STATE OF NEW YORK.

THIRTY-NINTH ANNUAL REPORT

OF THE

New York State Museum of Natural History,

BY THE

REGENTS OF THE UNIVERSITY.

1886.

Compliments of the author,

JAMES HALL,

State Geologist.

THIRTY-NINTH ANNUAL REPORT

OF THE

TRUSTEES

OF THE

State Museum of Natural History

FOR THE YEAR 1885.

TRANSMITTED TO THE LEGISLATURE JANUARY 14, 1886.

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IN ASSEMBLY,

JANUARY 14, 1886.

THIRTY-NINTH ANNUAL REPORT

OF THE TRUSTEES OF THE STATE MUSEUM OF NATURAL HISTORY.

To the Legislature of the State of New York:

I have the honor to transmit herewith the Thirty-ninth Annual Report of the Regents of the University as Trustees of the New York State Museum of Natural History, as required by law.

H. R. PIERSON,

Chancellor.

OFFICE OF THE REGENTS, *January* 13, 1886.

BOARD OF REGENTS.

TRUSTEES OF THE STATE MUSEUM.

Arranged in the Order of Their Appointment.

Museum Staff.

CONTENTS.

REPORT OF THE CHANCELLOR.

To the Legislature of the State of New York:

The Regents of the University, as Trustees of the State Museum of Natural History, respectfully submit their thirty-ninth annual report as required by law.

The ordinary operations of the Museum have been conducted without special incident, but with much activity and with substantial results. More than the usual amount of field-work has been undertaken, with a double view of settling certain important geological questions, and increasing the collections of the Museum in needed directions. For a fuller account of the purpose and results of these geological excursions the Trustees refer to the report of the Director, which is hereto appended. The international geological congress, held this year in Berlin, seemed an occasion of such importance as to justify the attendance of the Director. Accordingly, under leave of absence from the Trustees, he attended the sessions in October last, returning after an absence of only a few weeks from a most profitable and interesting conference. Acting in connection with other scientific bodies located in Albany, the Trustees joined in an invitation to the National Academy of Sciences to hold their autumn meeting in Albany. The meetings were held in rooms in the new Capitol, placed at their disposal by the trustees of public buildings. The sessions were well attended and were full of scientific interest, especially in those sciences represented by the State Museum.

The work of fitting up the State Hall for the purposes of the State Museum has been carried forward as far as the release of the rooms by the State officers will permit. The suite of rooms on the east side of the upper story has been fitted up with about two thousand drawers, and with tables and platform cases. These have been partially filled with material taken from the old Museum building, and from the State collections stored in rented buildings. The south-east basement room has also been fitted up and used for the storage of specimens. The north-east basement room has also been fitted up for the purpose of carrying on the work of making rock-sections, which have now become essential in all minute geological studies. Two rooms on the south-west corner of the second story, which were vacated by the Clerk of the Court of Appeals, have also been occupied, one by the State Herbarium and the office of the State Botanist, and the other as a present place for the storage of volumes of the Palæontology.

The Trustees are able to report the preparation and issue of the second volume of Palæontology, placed by law under their care. Owing to the ill-health of the Director in the earlier part of the year, and his necessary engagement with other imperative duties, the issue of the volume has been delayed beyond the stipulated time; but the unprecedented difficulty of the task of preparing such a work, and the care involved in securing the exquisitely delicate illustrations have made the delay entirely pardonable, and indeed inevitable. The work now issued completes the volumes on the Lamellibranchiata, which were provided for by the law of 1883. The next volume to be issued is upon the Corals and Bryozoa, and is already in a good degree of forwardness.

The preparation and distribution of collections of fossils among the academies of the State have been carried on as far as the strength of the staff would permit. The Museum contains an immense mass of duplicates of various departments which can be used for this purpose, and it is the wish and purpose of the Trustees to use this material for distribution among institutions of learning in the State. It is not, however, in the opinion of the Trustees, desirable to make this distribution so far indiscriminating as to give collections in places where they are not likely to be used with profit. It seems better to make the gift only to schools, where some interest is awakened in the subject of geology, and where, in consequence, the collections sent will be of substantial benefit.

Respectfully submitted,

H. R. PIERSON,
Chancellor.

DAVID MURRAY,
Secretary.

REPORT OF THE DIRECTOR.

ALBANY, *January*, 1886.

To the Honorable, the Board of Regents of the University of the State of New York:

GENTLEMEN — Under the requirements of the law organizing the State Museum, I beg leave herewith to communicate the annual report (being the thirty-ninth in consecutive order) upon the conditions of the collections in the several departments as far as the same have come under my knowledge or direction, with a statement of the additions made thereto, and the work done in the Museum during the past year.

The report of last year has been printed and delivered, some months since, and the series is now complete with the exception of the thirty-second report, which exists only as a legislative document. That report is an important one, and I would most earnestly recommend the early reprinting of the same, together with the plates which accompanied the original report on its presentation to the Legislature, but which were not published with the document edition.

Under the conditions of the public printing existing at the time this report was made, and also from the fact that no resolution was passed ordering the usual number of copies for the Board of Regents, I see no impropriety in re-communicating this report to the Legislature, accompanied by a statement of the facts, and leave the matter to the discretion of the committee on public printing.

In order to avoid longer delay I have herewith communicated, from the Thirty-second Report, an important paper on the Annelidæ Chaetopoda, which was printed in that Report without the accompanying illustrations. These had been mislaid by the printer, and were supposed to be lost until last year.

I have likewise communicated a copy of a "Report on Building Stones," made to the Capitol Commissioners in 1868.

It was originally the intention of the Director to make this report more complete by farther examinations of quarries within the State and elsewhere, and to insert the results of tests of strength which had been made during the investigations undertaken for the Capitol Commissioners, but other duties have prevented this work, and the report is offered as a small contribution to our knowledge on the subject.*

* Two hundred and fifty copies of the Report were printed by the Capitol Commissioners, and the pamphlet is now out of print.

In my preceding report, I have called your attention to the catalogues accompanying the thirty-fifth report on the State Museum, and the desirableness of having some extra copies of these catalogues for distribution to persons engaged in similar departments of science, and for annotations by the Museum staff, and by employees or friends of the Museum. The reports are, I believe, all stereotyped, and the expense of such copies would be very small.

It has been my desire to have complete catalogues of the contents of the Museum in its several departments; but with our limited staff, and absence of clerical assistance, it has not been possible to accomplish the work farther than has been shown in the successive reports. These catalogues of the thirty-fifth to thirty-eighth reports will be extremely useful in the preparation of a final catalogue of the Museum collections; and I would recommend the preparation of catalogues of the specimens in other departments of the Museum.

Owing to the necessity of completing the volumes upon Palæontology, the preparation of a bulletin on the fossil Lamellibranchiata, which was proposed two years since, has been delayed. From the same cause no farther progress has been made toward the publication of the Dictyospongidæ, the illustrations of which were brought before you last year. It is desirable that the lithographing of the illustrations be proceeded with, since a considerable time will be required to accomplish this part of the work; and more especially, I would urge this course since the descriptions of all the known species of the family are already printed in the thirty-fifth report.

I have appended to this report a statement of the space now occupied, and an estimate of the space required, for the collections and offices of the State Museum of Natural History, as the same existed in 1883. This, although communicated for the use of the Trustees at that time, has not been printed. I communicate the statement at this time, since it may be useful to have the same in print, for future reference and comparison.

In the last annual report of the Director, reference was made to the exhibit of the State of New York at the New Orleans Exposition. The collection for this purpose, consisting of ores, minerals, building stones, slates, and other natural products of the State, was made in months of October and November, 1884, under the direction and supervision of the Director of the Museum, and nearly all of the material was obtained by Mr. Chas. E. Hall, who visited mines, quarries and mineral localities for this purpose, making large collections himself, and receiving donations from many gentlemen interested. The whole was made without cost to the Museum, excepting the time given to it by the Director. At the close of the Exposition a large part of the whole collection was donated to the Tulane University in New Orleans, and also some portions to the University of Louisiana. To the former, among other material, was given the rock-column representing the geological formations of the State of New York. The remainder, consisting of the native woods of the State, the building-stones, slates and other natural products, has been given to the State Museum by the Commissioner, Hon. D. J. Johnston, of Cohoes. The collection was received in the early part of the summer, was unpacked and placed on exhibition temporarily on tables and pyramidal shelf-cases in the north-east room (No. 31) of the upper story of the State Hall. Recently it has been removed to the south-west corner room on the second floor of the same building, and there arranged on cases so as to be more accessible to the public. There are eighteen dressed and varnished specimen planks of native woods of the State; forty-six specimens of iron ores and associated minerals; twelve specimens of serpentine and ornamental stones; thirty-five of roofing and ornamental slates, and blocks of slate rock; eleven of miscellaneous natural products; and thirty-eight dressed blocks of building stone. The whole makes an interesting exhibit of the economic geological products of the State, and a valuable addition to the already large collection of building stones and iron ores belonging to the Museum. These together with the Museum collection will form a nucleus for a more specialized exhibit of all the natural products representing the economic geology of the State.

The appended list of specimens has been prepared by Charles E. Hall who had charge of the collection at New Orleans.

Current Work of the Museum.

The current work of the Museum, in the care, increase and preservation of the collections, has been carried on as usual.

In regard to the general Zoölogical Collection, I would beg leave to repeat the views which I expressed in my report of last year. I see no reason for any change at the present time, more especially as our resources are all needed in other work of more importance to the Museum, and to the general public. This collection has been cared for in the usual manner. The stuffed skins and the skeletons have been removed from their cases, and thoroughly cleaned, and restored to their positions, with some modifications of arrangement. The specimens in all the other collections of this department have been cleaned of dust, and restored to their former positions.

The reports on Botany and Entomology will show you that a large amount of work has been done in these departments.

The preparation of sections of fossil corals, for the study of their structure, and the cutting, shaping and polishing of specimens for the Museum collection, has been carried on as heretofore, and with very satisfactory results.

During the year 1885, 1,029 specimens of rocks and fossils, arranged in seven collections, were distributed among the following institutions:

1. Academic High School........................Auburn, N.Y.
   G. R. Cutting, *Principal.*
2. Canastota Union School and Academy.........Canastota, N.Y.
3. Hancock Union School.......Hancock, Delaware County, N.Y.
4. Kingston Academy...........................Kingston, N.Y.
   F. J. Cheney, *Principal.*

5. Staten Island Academy.......................Stapleton, N.Y.
F. E. Partington, *Principal.*
6. Ithaca High School............................Ithaca, N.Y.
7. Stamford Seminary and Union Free School.....Stamford, N.Y.
A. Gardenier, *Principal.*

No. 16 of the original Normal School collections, containing 487 specimens of minerals and fossils, together with a catalogue of the same, was sent to the

Ithaca High School................................Ithaca, N.Y.

The collections removed from the State Museum to the State Hall during the past year and arranged in drawers and table cases are as follows:

The Gould types of Mollusca, arranged in table cases.

The types of the Cephalopoda of Vol. V, pt. II, Palæontology of N. Y., arranged in drawers.

The Niagara Waldron selected collection and types, arranged in table cases.

The Emmons collection of crystallized minerals, arranged in table cases.

A collection of miscellaneous minerals, occupying about thirty drawers.

The collections sent to the State Hall from the private museum and laboratory of Mr. Hall, and heretofore in his custody, are as follows:

Niagara and Clinton groups of Canada — A collection presented to the museum through the Director, from Mr. Waddell, of Hamilton, Ontario, occupying twenty drawers; other collections from Hamilton made by the Museum, occupying five drawers; Clinton group of New York, four drawers.

Niagara group — Waldron collection, arranged in 330 drawers, with 110 slabs arranged on shelves. Seven boxes and one package of this collection still remain in the basement of the State Hall to be unpacked and arranged.

Coralline limestone, three drawers.

Lower Helderberg corals, eighteen drawers.

Oriskany sandstone, four drawers.

Corniferous limestone, corals arranged in 396 drawers.

Large specimens of corals and slabs of same arranged on tables and shelves, over 550 specimens.

Corals of the Corniferous limestone in the basement of the State Hall, twenty-six boxes, fourteen barrels, and over 200 on shelves, besides others not enumerated.

