer. Soc. Micr., pp. 165-175. Buffalo, 1882.

- MILLS, H.—Fresh Water Sponges, Proc. Amer. Soc. Micr., pp. 209–216, 1 plate. Buffalo, 1882.
- MILLS, H.—Serial Arrangement of Birotulata Spicules in Statoblasts of American Sponges. Amer. Month. Micr. Journ., vol. v, pp. 42, 43. Washington, 1884.
- NICHOLS, Prof., Drs. FARLOW and BURGESS.—Report on a Peculiar Condition of the Water supplied to the City of Boston. 1875–76.
- NICHOLS, Prof., and Dr. FARLOW.—Reports on Matter Connected with the Boston Water Supply. 1877.
- OLNEY, S. T.—Algæ Rhodiaceæ, a List of Rhode Island Algæ. The Lens, vol. i. pp. 129–135. Chicago, 1872.
- ONDERDONK, C.—The Movement of Diatoms. Amer. Month. Micr. Journ., vol. iv, pp. 61, 62. New York. 1883.
- PACKARD (JR.), A. S.—A Monograph of the Phyllopod Crustacea of North America, with Remarks on the Order Phyllocarida. Hayden's 12th Ann. Rep. U. S. Geol. and Geog. Survey, Part i, 1878, pp. 295–457, 39 plates. 8vo. Washington, 1883. This Monograph contains a Bibliography on Phyllopoda and Phyllocarida.
- PALMER, A. C.—Naias Flexilis and Cyclosis. Am. Month. Micr. Journ., vol. iii, pp. 150, 151. New York, 1882.
- PARKER, A. J.—Reproduction of Amphileptus fasciola. Proc. Acad. Nat. Sci., 1883, pp. 313, 314. 1884.
- POTTS, E.—On Fresh Water Sponges. Proc. Acad. Nat. Sci., pp. 356, 357. 1880.
- POTTS, E.—The Genus Carterella vs. Spongiophaga Pottsi. Proc. Acad. Nat. Sci., pp. 460–462. 1882.
- POTTS, E.—A New Form of Fresh Water Sponge. Proc. Acad. Nat. Sci., 176. 1881.
- POTTS, E.—Three more Fresh Water Sponges. Proc. Acad. Nat. Sci., pp. 12–14. 1882.
- POTTS, E.—Sponges from the Neighborhood of Boston. Proc. Acad. Nat. Sci., pp. 69, 70. 1882.
- POTTS, E.—Fresh Water Sponges, what, where, when, and who wants them. Bull. U. S. Fish Commission, vol. iii, pp. 389–391. Washington, 1883.
- POTTS, E.—Fresh Water Sponges as Improbable Causes of the Pollution of River Water. Proc. Acad. Nat. Sci., 1884, pp. 28–30. 1884.
- POTTS, E.—Note on Manayunkia Speciosa. Proc. Acad. Nat. Sci., 1884, pp. 21, 22. 1884.
- PRIEST, B. W.—Statoblasts of the Fresh Water Sponges. Amer. Month. Micr. Journ., vol. iv, pp. 208–213. New York, 1883.
- REMSEN, IRA.—On the Impurity of the Water Supply, Boston. 1881.
- RICHTER, P.—Form Cycle of Glæocystis. Amer. Month. Micr. Journ., vol. ii, pp. 25–28, 52, 53. New York, 1881.