Corniferous Limestone, fish remains occupying four drawers, and Gasteropoda, six drawers.

Hamilton group, corals arranged in seventy-two drawers, with slabs on tables and shelves.

Geological specimens, Lake Champlain, two drawers.

Minerals and fossils from the Skaneateles Library Association (in exchange), Trenton and Black River limestone, three drawers.

Numerous slabs of fossils from various geological formations, on shelves and tables.

Besides the above collections and others not enumerated, there are about 200 boxes filled with fossils from various geological formations, which have been removed from Mr. Hall's premises, and are now stored in the basement of the State Hall.

The two basement rooms in the south-east corner of the State Hall are so filled with boxes and casks of specimens that we are already greatly inconvenienced in any attempt at working. The room in the south-east corner is partially occupied by our boxes of fossils, but we have not control of the same, and it cannot be used as a working-room.

The collections of specimens representing the fossil Lamellibranchiata of the Upper Helderberg, Hamilton and Chemung groups have now been pretty thoroughly studied, and the species are separated and arranged in drawers in the private museum of the Director. Altogether, these fossils occupy about 800 drawers, and number more than 30,000 specimens. The second volume of the work, describing these fossils, being now completed, it is important that the specimens be correctly labeled before being removed from their present arrangement to the State Hall. As soon as this labeling can be completed, I would recommend that selections of specimens be made sufficient for any future use of the Museum, both for its collections and for exchanges; and that the remainder be arranged in series for distribution to the educational institutions of the State. This work will require much time and careful attention on the part of the Director and his special assistant, as well as additional assistance.

I would most earnestly recommend that the Director be authorized to employ competent assistants beyond the present Museum staff, and begin the work of distribution of all the duplicate fossils. If this work be not undertaken pretty soon, and while the services of persons competent for the work are available, I am quite sure it will never be done. The fossils in the unarranged and duplicate collections amount to nearly half a million of specimens, and to dispose of this enormous amount of material in a judicious manner will require most vigorous and earnest work, combined with knowledge of the subjects.

The details of this work and the disposition of the collections to result therefrom may be a subject for special future discussion and determination; and while the educational institutions of the State deserve the first consideration, I believe that it is due from the New York State Museum of Natural History, that authentic collections of these fossils shall be presented, or given in exchange, to the scientific museums of this country and Europe.

The Palæontology of New York has presented much that is new and very interesting to the science; these volumes are in all the scientific libraries of the world, and I believe it our duty to supplement this source of information with the more tangible evidence afforded by the fossils themselves; for while our illustrations are not inferior to any, and are superior to the majority of similar publications, every palæontologist appreciates the importance of working directly with the fossils themselves.

Very respectfully,

Your obedient servant,

JAMES HALL,

Director, State Museum of Natural History.

ADDITIONS TO THE STATE MUSEUM DURING THE YEAR 1885.

APPENDIX A.

I. Botanical Department.

Specimens of *Trillium grandiflorum* Salisb. var. *variegatum*, from Mrs. L. L. Goodrich, Syracuse, N. Y.

Specimens of the fruit of *Salisburia adiantifolia* Sm., from Miss E. G. Knight, New York, N. Y.

Specimens of *Festuca elatior* L., from Mrs. L. A. Millington, New Russia, N. Y.

Specimens of *Pyxidanthera barbulata* Mx., from Mrs. M. M. Patten, Albany, N. Y.

Specimens of *Hydrocotyle umbellata* L. and *Cypripedium acaule* Ait., from Rev. W. M. Beauchamp, Baldwinsville, N. Y.

Specimens of eleven species of grasses, from F. Lamson Scribner, Washington, D. C.

Specimens of ten species of flowering plants and one fern, from F. E. Wood, Clifton, Mich.

Specimens of *Puccinia Cryptotæniæ* Pk., from W. C. Stevenson, Jr., Philadelphia, Pa.

Specimens of *Crantzia lineata* Nutt., from E. S. Miller, Wading River, N. Y.

Specimens of the rare fungus, *Siphoptychium Casparya* Rostf., from Geo. A. Rex, M. D., Philadelphia, Pa.

Specimens of five species of fungi, from E. A. Rau, Bethlehem, Pa.

Specimens of nine species of flowering plants, two of them new to the State, from E. C. Howe, M. D., Lansingburgh, N. Y.

Specimens of fifteen flowering plants, from H. C. Gordinier, Troy, N. Y.

Specimens of five species of fungi new to the State, from Hon. G. W. Clinton.

Specimens of *Populus balsamifera* L., from Arthur Peck, Sandlake, N. Y.

Specimens of a root with a peculiar enlargement, from C. Vandeloo, Albany, N. Y.

Specimens of *Cylindrosporium Rubi* E. & M., from J. J. Brown, M. D., Sheboygan, Wis.

Specimens of the very rare fern, *Schizea pusilla* Pursh, from Geo. L. English, Philadelphia, Pa.

Specimens of eighty-four species of fungi, from W. A. Kellerman, Manhattan, Kansas.

Specimens of one hundred and fifty-five species of fungi, from H. W. Harkness, M. D., San Francisco, Cal.

Specimens of one hundred and ninety-eight species of plants, by collection of the Botanist, one hundred and fourteen of which are new to the Herbarium.

List of Native Woods, from the New York State Exhibit at the New Orleans Exposition.

(Presented by Hon. D. J. Johnston, of Cohoes.)

1.	Board of white pine,	12.	Board of chestnut,
2.	" Norway pine,	13.	" red elm,
3.	" spruce,	14.	" maple,
4.	" hemlock,	15.	" white wood,
5.	" cedar,	16.	" poplar,
6.	" oak,	17.	" basswood,
7	" white ash,	18.	" birch,
8.	" hickory,		" spruce,
9.	" black walnut,		" beech,
10.	" butternut,		" maple,
11.	" cherry,		" black walnut.

II. ZOÖLOGICAL DEPARTMENT.

(Additions to Zoölogical Collections of the State Museum, during the year 1885.)

A specimen of the Lota inornata (plain Burbot), found at Cohoes, in draining off the factory canal, which is fed from above the Cohoes Falls; 70 feet above tide. Presented by Cornelius Kelly, Cohoes, N. Y.

A common clam (Venus mercenaria) showing a break in the shell, which has been completely repaired by a nacreous deposit.

An irregularly-shaped pearl, from the shell of the common clam.

A group of twelve pairs of large oyster shells united at their apices; showing the manner of growth. Presented by W. H. Keeler, Albany, N. Y.

A very fine specimen of black hare. Presented by Dr. Leonard, Camden, Oneida county, N. Y.

By Purchase.

Head of buffalo (mounted), specimen, killed on the farm of Henry Gallien & Sons, Belfield, Billings county, Dakota Territory.

Two antelope heads (mounted).

Ostrich eggs, Batavia, Java. From Frank Lewis, Schoharie, N. Y.

III. MINERALOGICAL AND GEOLOGICAL.

A slice from the meteorite which fell at Tunkhannock creek, Rensselaer county. From S. C. H. Bailey, Cortland-on-the-Hudson.

A large block of asbestos from Pawling, Dutchess county. From C. J. Haight, of Pawling.

A collection of iron ores (carbonates) and the associated rocks from the mines at Burden, Columbia county, made in 1883–4 by Prof. J. C. Smock.

A collection, consisting of 547 members of crystalline and fragmental rocks from the Highlands of the Hudson and the adjacent geological formations. It represents nearly 200 localities in Dutchess, Putnam and Westchester counties, Stony Point and Tompkins' Cove, Rockland county, and the western borders of Fairfield and Litchfield counties, Conn. Made during the autumn of 1885, by Prof. J. C. Smock.

A collection of lithographic stones and associated rocks, from Lawrence county, Indiana. (36 Nos.) Presented by J. W. Latcher, of Edinburgh, Saratoga county.

A collection of specimens from the Mohawk Valley, illustrating the character of the beds at the junction of the Laurentian gneiss with the superincumbent rocks, consisting of gneiss, the representative beds of the Potsdam sandstone, with imbedded pieces of clay slate, breccia, and calciferous sandstone. Made by Mr. C. E. Beecher and Mr. C. E. Hall.

A collection of specimens representing a section of the Oneonta sandstone and superincumbent rocks in Chenango county, N. Y.

Mr. Geo. F. Kunz, of Hoboken, N. J., has placed on deposit with the Museum a collection illustrative of the rocks of New Hampshire. It is in part a duplicate of the New Hampshire collection of Prof. C. H. Hitchcock, and represents the more common types of the crystalline and semi-crystalline rocks of that State. This collection, consisting of 250 specimens, is very interesting and valuable for purposes of comparative study; it has been placed in drawers in the south-east corner room, and will be accessible to all students of geology.

Presented to the New York State Museum by Hon. D. J. Johnston, of Cohoes, State Commissioner to the New Orleans Exposition.

(A collection of specimens returned from the New Orleans Exposition, 1885.)

No.

1. Column of red granite (polished). International Scotch granite Co.. Jefferson County, N. Y., from R. Forsyth, Montreal.
2. Adirondack granite (block)........................New York.
3. Quincy granite..............................Quincy, Mass.
4. Gray granite..........................Saratoga Co., N. Y.
5. Gray granite..............Mount Vista, Saratoga Co., N. Y.
6. Gray granite................................Keene, N. H.
7. Gray granite..........................Mount Waldo, Me.
8. Gray granite ....Hallowell, Me.
9. Gray granite..Me.
10. Red granite (Internat'l Scotch Granite Co)..Jefferson Co., N. Y.
11. Gray granite.............................Fox Island, Me.

No.
12. Red granite......................Bay of Fundy, Nova Scotia.
13. Potsdam sandstone..........................Potsdam, N. Y.
14. Brown stone (from Hughes Bros., Syracuse). Oswego Falls, N. Y.
15. Sandstone................................Amherst, Ohio.
16. Sandstone..........................Dorchester, Nova Scotia.
17. Red Scotch sandstone...................Corsehill, Scotland.
18. Blue stone......................Oxford, Chemung Co., N. Y.
19. Limestone..............Tribes Hill, Montgomery Co., N. Y.
20. Limestone (from Hughes Bros., Syracuse). Onondaga Res'vation. (This stone is used for the U. S. Court-House and Post-office, etc., at Syracuse, N. Y.)
21. Black marble..........................Glens Falls, N. Y.
22. Shell marble.................Hudson, Columbia Co., N. Y.
23. Tennessee marble.......................Knoxville, Tenn.
24. Tuckahoe marble.......... Tuckahoe, Westchester Co., N. Y.
25. Wakefield marble ....Wakefield, Vt.
26. Wakefield variegated marble.................Wakefield, Vt.
27. Eastern Tennessee marble.................. Concord, Tenn.
28. Red granite..........................Stony Creek, Conn.
29. Brown hematite............Clove Mine, Dutchess Co., N. Y.
(From A. Tower, Esq., Poughkeepsie, N. Y.)
30. Verdantique marble...............Bolton, Warren Co., N. Y.
(From George Ives, Esq., Ticonderoga, N. Y.)
31. Talc......................Edwards, St. Lawrence Co., N. Y.
(From the Adirondack Pulp Company.)
32. Marble.........Whitney Marble Company, Gouverneur, N. Y.
35. Specular iron ore, red hematite, soapstone, etc., Caledonia Mine, Rossie, St. Lawrence Co., N. Y.
36. Milky quartz..............Fort Ann, Washington Co., N. Y.
37. Serpentine mica............Ayers' Quarry, Gouverneur, N.Y.
38. Birdseye limestone (polished)..........................N. Y.
39. Specular iron ore, red hematite, Old Sterling Mine, Jefferson Co., N. Y.
40. Slate — Different varieties — roofing and ornamental, Middle Granville, Washington Co., N. Y.
41. Red hematite, breccia, etc., Old Mine, three miles west of Ticonderoga, N. Y.
42. Ilmenite (titaniferous iron ore) and pig, Adirondack Iron and Steel Co., Essex Co., N. Y.
43. Magnetic iron ore, Hammondville, Crown Point, Essex Co., N. Y.
44. Magnetic iron ore (fine).............St. Lawrence Co., N. Y.
45. Magnetic iron ore, Schofield Mine, fourteen miles west of Ticonderoga, Schroon, Essex Co., N. Y.
46. Magnetic iron, Vineyard Mine, four miles north of Ticonderoga, Essex Co., N. Y.
47. Magnetic iron ore.....Forest of Dean Mine, Orange Co., N. Y.
48. Magnetic iron ore, twelve miles west of Ticonderoga, Essex Co., N. Y.

No.
49. Magnetic iron ore..Skiff Mine, Crown Point, Essex Co., N. Y.
50. Magnetic iron ore..New Bed Mine, Mineville, Essex Co., N. Y.
51. Magnetic iron ore..Old Bed Mine, Mineville, Essex Co., N. Y.
52. Iron ore (carbonate)............Burden, Dutchess Co., N. Y.

IV. Archæological.

A collection of arrow heads and spear heads, found in the town of Watervliet, Albany county, consisting of 58 examples, from Philip Emerich.

A second collection of 48 numbers from the same.

A hand-axe of trap-rock from the same. Also a remarkably elongated flint arrow point, found in Saratoga county, from the same donor.

One arrow head found on the farm of H. Schoonmaker, Cedar Hill, Albany county. Donor, H. Schoonmaker.

V. Library.

1. *By Donation and Exchange.*

U. S. Geological Survey, J. W. Powell. Director.
Fourth Annual Report, 1882-3. By J. W. Powell, 1884.
Monographs:
III. Geology of the Comstock Lode and Washoe District, with atlas. By Geo. F. Becker, 1882.
IV. Comstock Mining and Miners. By Eliot Lord, 1883.
V. Copper-bearing Rocks of Lake Superior. By Roland D. Irving, 1883.
VI. Contributions to the Knowledge of the Older Mesozoic Flora of Virginia. By Wm. M. Fontaine, 1883.
VII. Silver Lead Deposits of Eureka, Nevada. By Joseph S. Curtis, 1884.
VIII. Palæontology of the Eureka District. By Charles D. Walcott, 1884.
Bulletins, Nos. 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14.
Mineral Resources of the United States, 1883 and 1884. By Albert Williams, Jr.
U. S. Geological and Geographical Survey of the Territories. F. V. Hayden, Geologist in charge.
12th Ann. Rep., 1878, Maps and Panoramas.
Vol. III. Tertiary Vertebrata, Book I. By E. D. Cope, 1884.
Vol. VIII. Cretaceous and Tertiary Floras. By Leo Lesquereux, 1883.
Department of Agriculture, Washington, D. C.
Report of the Commissioners for the year 1883.
Report of the Commissioners for the year 1884.
Division of Statistics [new series], Nos. 3, 15, 16, 17, 21.
Miscellaneous Special Report, No. 3, 1883.
War Department, Chief Signal Officer, Gen. Wm. B. Hazen.
Report of the Chief Signal Officer for 1871.
Report of the Chief Signal Officer for 1872.

War Department — Continued.
- Report of the Chief Signal Officer for 1877.
- Report of the Chief Signal Officer for 1879.
- Report of the Chief Signal Officer for 1880.
- Report of the Chief Signal Officer for 1881.
- Report of the International Polar Expedition, to Pt. Barrow, Alaska, 1885.

Smithsonian Institution, Washington, D. C.
- Annual Report for 1883.
- A Catalogue of Scientific and Technical Periodicals. By Henry Carrington Bolton, 1885.
- Smithsonian Contributions to Knowledge, Vol. XXIV: (1) Results of Met. Obs. at Providence, R. I. By Alexis Caswell; (2) Tables of Precipitation in U. S. By Chas. A. Schott, 1882; Vol. XXV, Prehistoric Fishing in Europe and North America. By Charles Rau, 1884.

U. S. Commission of Fish and Fisheries.
- Bulletin, Vol. IV, for 1884. Spencer F. Baird, Commissioner.

U. S. Patent Office, Washington, D. C.
- Ann. Rep. of the Commissioner for 1884.
- Official Gazette: Vol. 29, Nos. 11, 12, 13; Vol. 30, Nos. 1–13; Vol. 31, Nos. 1–12; Vol. 32, Nos. 1–13; Vol. 33, Nos. 1–13.
- Alphabetical Lists of Patents and Inventions, for the quarters ending Sept. 30, 1884, and March 31, 1885.

Bureau of Education, Washington, D. C.
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The library has been partly re-arranged, and nearly all of the journals and periodicals to date of January, 1885, have been bound.

A manuscript catalogue is in course of preparation, made from a list of the volumes, bound and unbound, pamphlets and maps in the library up to the end of the current year. This catalogue will make the library more serviceable to those consulting it.

The accessions to the library of the Museum during the year consist of 35 bound, and 11 unbound volumes; 4 volumes of journals; 118 pamphlets, and 12 maps, through exchange and by donations. The purchases were 26 volumes, 7 volumes of journals, and 3 maps. The aggregate additions are 83 volumes, 118 pamphlets, and 15 maps.

APPENDIX B.

STATEMENT *of the Space now Occupied, and an Estimate of the Space required, for the Collections and Offices of the State Museum of Natural History.*

1. GEOLOGY.

There are now arranged in table and wall cases 3,350 specimens of rocks, representing the New York system. Two hundred and fifty specimens representing the section of the Hudson river.

These 3,600 specimens occupy 425 square feet of case-room (table and wall cases) on the second floor of the Museum.

The additions necessary for a proper exhibition of the geology of the State would require at least an equal amount of space in addition to that now occupied, or about 1,000 square feet.

2. Economic Geology.

The area now occupied in wall cases and floor-room is 180 square feet. Space needed for a proper arrangement and enlargement of the collection, equal to one-half that at present occupied — ninety square feet.

The specimens of this department now in the new Capitol, which will eventually go into the Museum, would require twice the space now used for this collection, or 360 square feet; and in order to provide for a proper exhibition of the iron ores of the State we should require an additional space of at least 200 square feet.

3. Minerals.

Area now occupied by the general collection in wall cases and table cases is as below:

One thousand five hundred specimens in cases occupying 413 square feet. Additional area required, 200 square feet.

The New York collection of minerals and ores numbers 1,500 specimens, occupying 1,181 square feet.

In each of these departments one-half more space is necessary for collections now on hand, without providing for future additions, which ought to require double the space now occupied, or an area of 800 square feet.

4. Palæontology.

Palæozoic.—There are now 11,700 specimens arranged in the cases on the second floor of the Museum, which occupy an area of 2,175 square feet, disposed of as follows:

	Square feet.
In table cases	1, 125
In wall cases.	840
In floor-room	210
Total area	2, 175

Of the above number of specimens, 9,000 are from the New York formations. The remainder are chiefly from the coal measures of Pennsylvania and the western States.

The number of specimens, the property of the State, which are not on exhibition, is upwards of 200,000. Of these, 25,000 are in the Museum in drawers and boxes, 155,000 in 3,200 drawers in the custody of James Hall, 20,000 in boxes in the custody of James Hall. Total number of non-exhibited specimens in Palæontology, 200,000. From this amount there will be taken the specimens occupying about 1,000 drawers for exhibition in the Museum; a portion of these are typical specimens.

The addition of this material will necessitate an area of 7,360 square feet, or nearly three times the space now occupied by this department. In the final arrangement will be more than *three times* greater than at present occupied by the palæontological collections of the palæozoic series or the New York formations and their representatives, or an entire area of 9,530 square feet.

SECONDARY AND TERTIARY.

The area of table cases now occupied is 300 square feet. The Mastodon and similar remains have a space of floor and table area of 448 square feet, or the total area of this department occupies 784 square feet.

The additional material for exhibition now occupies fifteen drawers, requiring 120 square feet when arranged in cases.

The collection is now comparatively small, and a proper increase in size would require three times the amount of space now occupied, or about 2,244 square feet.

WADSWORTH GALLERY OF CASTS.

Area now occupied:

In cases.....................................72 square feet.
In floor-room.. ....448 square feet.

Nearly 100 additional square feet would be necessary for the proper exhibition of the present collection.

5. ZOÖLOGY.

Radiates and Sponges.

Area at present occupied by these collections is 40 square feet. Area to be provided should be about 300 square feet.

CONCHOLOGY.

Gould collection of 60,000 specimens, now occupying 360 square feet, will require an additional area of 180 square feet for the exhibition of species which do not appear in the present cases for want of space.

The Mazatlan collection occupies................180 square feet.
The Smithsonian donations require................75 square feet.

These collections should be greatly increased. The New York shells, land, fresh-water and marine, contain 7,000 specimens now arranged and occupying 75 square feet; when completed and properly arranged will require at least one-half more area. For a representative collection of North American shells, three times the space now serving for this department would be necessary, or 250 square feet.

CRUSTACEA.

The area now occupied is 20 square feet. A considerable additional space is necessary for enlargement, to provide for the present and future collections of this class of animals from the State of New York.

Entomology.— No space has yet been provided. The number of specimens will be from 4,000 to 5,000. The collections are now in progress. The area needed will be equal to a case 2½ feet wide by 40 feet long, or 100 square feet.

Osteology.— There are 120 important specimens with numerous special preparations, which now occupy 216 square feet. The additional area required for proper exhibition of specimens on hand, without provision for future enlargement, would require 108 square feet, or one-half more than is now in use. And for the future increase of the collection an equal area, or at least a total of 600 square feet.

Ornithology.— The area occupied :

Foreign specimens	180 square feet.
New York specimens	480 square feet.

If completed for New York alone one-half more area would be needed, or 220 square feet, making altogether 700 square feet.

Mammalia.— The area now occupied is 528 square feet ; twice as much is needed for the proper arrangement of the collection, or 1,000 square feet altogether. The number of stuffed skins of vertebrata, mammals and birds in 1877 was 1,132 specimens.

Alcoholic Collections. — Forty-five square feet is now occupied. Twice this area is needed, or 100 square feet. In 1877 there were 1,200 specimens in 590 jars, upon exhibition — and for additions to be made, as much more space, or at least 200 square feet, will be required.

Fishes and Reptiles. — 1,500 specimens, a portion of which are in alcohol — stuffed skins and skeletons of fish, occupying an area of 60 square feet, are much too crowded in their arrangement, and no more space is available. For the present collection at least one-half more space is required. If properly completed for the State of New York, at least five times the present area would be required, or 300 square feet of case-room.

Birds' Eggs. — The area occupied is 24 square feet. No special or proper place has yet been reserved or assigned to this collection, and it should be increased to at least four times its present area — which will require at least 100 square feet.

6. Botany.

In all classes there are 7,100 species, occupying 210 square feet of closed wall cases. Additional space required for present collections, 250 square feet of wall case. For future collections an equal amount of space should be provided. Also for exhibition under glass of a generic collection, and of certain classes, especially fungi, at least 200 square feet. A room for the exhibition of woods, timber, etc., and showing their application and uses.

7. ARCHÆOLOGY ; ANTHROPOLOGY.

The area occupied 160 square feet. The area required for additional display and collections, 160 square feet.

SUMMARY.

	Number of specimens on exhibition.	Number to be added.	Additional space required, square feet.
Geology	3,600	1,000	300
Economic geology	180+25*	?	360
Minerals	3,000	1,500	800
Palæozoic palæontology	11,700	30,000	7,400
Secondary and tertiary palæontology	3,000	about 1,000 on hand, to provide for future additions.	1,500
Wadsworth's gallery — For the proper arrangement			100
Zoölogy — More than 80,000 specimens in the following classes, with additional space required in each, making a total of			1,760

Radiates	120
Conchology	430
Crustaceæ	40
Entomology	100
Osteology	100
Ornithology	220
Mammalia	500
Alcoholic specimens	100
Birds' eggs	50
Reptiles and fish	100
	1,760

	Additional space required, square feet.
Botany. — Number of species in all classes, 7,100	210+
" A generic collection	200
" For woods and timber, etc	...
Archæology. — Area occupied	160

Additional area needed.

Twelve thousand specimens now on exhibition in the cases of the Museum.

The present area of the Museum is 7,389 square feet, now occupied for the exhibition of collections.

An additional area of 12,790 square feet is required for the

* Blocks of iron ore.

proper exhibition of the collections on hand and to provide for a moderate increase. Area occupied by duplicates which are mainly in drawers, 15,000 square feet.