- SHULTZ, C. S.—*Volvox Globator*. (Where they may be found.) Amer. Journ. Micr. Pop. Sci., vol. iii, p. 91. New York, 1878.
- SMITH, H. L.—Notes on Cent. I. of the Species Typicae Diatomacearum. Amer. Journ. Micr. Pop. Sci., vol. ii, pp. 99-103, 127-129, 164-167. New York, 1878.
- SMITH, H. L.—Description of New Species of Diatoms. Amer. Quart. Micr. Journ., vol. i, pp. 12-18, 1 plate. New York, 1878-79.
- SMITH, H. L.—Fineness of Striation as a Specific Character of Diatoms. Amer. Month. Micr. Journ., vol. ii, pp. 221-223. New York, 1881.
- SMITH, H. L.—Desmids and Diatoms. Amer. Month. Micr. Journ., vol. iii, pp. 84, 85. New York, 1882.
- SMITH, H. L.—*Rhizosolenia gracilis*, N. Sp. Proc. Amer. Soc. Micr., pp. 177, 178. Buffalo, 1882.
- SMITH, S. J.—The Crustacea of the Fresh Water of the United States. Rept. U. S. Fish Comm., 1872-73, pp. 637-661. Washington, 1874.
- SMITH, S. J.—The Crustacean Parasites of the Fresh Water Fish of the United States. Rept. U. S. Fish Comm., 1872-73, pp. 661-665. Washington, 1874.
- SMITHS, S. J.—Sketch of the Invertebrate Fauna of Lake Superior. Rept. U. S. Fish Comm., 1872-73, pp. 690-707. Washington, 1874.
- STOKES, A. C.—Leaves from a Summer Note Book. Amer. Journ. Micr., and Pop. Sci., vol. vi, pp. 189-194, 1 plate (*Clathrulina elegans*). New York, 1881.
- STOKES, A. C.—*Sphagnun*, Desmids, Rhizopods, Eels. Amer. Month. Micr. Journ., vol. iii, pp. 152, 153. New York, 1882.
- STOKES, A. C.—A New Theoricola. Amer. Month. Micr. Journ., vol. iii, pp. 182, 183. New York, 1882.
- STOKES, A. C.—A Food Habit of *Diffugia pyriformis*. Amer. Month. Micr. Journ., vol. iii, p. 93. New York, 1882.
- STOKES, A. C.—A New Vorticella. Amer. Month. Micr. Journ., vol. iv, p. 208. New York, 1883.
- STOKES, A. C.—New Members of the Infusorial Order Choano-Flagellatae, S. K. Amer. Month. Micr. Journ., vol. iv, pp. 204-208. New York, 1883.
- STOKES, A. C.—Notes on Some Apparently Undescribed Infusoria from Putrid Waters. Amer. Nat., vol. xviii, pp. 133-140, woodcuts. Philadelphia, 1884.
- STOKES, A. C.—Notes on a New Infusorian. Amer. Nat., vol. xviii, pp. 659-664, woodcuts. Philadelphia, 1884.
- STOKES, A. C.—A New Infusorian belonging to the Genus *Pyxicola*. Amer. Month. Micr. Journ., vol. v, pp. 25, 24. Washington, 1884.

- STOKES, A. C.—Has Salpingoëca Urceolata, S. K., a Fresh Water Habitat. Amer. Month. Mic. Journ., vol. v, pp. 25, 26. Washington, 1884.
- STOKES, A. C.—New Member of the Infusorial Order Choamo—Flagellata, S. K. Amer. Month. Mic. Journ., vol. v, pp. 43-45. Washington, 1884.
- STOKES, A. C.—Notices of New Fresh Water Infusoria. Amer. Month. Mic. Journ., vol. v, pp. 121-125, woodcuts. Washington, 1884.
- STOKES, A. C.—Phialonema Cyclostomum, Stein. Amer. Month. Mic. Journ., vol. v, pp. 142. Washington, 1884.
- STOKES, A. C.—Notices of Some New Parasitic Infusoria. Amer. Nat., vol. xviii, pp. 1081-1086, 4 woodcuts. Philadelphia, 1884.
- THOMAS, B. W.—Microscopical Examination of the Water of Lake Michigan. Third Annual Report, Dept. Public Works. Chicago, 1879.
- TORREY, J.—Microscopical Examination of the Croton Water. Ann. Rept. Croton Aqueduct, 1859, pp. 28-33. New York, 1860.
- UP DE GRAFF, T. S.—Descriptions of Certain Worms. Proc. Amer. Soc. Mic., 1883, pp. 117-119. Buffalo, 1883.
- VERRILL, A. E.—Synopsis of the North American Fresh Water Leeches. Report U. S. Fish Comm. 1872-73, pp. 636-689. Washington, 1874.
- VORCE, C. M.—Is it Tintinnus? Amer. Month. Mic. Journ., vol. ii, pp. 223-234. New York, 1881.
- VORCE, C. M.—Forms observed in Water of Lake Erie. Proc. Amer. Soc. Mic., pp. 51-60, 1 plate. Buffalo, 1881.
- VORCE, C. M.—Microscopic Forms observed in Water of Lake Erie. Proc. Amer. Soc. Mic., pp. 187-196, 1 plate. Buffalo, 1882.
- VORCE, C. M.—The Motion of Diatoms. Amer. Month. Mic. Journ., vol. iii, pp. 43-45. New York, 1882.
- W. J.—Fresh Water Algæ. (Minneapolis, Minn.) Amer. Month. Mic. Journ., vol. iv, p. 18. New York, 1883.
- W. J.—Notes on Stentor Cæruleus, or the Blue Stentor. Amer. Month. Mic. Jour. Washington, 1884.
- WALLER, E.—Report on Croton Water during the Years 1876 and 1877. Amer. Month. Mic. Jour., vol. ii, p. 238. New York, 1881.
- WAGSTAFF, E. H.—Pond Life in Winter. Amer. Month. Mic. Jour., vol. v, pp. 144-145. Washington, 1884.
- WOLLE, F.—Fresh Water Algæ. Bull. Torrey Bot. Club. vol. vi, pp. 121-123, 137-142, 181-189. 1875. I. II. III.
- WOLLE, F.—Dubious Character of Some of the Genera of Fresh Water Algæ. Amer. Quart. Mic. Journ., vol. i, pp. 205-208, 1 plate. New York, 1878-79.