Number of drawers in State Museum..................	970
Number of drawers occupied by specimens belonging to the State and arranged in private museum and working rooms of James Hall............................	3,200
	4,170

Two-thirds of these drawers may be regarded as occupied by duplicate collections. In addition to the specimens in drawers there are large slabs and masses of corals which occupy an area equal to 1,000 drawers.

Besides the rooms for collections, there should be provided a room for a scientific library, which for the present could be limited to an area of 900 or 1,000 square feet with provision for increase in the future.

Working Rooms.— For the Botanist a working-room of 18 x 25 feet would suffice, with adjacent room for the collections, of 25 x 30 feet.

For the general collections in Zoölogy a room for work and study of 20 x 25 feet, a preparatory room, as a work-room, with water, tanks, etc., 25 x 30 feet.

Geology and Palæontology. — A receiving-room with space for library in use of 25 x 30 feet and adjacent to a room of 30 x 40 feet furnished with at least 1,000 drawers to contain the collections under investigation and comparison.

Also a wook-room with tables and appliances for cleaning, ticketing and preparing specimens for study and arrangement. This room should, if possible, be adjacent to a lathe-room, with machinery for cutting and polishing specimens. These two rooms would require an area of at least 1,200 square feet.

For general storage of *minerals*, *geological specimens* and *fossils* preparatory to a distribution of the duplicates, a room of 35 x 45 or 40 x 50 feet, with drawers, to contain the specimens and conveniences necessary for the arranging, labeling and packing specimens.

Students' Rooms. — Rooms should be provided for students in special branches of scientific study, since the increased attention to science will soon demand such conveniences. These would require an area of 10,000 feet of floor space.

If the building be fire-proof the typical collections may be arranged in the same rooms, but in separate cases, with the general collections of the same department.

Considering the condition of the building now occupied by the State Museum, the committee regard it as very important to secure, as soon as possible, rooms for the typical collections in some fire-proof building. The area required would be 30 x 40 feet.

Director's Room. — A small room as a private office for conference, consultation and correspondence should be provided for the Director of the Museum.

REPORT OF THE BOTANIST.

To the Honorable the Board of Regents of the University of the State of New York:

GENTLEMEN — I have the honor of communicating to you the following statement of the work of the Botanist for 1885:

In the prosecution of the work on the State Herbarium, specimens of plants have been collected in the counties of Albany, Essex, Genesee, Herkimer, Orange, Rensselaer, Saratoga, Schoharie, and Ulster. Of the collected specimens, those representing one hundred and ninety-eight species have been prepared, mounted and added to the Herbarium. Of these, one hundred and fourteen species were not before represented therein. The remaining eighty-four species are illustrated more completely and satisfactorily by the added specimens.

Specimens have been received from nineteen contributors. A large number of these represent extra-limital species of fungi, but among those from this State are six species new to the Herbarium, and not among my collections of the past season. The whole number of added species, both collected and contributed, is two hundred and ten; the whole number new to the Herbarium is one hundred and twenty. A list of the names of the added species is marked (A). A list of the names of the contributors and their respective contributions is marked (B).

Descriptions of forty-two species of fungi, which are deemed new or hitherto unpublished, have been prepared. A part of these have been illustrated by two plates of drawings. The descriptions of new species, together with a record of the occurrence and locality of others new to our flora, are in a part of the report marked (C).

A record of observations on common or well-known species not new to our flora is marked (D). It has reference to any thing peculiar, interesting, or instructive in the variation, distribution, behavior or habitat of the plant. Sometimes useful hints may be obtained by such observations. For example, a variety of the common blueberry, *Vaccinium Pennsylvanicum*, was noticed on the summit of one of the mountains in the northern part of Saratoga county. Its fruit was black and shining, destitute of bloom, very large, sweet, juicy and pleasant flavored. It grew in compact clusters at the ends of the branches, and could be easily and rapidly picked. Such a susceptibility to variation and improvement in the fruit of this plant, in its natural and wild condition, indicates for it a peculiar value and a possibility of usefulness under cultivation and domestication.

An interesting point in the behavior of some of our pulpy-fruited trees and shrubs the past season, and one that seems worthy of record, is their great productiveness. In this part of the State wild-cherry trees, cornel bushes, viburnums, wild gooseberry bushes, various blueberry bushes and the shadbush were all observed heavily laden with fruit. In the Adirondack region the crop of Canadian blueberries (*Vaccinium Canadense*) was remarkable both for its abundance and for the large size and fine quality of the berries. In the Albany market the fruit of the shadbush (*Amelanchier Canadensis*) was offered for sale under the name "blueberries," its very abundance, apparently, having prompted the attempt to introduce it. The name given it, however, was scarcely appropriate, since there is nothing in its botanical relations or in its color suggestive of it. This unusual fruitfulness extended in some instances to cultivated fruit trees. For example, pears were never more plentiful nor cheaper in our markets than in the season just passed. The cause of this exceptional productiveness is apparently, to a great extent, climatic, yet it is interesting to trace effects to causes, even when the latter are beyond our control. In the eastern and northern part of the State, at the time when these fruit trees and shrubs were in flower, there was almost continuous fair weather with little or no rain. This was favorable to the extensive pollenization of the flowers. Insects could ply their vocation and carry pollen from flower to flower, day after day, without interruption or hindrance. The consequence was the young fruit set in abundance. This was followed later in the season by frequent showers and generous rains, which afforded the necessary moisture for the proper and full development of the fruit. Possibly the late and severe frosts of the spring of 1884 may have contributed something toward this result, by diminishing the fruitfulness of that year, and thus leaving the trees and shrubs in a more vigorous condition this year, and, therefore, more capable of perfecting an abundant crop.

In pursuance of the plan of giving, from time to time, monographs of certain groups or genera of our Agaricini, descriptions have been written of the New York species of the genera Pleurotus, Claudopus and Crepidotus. To these genera belong such Agarics, mostly wood-inhabiting, as are either wholly destitute of a stem or have it lateral or eccentric. The spore characters have been given in all cases. The great importance of this in the descriptions of Agarics will readily be seen in some of the species now described. Thus *Pleurotus spathulatus*, the Spathulate Agaric, and *Pleurotus petaloides*, the Petal-like Agaric, have generally been considered one and the same species, probably through neglect of the spore characters. But it seems to me that any one examining the spores of the two forms will at once pronounce them distinct. The general neglect of the spore characters of Agarics by European authors is much to be regretted and is often the source of much perplexity in the identification of our species. The descriptions of the species of the three genera mentioned are marked (E).

The Herbarium has been removed from Geological Hall to State Hall. It now occupies a room on the second floor of the building and is in more commodious quarters than before.

Thanks are due to the correspondents and botanists who have aided me in the prosecution of my botanical work, both by the contribution of specimens and of information.

Very respectfully submitted,

CHAS. H. PECK.

ALBANY, *December* 31, 1885.

(A.)

PLANTS MOUNTED.

New to the Herbarium.

Solidago speciosa *Nutt.*
Betula nigra *L.*
Cypripedium candidum *Muhl.*
Eragrostis Frankii *Meyer.*
Agaricus lascivus *Fr.*
A. rubescentifolius *Pk.*
A. cerussatus *Fr.*
A. amplus *Pers.*
A. esculentoides *Pk.*
A. fuscolilacinus *Pk.*
A. amabillissimus *Pk.*
A. spathulatus *Pers.*
A. atropellitus *Pk.*
A. pascuensis *Pk.*
A. fuscogriseëllus *Pk.*
A. formosus *Fr.*
A. depluens *Fr.*
A. marginatus *Batsch.*
A. unicolor *Fr.*
A. blattarius *Fr.*
A. calamistratus *Fr.*
A. eutheles *B. & Br.*
A. alnicola *Fr.*
A. elatior *Pk.*
A. croceitinctus *Pk.*
Cortinarius arenatus *Fr.*
Hygrophorus pudorinus *Fr.*
Russula crustosa *Pk.*
Boletus subaureus *Pk.*
B. flavipes *Pk.*
Polyporus confluens *Fr.*
Hydnum geogenium *Fr.*
H. farinaceum *Pers.*
Grandinia granulosa *Fr.*
Corticium puteanum *Fr.*
C. radiosum *Fr.*
C. cinerascens *Berk.*
Clavaria circinans *Pk.*
C. gracilis *Pers.*
C. byssiseda *Pers.*
Tremella pinicola *Pk.*
Siphoptychium Caspari *Rostf.*
Phyllosticta Mitellæ *Pk.*
P. Hamamelidis *Pk.*
Dendrophoma Tiliæ *Pk.*
D. Cephalanthi *Pk.*
Cytispora intermedia *Sacc.*
Phoma aquilina *S. & P.*
P. strobiligena *Desm.*
P. sordida *Sacc*
P. Phillipsiana *S. & R.*
P. Clintonii *Pk.*
P. Majanthemi *Pk.*
Sphæropsis tiliacea *Pk.*
S. Linderæ *Pk.*
S. Juniperi *Pk.*
Sphæropsis pallida *Pk.*
S. sphærospora *Pk.*
S. maculans *Pk.*
Coniothyrium Staphyleæ *Pk.*
Vermiculari uncinata *B. & C.*
Septoria oleandrina *Sacc.*
S. Osmorrhizæ *Pk.*
S. lineolata *S. & S.*
S. graminum *Desm.*
Rhabdospora Xanthii *Pk.*
R. pleosporoides *Sacc.*
Phlyctæna septorioides *Sacc.*
P. complanata *Sacc.*
Diplodina Ellisii *Sacc.*
Zythia ovata *Pk.*
Thyrsidium Micheneri *Sacc.*
Marsonia Martini *S. & E.*
Coryneum compactum *B. & Br.*
Pestalozzia Saccardoi *Speg.*
P. consocia *Pk.*
P. campsosperma *Pk.*
Uredo Ledi *A. & S.*
Puccinia hastata *Cke.*
Gymnosporangium clavariæforme *D. C.*
Periconia pycnospora *Fres.*
Sporodinia grandis *Lk.*
Illosporium humigenum *P. & S.*
Monilia Peckiana *S. & V.*
Ramulari Geranii *Fckl.*
Saprolegnia ferax *Kutz.*
Geoglossum viscosum *Pers.*
Leotia marcida *Pers.*
Godronia Cassandræ *Pk.*
Tympanis saligna *Tode.*
Stictis Saccardoi *Rehm.*
Lichenopsis sphæroboloidea *Schw.*
Ascomyces extensus *Pk.*
Microsphæria Ceanothi *Pk*
Valsa rhoophila *C. & E.*
V. glandulosa *Cke.*
V. cenisia *DeN.*
Læstadia Æsculi *Pk.*
Rosellinia ambigua *Sacc.*
R. mastoidea *Sacc.*
Hypoxylon semiimmersum *Nits.*
Sphærella maculosa *Sacc.*
S. macularis *Auersw.*
S. Lycopodii *Pk.*
Diaporthe Carpini *Fckl.*
D. Robergeana *Niessl.*
D. galericulata *Sacc.*
D. Neilliæ *Pk.*
D. marginalis *Pk.*
D. sparsa *Pk.*
Didymosphæria bacchans *Pass.*
Leptosphæria Typharum *Karst.*
L. Kalmiæ *Pk.*
Zignoella diaphana *Sacc.*

Pyrenophora relicina *Sacc.*
Cryptospora Tiliæ *Tul.*
Hypocrea fungicola *Karst.*
Pleonectria Berolinensis *Sacc.*

Not new to the Herbarium.