- WOLLE, F.—Cell-multiplication in *Chantransia Violacea*. Amer. Month. Mic. Journ., vol. i, p. 43. New York, 1880.
- WOLLE, F.—Notes on the Fresh Water Algæ. Amer. Month. Mic. Journ., vol. i, pp. 83-121. New York, 1880.
- WOLLE, F.—Algæ, Exsiccatae. Amer. Month. Mic. Journ., vol. ii, p. 15. New York, 1881.
- WOLLE, F.—Fresh Water Algæ. Amer. Month. Mic. Journ., vol. iii, pp. 147-148. New York, 1882.
- WOLLE, F.—Fresh Water Algæ. Bull. Torrey Bot. Club., N. Y.
 Vol. vii, pp. 43-48, 1 plate, iv, 1880.
 Vol. viii, pp. 37-40, v, 1881.
 Vol. ix, pp. 1-4, 1 plate, vi, 1881.
 Vol. x, pp. 13-21, 1 plate, vi, 1883.
 Vol. xi, 13-17, 1 plate, vii, 1884.
- WOLLE, F.—Desmids of the United States and List of American Pediastrums, with Eleven Hundred Illustrations on Fifty-three Colored Plates. Bethlehem, 1884.
- WOLLE, F.—Rotifer Nests. Amer. Month. Mic. Journ., vol. iii, pp. 101-102. New York, 1882.
- WOLLE, F.—Notes on the Desmidiæ of the United States. Proceed. Amer. Soc. Micr., 1883, pp. 137-139. Buffalo, 1883.
- WOOD, H. C.—A Contribution to the History of the Fresh Water Algæ of North America. Smithsonian Contribution to Knowledge, vol. xix. Washington, 1874.

New York Botanical Garden Library
 QK 129 .G7 c.2
 Gratacap, Louis Pop/Fresh water flora an gen

 3 5185 00127 0592

PAMPHLET BINDERS

This is No. 1523

also carried in stock in the following sizes

	HIGH	WIDE	THICKNESS		HIGH	WIDE	THICKNESS
1523	9 inches	7 inches	$\frac{1}{2}$ inch	1529	12 inches	10 inches	$\frac{1}{2}$ inch
1524	10 "	7 "	"	1530	12 "	9 $\frac{1}{8}$ "	"
1525	9 "	6 "	"	1932	13 "	10 "	"
1526	9 $\frac{3}{4}$ "	7 $\frac{1}{8}$ "	"	1933	14 "	11 "	"
1527	10 $\frac{1}{2}$ "	7 $\frac{3}{8}$ "	"	1934	16 "	12 "	"
1528	11 "	8 "	"				

Other sizes made to order.

MANUFACTURED BY
LIBRARY BUREAU

DIVISION OF SPERRY RAND CORPORATION
 Library Supplies of all Kinds