Ranunculus acris *L.*
R. multifidus *Ph.*
Actæa alba *Bigel.*
A. rubra *Mx.*
Arabis lyrata *L.*
Barbarea vulgaris *R. Br.*
Camelina sativa *Crantz.*
Amelanchier Canadensis *T. & G.*
Potentilla Canadensis *L.*
Pryus arbutifolia *L.*
Ribes rubrum *L.*
R. rotundifolium *Mx.*
R. hirtellum *Mx.*
Thaspium aureum *Nutt.*
Cornus paniculata *L'Her.*
Lonicera oblongifolia. *Muhl.*
Petasites palmata *Gr.*
Senecio aureus *L.*
Vaccinium Pennsylvanicum *Lam.*
Castilleia coccinea *Spreng.*
Gratiola aurea *Muhl.*
Echium vulgare *L.*
Hydrophyllum Virginicum *L.*
Menyanthes trifoliata *L.*
Apocynum androsæmifolium *L.*
Asclepias obtusifolius *Mx.*
A. tuberosa *L.*
Chenopodium album *L.*
Atriplex patula *L.*
Amarantus blitoides *Wats*
A. hypochondriacus *L.*
Euphorbia Peplus *L.*
Celtis occidentalis *L.*
Morus alba *L.*
Alnus viridis *D.C.*
Salix longifolia *Muhl.*
Populus monilifera *Ait.*
P. balsamifera *L.*
Abies nigra *Poir.*
A. balsamea *Marsh.*
Juniperus sabina *L.*
Arisæma triphyllum *Torr.*
Orontium aquaticum *L.*
Triglochin maritimum *L.*
Cypripedium acaule *Ait.*
C. pubescens *Willd.*
C. parviflorum *Salisb.*
Liparis Lœselii *Rich.*
Uvularia grandiflora *Sm.*
U. sessilifolia *L.*
Streptopus roseus *Mx.*
Fimbristylis capillaris *Gr.*
Cyperus cylindricus *Britton.*
Carex gynocrates *Wormsk.*
C. sterilis *Willd.*
C. canescens *L.*
C. pedunculata *Muhl.*
C. Emmonsii *Dew.*
C. gynandra *Schw.*
C. pseudocyperus *L.*
Festuca elatior *L.*
Osmunda regalis *L.*
Agaricus Austinii *Pk.*
A. sapidus *Kalchb.*
Lentinus strigosus *Schw.*
Marasmius androsaceus *Fr.*
Trogia crispa *Fr.*
Polporus Vaillantii *Fr.*
P. biformis *Fr.*
P. adustus *Fr.*
P. applanatus *Fr.*
P. fomentarius *Fr.*
P. pinicola *Fr.*
P. betulinus *Fr.*
P. albellus *Pk.*
P. chioneus *Fr.*
Irpex cinnamomeus *Fr.*
Hydnum mucidum *Pers.*
Stereum versiforme *B. & C.*
S. spadiceum *Fr.*
S. versicolor *Fr.*
Clavaria pyxidata *Pers.*
Sphæronema pruinosum *Pk.*
Puccinia Calthæ *Lk.*
Ustilago Junci *Schw.*
Fusicladium dendriticum *Wallr.*
Macrosporium Cheiranthi *Fr.*
Glomerularia Corni *Pk.*
Uncinula spiralis *B. & C.*
Metasphæria Peckii *Sacc.*

(B.)

CONTRIBUTORS AND THEIR CONTRIBUTIONS.

Mrs. L. L. Goodrich, Syracuse, N. Y.

Trillium grandiflorum *Salisb.* var. variegatum *Pk.*

Miss E. G. Knight, New York, N. Y.

Fruit of Salisburia adiantifolia *Sm.*

Mrs. L. A. Millington, New Russia, N. Y.

Festuca elatior *L.*

Mrs. M. M. Patten, Albany, N. Y.

Pyxidanthera barbulata *Mx.*

Rev. W. M. Beauchamp, Baldwinsville, N. Y.

Hydrocotyle umbellata *L.*
Cypripedium acaule *Ait.*

Prof. F. Lamson Scribner, Washington, D. C.

Bromus sterilis *L.*
B. tectorum *L.*
Elymus Virginicus *L.*
Buchlœ dactyloides *Engl.*
Arundinaria tecta *Muhl.*
Poa arachnifera *Torr.*
Chloris verticillata *Nutt.*
Deschampsia atropurpurea *Wahl.*
Melica mutica *Walt.*
M. diffusa v. nitens *Scrib.*
Setaria verticillata *Bv.*

F. E. Wood, Clifton, Mich.

Amelanchier Can. v. oligocarpa *Gr.*
Artemisia frigida *Willd.*
Mertensia paniculat *Don.*
Vaccinium myrtilloides *Hook.*
Castilleia pallida *Kunth.*
Physalis grandiflora *Hook.*
Betula glandulosa *Mx.*
Calypso borealis *Salisb.*
Corallorhiza Macræi *Gr.*
Comandra livida *Rich.*
Aspidium Lonchitis *Sw.*

W. C. Stevenson, Jr., Philadelphia, Pa.

Puccinia Cryptotæniæ *Pk.*

E. S. Miller, Wading River, N. Y.

Crantzia lineata *Nutt.*

Geo. A. Rex, M. D., Philadelphia, Pa.

Siphoptychium Casparya *Rostf.*

E. A. Rau, Bethlehem, Pa.

Æcidium Dicentræ *Trelease.*
Æ. tenue *Schw.*
Glœosporium betularum *E. & M.*
Fusarium scolecoides *S. & E.*
Gonatobotrys maculicola *Wint.*

E. C. Howe, M. D., Lansingburgh, N. Y.

Solidago speciosa *Nutt.*
Rumex Brittanica *L.*
Trifolium hybridum *L.*
Aster Tradescanti *L.*
Eragrostis Frankii *Pursh.*
Carex siccata *Dew.*
C. alopecoidea *Tuckm.*
C. scabrata *Schw.*
C. monile *Tuckm.*

H. C. Gordinier, Troy, N. Y.

Negundo aceroides *Mœnch.*
Fedia radiata *Mx.*
Patasites palmata *Gr.*
Solidago uliginosa *Nutt.*
S. Virg. v. alpina *Bigel.*
Nabalus nanus *D. C.*
Juncus pelocarpus *Meyer.*
Aster ptarmicoides *T. & G.*
Hieracium pilosella *L.*
H. aurantiacum *L.*
Statice Limonium *L.*
Pogonia verticillata *Nutt.*
Salix longifolia *Muhl.*
Carex Buxbaumii *Wahl.*
Trisetum subspicatum *Bv.*

W. H. Kellerman, Manhattan, Kansas.

Polyporus picipes *Fr.*
P. adustus *Fr.*
P. fraxinophilus *Pk.*
Merulius tremellosus *Schrad.*
Craterellus cornucopioides *Fr.*
Stereum frustulosum *Fr.*
Hirneola auricula-Judæ *Berk.*
Phyllosticta Podophylli *Wint.*
P. Labruscæ *Thum.*
P. Chenopodii *West.*
P. Ampelopsidis *E. & M.*
P. smilacina *E. & M.*

Septoria Verbenæ *R. & D.*
S. Cerastii *R. & D.*
S. Verbascicola *B. & C.*
Leptostroma vulgare *Fr.*
L. Actææ *Schw.*
Sphæronema Persicæ *Schw.*
Vermicularia Dematium *Fr.*
Darluca filum *Cast.*
Phragmidium Potentillæ *Pers.*
Puccinia nigrescens *Pk.*
P. solida *Schw.*
P. Menthæ *Pers.*
P. Silphii *Schw.*
P. Sorghi *Schw.*
P. Artemisiarum *Duby.*
P. Polygonorum *Lk.*
P. Mariæ-Wilsoni *Clinton*
P. Myrrhis *Schw.*
P. Chærophylli *Purt.*
P. Xanthii *Schw.*
P. aculeata *Schw.*
Uromyces Lespedezæ (*Schw.*)
U. Hyperici *Schw.*
U. appendiculata *Lev.*
Ustilago segetum *Lk.*
Roestelia lacerata *Tul.*
Æcidium Caladii *Schw.*
Æ. Dicentræ *Tuel.*
Æ. Œnotheræ *Pk.*
Æ. leucospermum *D. C.*
Æ. Ficariæ *Pers.*
Uredo Smilacis *Schw.*
U. Agrimoniæ *D. C.*
U. Alchemillæ *Pers.*
Trichobasis Crotonis *Cke.*
Coleosporium Sonchi *Pers.*
Chrysomyxa pyrolatum *Kœnig.*
Synchytrium decipiens *Farl.*
S. Taraxaci *De By.*
S. Anemones *Woron.*
Sporocybe byssoides *Fr.*
Macrosporium Maydis *C. & E.*
M. Solani *E. & M.*
Helminthosporium gracile *Wallr.*
Pyricularia grisea *Sacc.*
Cercospora Gymnocladi *E. & M.*
C. Ampelopsidis *Pk.*
Ramularia rufomaculans *Pk.*
Cylindrosporium Fraxini *E. & M.*
Peronospora gangliformis *De By.*
Cystopus cubicus *Lev.*
Botrytis vulgaris *Berk.*
Peziza nivea *Fr.*
Phacidium Medicaginis *Lasch.*
Exoascus deformans *Fckl.*
Podosphæria tridactyla *De By.*
Uncinula macrospora *Pk.*
U. adunca *Lev.*
Microsphæria Euphorbiæ *B. & C.*
Eyrsiphe Martii *Lev.*
E. lamprocarpa *Lev.*
Sphæria Arthuriana *Sacc.*
Diatrype hypophlœa *B. & C.*
Rosellinia millegrana *Schw.*
Hypoxylon atropunctatum *Schw.*
H. Sassafras *Schw.*
Gnomonia setacea *C. & D.*
Melanomma pulvis-pyrius *Fckl.*
Ophiobolus porphyrogonus *Sacc.*
Sphærella maculæformis *Pers.*
Phyllachora Trifolii *Fckl.*.
Pleonectria denigrata *Wint.*

Hon. G. W. Clinton, Albany, N. Y.

Rhabdospora pleosporoides *Sacc.*
Phoma Clintonii *Pk.*
Illosporium humigenum *P. & S.*
Læstadia Æsculi *Pk.*
Morus alba *L.*

Arthur Peck, Sandlake, N. Y.

Populus balsamifera *L.*

H. W. Harkness, M. D., San Francisco, Cal.

Montagnites Candollei *Fr.*
Polyporus leucospongia *C. & H.*
Thelephora Harknessii *Ph.*
Corticium carneum *B. & Cke.*
C. pactolinum *C. & H.*
Hymenula aciculosa *E. & H.*
Octaviana rosea *Hk.*
Polyplocium Californicum *Hk.*
P. inquinans *Berk.*
Arcyria vitellina *Ph.*
Cryptosporium Lupini *Cke.*
Chromosporium lateritium *C. & H.*
Chætophoma atriella *C. & H.*
C. quercifolia *Cke.*
Septoria Aceris *B. & Br.*
Morthiera Mespili *Fckl.*
Marsonia Populi *Desm.*
M. Potentillæ *S. & E.*
M. Neilliæ *Hk.*
Glœosporium Pteridis *Hk.*
G. nervisequum *Fckl.*
Septoglœum defolians *Hk.*
S. Fraxini *Hk.*
S. maculans *Hk.*
S. Nuttallii *Hk.*
Diplodia lata *C. & H.*
D. Eucalypti *C. & H.*
D. Pittospori *C. & H.*
D. millegrana *C. & H.*
D. Symphoricarpa *C. & H.*
D. Sarothamni *C. & H.*
D. extensa *C. & H.*

Diplodia Lupini *C. & H.*
D. Amygdali *C. & H.*
D. maculata *C. & H.*
D. Phoradendri *Cke.*
D. decorticata *C. & E.*
Macrodiplodia Sambuci *Cke.*
M. Arctostaphyli *Vize.*
Hendersonia Lupini *C. & H.*
Harknessia Eucalypti *Cke.*
Pestalozzia Moorei *Hk.*
P. anomala *Hk.*
Dichomera Compositarum *C. & H.*
Phragmidium Fragariæ *D. C.*
Uromyces intricata *Cke.*
U. Terebinthi *D. C.*
U. Nevadensis *Hk.*
U. Spragueæ *Hk.*
U. Chorizanthis *E. & H.*
Puccinia variolans *Hk.*
P. evadens *Hk.*
P. Symphoricarpi *Hk.*
P. Harknessii *Vize.*
P. Œnotheræ *Vize.*
P. striata *Cke.*
P. Solani *Cke.*
P. Asari *Lk.*
Sorosporium Californicum *Hk.*
Synchytrium papillatum *Farl.*
S. pluriannulatum *Farl.*
Graphiola phœnicis *Poir.*
Torula glutinosa *C. & H.*
Camptoum cuspidatum *C. & H.*
Triposporium elegans *Cd.*
Theclospora bifida *Hk.*
Stigmina Platani *Sacc.*
S. Thermopsi *Hk.*
Chætopsis fusca *Cd.*
Zygosporium oscheoides *Mont.*
Helicosporium vegetum *N.*
Chalaza setosa *Hk.*
C. fusidioides *Cd.*
C. montellica *Sacc.*
C. brachyptera *Sacc.*
Beltrania quernea *Hk.*
Hemileia vastatrix *B. & Br.*
Cercospora glomerata *Hk.*
Didymaria spissa *Hk.*
Dicranidion fragile *Hk.*
Volutella Buxi *Berk.*
Helvella Californica *Ph.*
Peziza tautilla *Ph. & H.*
P. Escholtziæ *Ph. & H.*
P. labrosa *Ph. & H.*
P. sphærophoroides *Ph. & H.*
Phillipsiella purpurea *Ph. & H.*
Belonidium fuscum *Ph. & H.*
Cenangium ferruginosum *Fr.*
Phacidium Arbuti *C. & H.*
P. albidum *Ph. & H.*
P internum *Ph.*
Rhytisma Arbuti *Ph.*
R. punctatum *Fr.*

Stictis Lupini *Ph. & H.*
S. Megarrhizæ *Ph. & H.*
S. monilifera *Ph. & H.*
S. pelvicula *Ph.*
Triblidium rufulum *Spr.*
T. turgidulum *Ph. & H.*
Hysterium connivens *C. & H.*
H. Eucalypti *Ph. & H.*
H. prominens *Ph. & H.*
H. formosum *Cke.*
H. Mulleri *Duby.*
Ailographum acicolum *Hk.*
A. reticulatum *Ph. & H.*
Geopora Cooperi *Hk.*
Sphærotheca lanestris *Hk.*
Asterina anomala *C. & H.*
Capnodium heteromeles *C. & H.*
Lasiobotrys affinis *Hk.*
Valsa Lupini *C. & H.*
V. agnostica *C. & H.*
Diatrype prominens *C. & H.*
D. disciformis *Fr.*
Hypoxylon stigmateum *Cke.*
Gnomonia Coryli *Batsch.*
G. Alni *Plow.*
Phomatospora Datiscæ *Hk.*
Trabutia quercina *S. & R.*
Botryosphæria ambigua *Sacc.*
Sphærella Umbellulariæ *C. & H.*
S. Dendromeconis *C. & H.*
Eriosphæria investans *Cke.*
Diaporthe Lupini *Hk.*
D. gorgonoidea *C. & H.*
Amphisphæria decorticata *C. & E.*
A. dothideospora *C. & H.*
Valsaria Eucalypti *K. & C.*
Leptosphæria Ceanothi *C. & H.*
L. Ogilviensis *B. & Br.*
L. consessa *C. & E.*
L. Californica *C. & H.*
Heptameria mesædema *Sacc.*
Massaria pulchra *Hk.*
Pleospora vitrispora *C. & H.*
P. compressa *Hk.*
Thyridium Garryæ *C. & H.*
Sphæria tumulata *Cke.*
S. conflicta *Cke.*
S. confertissima *Plow.*
S. epipteridis *C. & H.*
S. anisometra *C. & H.*
Dialonectria filicina *C. & H.*
D. depallens *C. & H.*
D. Eucalypti *C. & H.*
Thyronectria virens *Hk.*
Acrospermum corrugatum *Ell.*
Dothidea Sequoiæ *C. & H.*
Ophiodothis tarda *Hk.*
Plowrightia phyllogona *Hk.*
P. Calystegiæ *C. & H.*
P. tuberculiformis *Ell.*
Lophiostoma congregatum *Hk.*

C. Vanderloo, Albany, N. Y.

Specimen of root with enlargement.

J. J. Brown, M. D., Sheboygan, Wis.

Cylindrosporium Rubi *E. & M.*

George L. English, Philadelphia, Pa.

Schizea pusilla *Pursh.*

(C.)

PLANTS NOT BEFORE REPORTED.

Solidago speciosa, *Nutt.*

Brunswick, Rensselaer county. *E. C. Howe.*

Eragrostis Frankii, *Meyer.*

Center island near the railroad bridge at Troy. *Howe.*

Agaricus (Tricholoma) rubescentifolius, *n. sp.*

Pileus thin, convex or nearly plane, subumbilicate, at first brownish, then smoky-yellow, sometimes obscurely squamulose; lamellæ narrow, close, adnexed, creamy-white or pale yellow, becoming smoky-red in drying; stem glabrous or slightly fibrillose, hollow, pruinose at the top, colored like the pileus; spores minute, subglobose, .00016 to .0002 in. long.

Plant subcæspitose, 1 to 1.5 in. high, pileus 6 to 12 lines broad, stem 1 to 2 lines thick.

Pine stumps. North Greenbush. Aug.

Agaricus lascivus, *Fr.*

Woods. Delmar. Sept. The plant is apparently a variety; being odorless and having the pileus almost white.

Agaricus cerussatus, *Fr.*

Thin woods. Karner. Sept.

Agaricus amplus, *Pers.*

Sandy soil. Karner. Sept.

Agaricus (Collybia) fuscolilacinus, *n. sp.*

Pileus thin, convex, glabrous, hygrophanous, even and watery-brown when moist, lilac-brown and rugose when dry; lamellæ close, ventricose, adnexed, brownish; stem slender, flexuous, hollow, colored like the pileus, mealy or pruinose at the top, with a whitish villosity at the base; spores subglobose or broadly elliptical, .C0016 to .0002 in. long.

Pileus 4 to 8 lines broad, stem 1.5 to 3 in. long, about 1 line thick.

Among moss and fallen leaves in open places in woods. Adirondack mountains. Aug.

The species should be referred to the section Tephrophanæ.

Agaricus (Collybia) esculentoides, *n. sp.*

Pileus hemispherical or convex, umbilicate, glabrous, pale yellowish-brown; lamellæ moderately close, broad, thick, whitish; stem slender, hollow, somewhat tenacious, colored like the pileus; spores elliptical, .00025 to .0003 in. long, .0002 in. broad.

Pileus 8 to 12 lines broad, stem 1.5 to 2 in. long, 1 to 1.5 lines thick.

Sandy soil. West Albany. Karner and Delmar. Sept.

This species resembles *A. esculentus* in size and color, but it differs in its stem which is not radicated, and in its pileus which soon becomes umbilicate or more or less centrally depressed. It has a bitter taste, a character attributed to *A. esculentus* also. Our plant occurred in autumn, but *A. esculentus* is said to grow in early spring.

Agaricus (Mycena) amabillissimus, *n. sp.*

Pileus submembranous, campanulate, obtuse or acute, glabrous, obscurely striatulate when moist, bright-red or scarlet; lamellæ ascending, whitish or tinged with red; stem slender, pallid, subpellucid, with a white villosity at the base.

Pileus 3 to 6 lines broad and high; stem about 1 in. long.

Among mosses and ferns in marshes. Karner. Sept.

This species is closely related to *A. acicula* of which it may possibly be a large form, but inasmuch as it differs not only in size but also in its longer and more conical or campanulate pileus and in its differently colored lamellæ it seems best to keep it distinct.

Agaricus spathulatus, *Pers.*

Ground. Sandlake. June.

Agaricus (Pleurotus) atropellitus.

Decaying wood and bark both of frondose and acerose trees. Maryland. Helderberg and Adirondack mountains. June to Oct.

Agaricus (Clitopilus) pascuensis, *n. sp.*

Pileus fleshy, compact, centrally depressed, glabrous, pale-alutaceous, the cuticle of the disk cracking into minute areas; lamellæ rather narrow, close, decurrent, whitish, becoming flesh-colored; stem short, equal or tapering downward, solid, glabrous, colored like the pileus; spores subelliptical, pale-incarnate, .0003 to .0004 in. long, .0002 to .00025 broad.

Pileus 2 to 3 in. broad, stem 8 to 18 lines long, 4 to 6 lines thick. Pastures. Day, Saratoga county. July.

The species is closely related to *A. prunulus*. It has a farinaceous taste but no odor. Its shorter spores, its pileus without any pruinosity and appearing slightly scaly on the disk and tinged with tan color will readily distinguish it from that species. *A. prunulus* grows in woods in autumn, this species in pastures in midsummer. It is solitary or gregarious.

Agaricus (Nolanea) fuscogriseëllus, *n. sp.*

Pileus submembranous, convex, conic or campanulate, either with or without a central papilla, hygrophanous, grayish-brown, and striatulate when moist, paler and shining when dry, but the disk or papilla often remaining dark-colored; lamellæ moderately close, subventricose, whitish, then flesh-colored; stem slender, brittle, glabrous, hollow, slightly pruinose, or mealy at the top, pallid or livid, with a white mycelium at the base; spores irregular, .0004 in. long, .0003 broad.

Pileus 6 to 12 lines broad, stem 1.5 to 3 in. long, 1 to 2 lines thick.

Mossy ground in open places. Adirondack mountains. Aug.

This is more slender than *A. pascuus* to which it is related, and its stem is not fibrous and silky.

Agaricus formosus, *Fr.*

Woods and open places, especially under brakes, *Pteris aquilina*. Adirondack mountains. Aug.

It closely resembles the very common *A. asprellus*, from which it may be distinguished by the yellowish hue of the pileus.

Agaricus depluens, *Fr.*

Decaying wood. Catskill mountains. Gansevoort and Sterling. July and August.

Agaricus marginatus, *Batsch.*

Decaying wood. Guilderland. Sept.

Agaricus unicolor, *Fr.*

Decaying wood. Adirondack mountains. Aug. In color and size this species bears a striking resemblance to *A. laccatus*, but its habitat and the character of the spores readily distinguish it.

Agaricus blattarius, *Fr.*

Woods. Adirondack mountains. Aug.

Agaricus calamistratus, *Fr.*

Damp ground. Delmar. Sept. Our specimens had no decided odor, but the essential characters of the species, including the peculiar bluish color toward the base of the stem, were present.

Agaricus eutheles, *B. & Br.*

Under pine trees. West Albany. Sept. In these specimens the farinaceous odor attributed to the species was not observed, but the other characters were present.

Agaricus alnicola, *Fr.*

At the base of alders and on birch stumps. Delmar. Sept.

The American specimens have the bitter taste ascribed to the European plant. The form found on birch stumps has the lamellæ rounded behind, while that found at the base of alders has them adnate. The young plant has a noticeable annulus but it nearly or quite disappears with age.

Agaricus (Naucoria) elatior, *n. sp.*

Pileus thin, at first conical or subcampanulate, then convex or nearly plane, glabrous, slightly viscid and striatulate on the margin when moist, livid or grayish-brown; lamellæ broad, ventricose, distant, whitish or livid, then dark-ferruginous, white on the edge; stem elongated, slender, hollow, flexuous, slightly fibrillose, pallid; spores brownish-ferruginous, oblong-elliptical, .0007 to .0008 in. long, .0003 to .0004 broad.

Pileus 5 to 10 lines broad, stem 3 to 5 in. long, about 1 line thick.

In sphagnum. Karner. Sept. Related to *A. scorpioides*.

Cortinarius arenatus, *Fr.*

Sandy soil under pine trees. Delmar. Sept.

A form with longer stem and subconical pileus sometimes occurs in marshes among sphagnum.

Hygrophorus pudorinus, *Fr.*

Pine woods. Delmar. Sept.

Our plant does not strictly agree with the description of the species to which we have referred it. The color of the pileus is darker in the center, where it is a brownish-red, but it fades toward the margin, where it is nearly white. The stem is not conspicuously contracted at the apex, but in other respects it agrees so well with the description of *H. pudorinus* that it seems to us to belong to that species.

Russula crustosa, *n. sp.*

Pileus at first convex, then nearly plane or centrally depressed, slightly viscid when moist, striate on the margin, brownish-yellow, greenish or subolivaceous, the cuticle cracking and forming small spot-like areolæ or pseudo-verrucæ; lamellæ nearly entire, some of them forked at the base, narrowed behind and nearly free, white; stem cylindrical, stuffed or hollow, white; spores white, subglobose, .0003 to .00035 in. broad; flesh white, taste mild.

Pileus 3 to 5 in. broad, stem 1 to 2.5 in. long, 6 to 12 lines thick.

Rocky ground in thin woods. Day. July and Aug.

This plant approaches *R. æruginea* so closely, that it may be a question whether it is a distinct species or a mere variety. It differs in the breaking up of the cuticle and in having the disk generally paler instead of darker than the rest of the pileus. The cuticle usually remains entire on the disk, which is of a dingy yellowish hue, while toward the margin the color is greenish or smoky-green, though in some instances it also is yellowish or dirty straw-color. The greenish specimens so closely resemble *R. virescens*, that in a dry time they might easily be confused with that species. The viscid pileus and its striate margin will distinguish it. The lamellæ are rather narrow anteriorly.

Boletus subaureus, *n. sp.*

Pileus convex, becoming nearly plane, soft, viscose, pale-yellow or golden-yellow, sometimes mottled with darker spots or tufts of hairs, the young margin adorned with a slight grayish tomentum, flesh pale-yellow; tubes subdecurrent, small, angular or subrotund, at first yellow then ochraceous-yellow; stem cylindrical, solid, glandular-punctate, yellow without and within; spores oblong-elliptical, .00035 to .0004 in. long; .00016 broad.

Pileus 2 to 4 in. broad, stem 1.5 to 2.5 in. long, 5 to 6 lines thick.

Woods. Day. July.

This species is intermediate between *B. flavidus* and *B. granulatus*. It has the stout stem, thick pileus and general aspect of the latter, but the yellow color of the stem and young tubes connect it more closely with the former.

Boletus flavipes, *n. sp.*

Pileus convex or nearly plane, glabrous, dull-red, inclining to chestnut color; tubes nearly plane or convex, small, subrotund, pale-yellow, becoming a little darker with age; stem cylindrical, solid, furfuraceous, pale-yellow; spores oblong-fusiform, olivaceous, .0005 to .0006 in. long, .00016 to .0002 in. broad.

Pileus 1.5 to 2.5 in. broad, stem 2 to 3 in. long; 4 to 6 lines thick.

Woods. Caroga and South Ballston. July and Aug.

Polyporus confluens, *Fr.*

Pine woods. New Scotland. Sept.

Our specimens are not at all squamulose, and this character is not attributed to the species by all authors. It is probable that it is not uniform in this respect.

Polyporus Schweinitzii, *Fr.*

Pine woods, generally at or near the base of stumps and trees. West Albany. Sept.

P. hispidoides is a dimidiate form of this species, and not a variety of *P. hispidus*.

Hydnum geogenium, *Fr.*

Woods. South Ballston. Aug.

I am not aware that this rare and interesting species has before been noticed in this country. According to Fries, the species is very variable, so much so that some specimens might be referred to the section Pleuropoda, others to Mesopoda, and others still to Apoda, to which the typical form belongs.

Hydnum farinaceum, *Pers.*

Decaying wood of hemlock. Osceola. Aug.

Grandinia granulosa, *Fr.*

Dead bark of alders. Karner. Sept.

A variable species, referred to Thelephora by Albertina and Schweinitz, to Hydnum by Persoon, and to Grandinia by Fries. Our specimens were whitish when fresh, but they become ochraceous or subalutaceous when old and dry. They are also rimose, thus answering to variety *rimosa Pers.*

Corticium puteanum, *Fr.*

Decaying wood in swamps. Guilderland. Sept.

Corticium radiosum, *Fr.*

Decaying wood. Osceola. Aug.

Corticium cinerascens, *Berk.*

Dead branches of oak. Albany. Aug.

Our specimens are resupinate. The hymenium when moist was tuberculose and of a dingy hue; in the dry state it is cinereous and rimose. The spores are elliptical.

Clavaria circinans, *n. sp.*

Stem short, solid, dichotomously or subverticillately branched; branches slightly diverging or nearly parallel, nearly equal in length, the ultimate ones terminating in two or more short acute concolorous ramuli; spores ochraceous.

Plant 1 to 2 in. high, obconic in outline, flat topped, appearing almost as if truncated, pallid or almost whitish in color, generally growing in imperfect circles or curved lines.

Under spruce and balsam trees. Adirondack mountains. Aug.

Clavaria gracilis, *Pers.*

Ground in open places, especially under brakes, *Pteris aquilina.* Adirondack mountains.

The typical form has the branches numerous, nearly straight and slender, but forms occur in which they are thicker, more loose and flexuous. Such forms approach *C. Kunzei* in appearance, but they may be distinguished by their pallid stem, more tenacious substance and yellowish spores. The plant is slightly fragrant.

Clavaria byssiseda, *Pers.*

Decaying wood twigs and bark in woods. Adirondack mountains. Aug.

Easily known by its small size, pallid color, and abundant white creeping fibrillose mycelium.

Tremella pinicola, *n. sp.*

Pulvinate, gyrose-plicate, somewhat lobed and lacunose, raisin-colored when moist, blackish when dry, filaments slender, branched; spores oblong, curved, colorless, .0005 in. long, .0002 broad.

Dead branches of pine. Day. July. It belongs to the section Cerebrina.

Siphoptychium Casparyi, *Rost.*

Decaying wood. Lake Placid. Adirondack mountains. *G. A. Rex.*

Phyllosticta Mitellæ, *n. sp.*

Spots suborbicular, brown; perithecia minute, .0025 to .003 in. broad, amphigenous, black; spores subglobose, colorless, .0002 to .00025 in. long.

Living leaves of mitre-wort, *Mitella diphylla.* Newburgh. Sept.

Phyllosticta Hamamelidis, *n. sp.*

Spots very large, sometimes occupying nearly half the leaf, irregular, angular, reddish-brown above, paler beneath; perithecia small, .004 in. broad, amphigenous, black; spores broadly elliptical, colorless, .0005 to .0006 in. long, .00035 to .0004 broad, often containing a single large nucleus.

Living leaves of witch-hazel, *Hamamelis Virginiana.* Day. July.

Phoma aquilina, *S. & P.*

Dead stems of ferns. West Albany. May.

Phoma Strobiligena, *Desm.*

Scales of pine cones. Albany. *G. W. Clinton.* Elizabethtown. May.

Phoma sordida, *Sacc.*

Dead branches of water beech, *Carpinus Americana.* Saugerties. May.

Phoma Phillipsiana, *S. & R.*

Dead branches of alders, *Alnus viridis.* Elizabethtown. May.

The spores in our specimens do not fully agree with the description of the species. They are elliptical or oblong and somewhat variable and irregular, but the differences scarcely seem worthy of specific distinction.

Phoma Majanthemi, *n. sp.*

Perithcia minute, .007 to .010 in. broad, amphigenous, subglobose, prominent, black; spores oblong, subtruncate at each end, colorless, 00025 to .0003 in. long, .00012 broad. Dead leaves of two-leaved Solomon's seal, *Majanthemum bifolium*. Elizabethtown. May.

Phoma Clintonii, *n. sp.*

Perithecia numerous, sunk in the wood, oblong or subhysteriiform, black; spores oblong-ovate, colorless, .0004 to .00045 in. long, .00016 broad, supported on slender basidia.

Decorticated wood of horse-chestnut, *Æsculus Hippocastanum*. Albany. May. *Clinton*.

This is quite distinct from *P. diplodioides*, both in habit, form of perithecia and character of the spores.

Dendrophoma Cephalanthi, *n. sp.*

Perithecia small, .02 to .025 in. broad, erumpent, depressed, with a papillate ostiolum, black; spores abundant, straight or slightly curved, colorless, .00016 to .0002 in. long; basidia very slender, branched above, .001 to .0015 in. long.

Dead branches of button bush, *Cephalanthus occidentalis*. Karner. Oct.

Dendrophoma Tiliæ, *n. sp.*

Perithecia minute, scattered, erumpent, black, white within; spores oblong or subcylindrical, obtuse, colorless, .0006 to .001 in. long, .0003 to .00035 broad; basidia filiform, branched.

Dead branches of bass wood, *Tilia Americana*. Quaker Street. June.

Vermicularia uncinata, *B. & C.*

Dead stems of *Desmodium nudiflorum*. Sandlake. June.

Cytispora intermedia, *Sacc.*

Dead branches of oak, *Quercus rubra*. Albany. Apr.

Sphæropsis tiliacea, *n. sp.*

Perithecia at first covered, then erumpent, subglobose or depressed, numerous, minute, .007 to .010 in. broad, opening by a minute pore, black; spores oblong or subelliptical, at first pale, then colored, .0007 to .0009 in. long, .0005 to .0006 broad; sporophores scarcely as long as the spores.

Dead bark of basswood, *Tilia Americana*. Albany. Apr.

Sphæropsis Linderæ, *n. sp.*

Perithecia numerous, minute, .005 to .010 in. broad, erumpent, black, white within; spores obvate or elliptical, at first pale, then colored, .0008 to .0011 in. long, .0005 to .0006 broad supported on sporophores shorter than themselves.

Dead branches of spice bush, *Lindera benzoin*. Albany. May.

Very near the preceding species.

Sphæropsis Juniperi, *n. sp.*

Perithecia gregarious, numerous, small, .008 to .011 in. broad, erumpent, black; spores oblong or elliptical, 0008 to .00095 in. long, .00045 to .0005 broad.

Dead bark of red cedar, *Juniperus Virginiana.* West Albany May.

Sphæropsis pallida, *n. sp.*

Perithecia cæspitose, erumpent, .011 to .013 in. broad, black; spores subglobose, slightly colored, .0007 to .0008 in. long, .00065 to .00075 broad, containing one to three nuclei; sporophores very short.

Dead branches of sumac, *Rhus typhina.* Saugerties. May.

This fungus has the general appearance of *S. Sumachi,* but the perithecia are usually smaller than in that species, and the spores paler and of a different shape, being nearly globose.

Sphæropsis Sphærospora, *n. sp.*

Perithecia numerous, minute, .006 to .007 in. broad, subglobose or depressed, at first covered by the epidermis, black, opening by a minute pore; spores globose or subovate, slightly colored, .0004 to .0005 in. long, usually containing a single large nucleus.

Dead stems of silk weed, *Asclepias cornuti.* Sandlake. June.

Sphæropsis maculans, *n. sp.*

Perithecia immersed in the matrix, .016 to .02 in. broad, black, with a papillate ostiolum; spores elliptical, colored, .0004 to .0005 in. long, .0002 to .00025 broad.

Dead decorticated branches. Adirondack mountains. May.

This is a peculiar and well-marked species. The perithecia are immersed in the wood which is stained black just about each perithecium. The black ostiolum projects slightly above the surface of the wood.

Coniothyrium Staphyleæ, *n. sp.*

Perithecia minute, .007 to .011 in. broad, subglobose, slightly prominent, at first covered by the epidermis th umpent, black; spores very minute, elliptical, slightly colored, .00016 in. long, .00012 broad.

Dead whitened twigs of *Staphylea trifolia.* Saugerties. May.

Septoria Osmorrhizæ, *n. sp.*

Spots small, subangular or irregular, brown; perithecia epiphyllous, .004 to .005 in. broad, slightly prominent, centrally depressed, reddish-brown or amber-colored; spores filiform, more or less curved or flexuous, colorless, .002 to .0028 in. long, .00016 broad, oozing out and forming a whitish tendril. Living leaves of sweet cicely, *Osmorrhiza longistylis.* Schoharie. July.

Septoria oleandrina, *Sacc.*

Living or languishing leaves of oleander, *Nerium Oleander.* Sandlake. June.

Septoria lineolata, *S. & S.*

Dead leaves of sedges, *Carex varia.* Elizabethtown. May.

Septoria graminum, *Desm.*

Living leaves of black-fruited mountain rice, *Oryzopsis melanocarpa.* Day. July.

Rhabdospora pleosporoides, *Sacc.*

Dead stems of Scotch thistle, *Onopordon acanthium.* Albany. May. *Clinton.*

Rhabdospora Xanthii, *n. sp.*

Perithecia numerous, small, .011 to .014 in. broad, depressed, covered by the thin browned or blackened epidermis which is pierced by the ostiola; spores filiform, curved, colorless, .0008 to .0012 in. long, .00006 broad.

Dead stems of cocklebur, *Xanthium strumarium.* Albany and North Greenbush. Apr.

The tissues surrounding the perithecia are often colored in such a way as to impart a smoky-brown hue to the affected patches.

Phlyctæna septorioides, *Sacc.*

Dead stems of poke weed, *Phytolacca decandra.* Albany. Nov.

Phlyctæna complanata *Sacc.*

Dead stems of Polygonum. North Greenbush. May.

Zythia ovata, *n. sp.*

Perithecia ovate, reddish or flesh colored when fresh and moist, black when dry, single or two to three in a cluster, nearly superficial, .025 to .030 in. long, .017 to .018 broad; spores oblong, colorless, .0003 in. long, .00012 broad; basidia densely and fasciculately branched.

Dead bark of poplar. South Ballston. Sept.

Diplodina Ellisii, *Sacc.*

Dead stems of goose foot, *Chenopodium album.* North Greenbush. Apr.

This was originally *Diplodia hyalospora,* C. & E. The perithecia are .008 to .01 broad. The spores are at first simple, then uniseptate. They are .0007 to .001 long, .00035 to .0004 broad.

Thyrsidium Micheneri, *Sacc.*

Dead branches of water beech, *Carpinus Americana.* West Troy. May.

This is *Cheirospora Micheneri,* B. & C.

Marsonia Martini, *S. & E.*

Living leaves of *Quercus prinoides.* Karner. Sept.

Coryneum compactum, *B. & Br.*

Dead branches of red birch, *Betula nigra.* Saugerties. May.

Pestalozzia Saccardoi, *Speg.*

Dead leaves of oak, *Quercus alba.* Day. July. The spots on the leaves are less black and the colored cells of the spores are more numerous in this species than in *P. monochæte,* which also inhabits oak leaves.

Pestalozzia consocia, *n. sp.*

Spots very large, sometimes occupying nearly half the leaf, irregular or angular, reddish-brown above, paler beneath ; acervuli amphigenous, minute, punctiform, black ; spores oblong-fusiform, .0012 to .0014 in. long, .0003 broad, five septate, with four colored cells, .0009 to .0011 in. long and a single bristle at the apex.

Living leaves of witch-hazel, *Hamamelis Virginiana.* Day. July.

The species is associated with and occupies the same spots as *Phyllosticta Hamamelidis.* It may be a question as to which species causes the spots, though they are probably due to the Phyllosticta.

Pestalozzia ? campsosperma, *n. sp.*

Acervuli hypophyllous, minutely tufted ; spores fusiform, curved, triseptate, .0008 to .0012 in. long, .00028 to .00032 in. broad, with two colored cells .0005 in. long, the apical cell hyaline, conical, ending in an acuminate point, the lower cell tapering into the short pedicel.

Dead leaves of balsam fir, *Abies balsamea.* Adirondack mountains. June.

This is a singular species. I have seen no terminal cilia and am not able to say whether they are entirely wanting or whether they are early deciduous. The characters otherwise are so exactly like those of Pestalozzia that I have, with some doubt, referred our plant to that genus. The curved spores are very characteristic of the species.

Uredo Ledi, *A. & S.*

Living leaves of Labrador tea, *Ledum latifolium.* Bergen swamp, Genesee county, and Sandlake, Rensselaer county. June.

The authors of this species remark that the leaves attacked by the fungus appear broader than usual. This peculiarity was very perceptible in the Bergen swamp specimens, the usually involute margins of the leaves being almost wholly expanded or unrolled. The spores, which occur on the lower surface of the leaf and are partly concealed by its tomentum, are .0008 to .0009 in. broad. Their smaller size, different place of occurrence, and the different color of the spots readily distinguish this species from *Uredo ledicola.*

Puccinia hastata, *Cke.*

Living leaves of *Viola primulæfolia.* Riverhead. Sept. The typical form was discovered in Maine on leaves of *Viola hastata.* In our specimens teleutospores and stylospores occur on the same leaf and sometimes in the same sorus.

Gymnosporangium clavariæforme, *D. C.*

Branches of Juniper, *Juniperus communis.* Elizabethtown. May.

This was in some instances associated with *Gymnosporangium clavipes,* the two occurring near each other on the same branch. The species is a rare one in this country, and has hitherto been reported from Maine only.

Periconia pycnospora, *Fres.*

Dead stems of melilot. Bethlehem. Apr.

Sporodinia grandis, *Lk.*

Decaying *Agaricus abortivus.* Osceola. Aug.

Illosporium humigenum, *Pk. & Sacc.*

Tufts subglobose or pulvinate, rather compact, often botryoidal by confluence, sordid red, grayish or subcinereous; spores globose, at first three or more aggregated, then free, colorless, .0002 to .00028 in. broad; basidia none or obsolete.

Damp ground, horse dung, etc. Lebanon Springs. *Clinton.* Copake. Aug. and Sept.

Monilia Peckiana, *Sacc.*

Petioles of dwarf blueberry, *Vaccinium Pennsylvanicum.* Cobble Hill, near Elizabethtown. May.

This is a very destructive fungus. The leaves, of which the petioles are attacked, soon wither, turn brown and die. The destruction of the leaf tissues progresses from the base toward the apex as if destroyed by the advancing mycelium. But the strings of spores, so far as I have observed, are produced on the petioles only. The spores vary very much in size, ranging from .0005 to .0012 in. long, and from .0005 to .0009 broad. They are globose or subelliptical and usually have a slight prominence or apiculus at one or both ends.

Variety *angustior* Sacc. Young fruit of choke cherry, *Prunus Virginiana.* Schoharie. July. This differs from the typical form not only in its host plant and place of development, but also in the size of the spores. These are subglobose and .0004 to .0005 in. long. These differences seem to me to indicate a difference of species, but Prof. Saccardo regards this fungus as a mere variety of the former. It is very destructive to the young cherries. In some instances nearly all the cherries in a raceme were affected by it. Those attacked were smaller than the healthy ones. They were of a brownish or grayish-brown hue, and more or less frosted by the fungus. Should this parasite ever escape from its native host plant and attack our cultivated cherries, it might become a very annoying and destructive pest.

Ramularia Geranii, *Fckl.*

Living or languishing leaves of wild geranium, *Geranium maculatum.* Schoharie. July.

Saprolegnia ferax, *Kutz.*

On fishes in an aquarium. Albany. Also in an artificial fish pond. Sandlake. It is sometimes very destructive to fish.

Geoglossum viscosum, *Pers.*

Ground under brakes, *Pteris aquilina.* Adirondack mountains. Aug. This may be distinguished by its triseptate spores from *G. Peckianum,* which it much resembles.

Leotia mercida, *Pers.*

Swampy places. Delmar and Karner. Sept.

Godronia Cassandræ, *n. sp.*

Receptacle small, .02 to 03. in. broad, sessile or nearly so, depressed, urceolate, tawny-brown, the hymenium whitish or livid when moist, darker when dry, the narrow mouth entire or slightly dentate-lacerate, almost closed when dry ; asci cylindrical, .0045 to .005 in. long, .0003 to .0004 broad ; spores filiform, nearly straight, .002 to .003 in. long ; paraphyses filiform, numerous.

Dead branches of leather leaf, *Cassandra calyculata*. Karner. Aug.

Tympanis saligna, *Tode.*

Dead branches of willow, *Salix purpurea*. West Albany. Apr. The specimens are without fruit and to this extent doubtful.

Stictis Saccardoi, *Rehm.*

Dead stems of scouring rush, *Equisetum hyemale*. Delmar. Sept.

Lichenopsis sphæroboloidea, *Schw.*

Dead stems of Cornus. Elizabethtown. May.

Asoomyces extensus, *Pk.*

Spots large, irregular, brown, usually somewhat convex above and concave below, most frequently occurring at the apical end of the leaf or of its lobes ; asci hypophyllous, cylindrical, obtuse or subtruncate, .002 to .0025 in. long, .0009 to .0011 broad ; spores globose or broadly elliptical, variable in size, .00016 to .0003 in. long, .00016 to .00025 broad.

Living leaves of the over-cup oak, *Quercus macrocarpa*. Plattsburgh. July. *Gen. J. M. Robertson.*

The specimens were first sent by Gen. Robertson to the editors of the *Country Gentleman*, with the information that nearly every leaf on the tree was affected in a manner similar to those sent. In these the dead spots occupied one-fourth to one-half the entire leaf. They number from one to three spots on a leaf. It is very evident that the vital functions of leaves so extensively affected must be much impaired, and that the health and vigor of the tree must be correspondingly weakened. It was also stated that many other oaks in that region were similarly affected. The species is distinct from *A. Quercus* Cke., in the character of the spots and also of the spores.

Microsphæria Cæanothi, (*Schw.*).

Living leaves of New Jersey tea, *Ceanothus Americanus*. New Scotland. Oct.

This appears to be the fungus described by Schweinitz as *Erysiphe Ceanothi*, although the perithecia in our specimens can scarcely be described as "immersed" and the species is a Microsphæria, not an Erysiphe. It is closely related to *M. penicillata*, having about four eight-spored asci in a perithecium, but it differs from that fungus in occurring only on the upper surface of the leaves. It sometimes attacks the immature fruit which it covers with a more dense white mycelium.

Valsa rhoophila, *C. & E.*

Dead branches of poison sumach, *Rhus venenata.* Guilderland. May.

Valsa glandulosa, *Cke.*

Dead branches of *Ailanthus glandulosus.* Cold Spring. June.

Valsa cenisia, *De Not.*

Dead branches of red cedar, *Juniperus Virginiana.* West Albany. May.

Rosellinia ambigua, *Sacc.*

Decorticated stems of red-berried elder, *Sambucus pubens.* Adirondack mountains and Sandlake. June.

The species belongs to the section Coniochæta. The perithecia in some of our specimens are so densely crowded that they form a continuous black stratum.

Rosellinia mastoidea, *Sacc.*

Fallen decorticated branches of willow, *Salix purpurea.* West Albany. Apr.

Hypoxylon semiimmersum, *Nits.*

Decaying wood. Adirondack mountains. June.

Læstadia Æsculi, *n. sp.*

Perithecia small, .007 in. broad, lenticular, covered by the epidermis, erumpent, opening by a minute pore, black; asci subclavate; spores crowded, subelliptical, colorless, .0003 to .0004 in. long, .0002 to .00025 in. broad.

Fallen petioles of horse chestnut, *Æsculus Hippocastanum.* Albany. May. *Clinton.*

Sphærella maculosa, *Sacc.*

Fallen leaves of poplar, *Populus tremuloides.* Adirondack mountains. June.

This species resembles *S. orbicularis*, but the perithecia are smaller and hypophyllous, and the spores are larger and distinctly colored.

Sphærella macularis, *Auersw.*

Fallen leaves of poplar. Adirondack mountains. June.

In this species the spots are small and angular, the perithecia are amphigenous and the spores are smaller than in *S. maculosa.*

Sphærella Lycopodii, *n. sp.*

Perithecia minute, .004 in. broad, blackish; asci oblong or subcylindrical, often slightly narrowed toward the apex, .0012 to .0016 in. long, .0004 broad; spores oblong, .00045 to .0005 in long, .00016 to .0002 broad.

Scales of dead spikes of club moss, *Lycopodium clavatam.* Adirondack mountains. June.

This differs from *S. lycopodina*, in its place of growth and in its smaller asci and spores.

Diaporthe Carpini, *Fckl.*

Dead branches of water beech, *Carpinus Americana.* Albany. Apr.

Diaporthe Robergeana, *Niessl.*

Dead branches of bladder-nut, *Staphylea trifolia.* Albany. Apr.

Diaporthe galericulata, *Sacc.*

Dead branches of beech, *Fagus sylvatica.* Sandlake. June.

Diaporthe Neilliæ, *n. sp.*

Perithecia numerous, .02 to .024 in. broad, loosely and irregularly aggregated in extensive patches, immersed in the interior bark and often forming a slight depression in the wood, covered by the epidermis which is pierced by the black conical or rostellate ostiolum, the base often concave beneath ; asci subcylindrical, the sporiferous part about .0025 in. long, .0003 to. 0004 broad; spores crowded or biseriate, oblong or subfusiform, slightly constricted at the septum, two or four nucleate, .00055 to .00065 in. long, .0002 to .00025 broad.

Dead branches of nine bark, *Neillia opulifolia.* Albany. Apr.

The surface of the affected branch is rough to the touch by reason of the projecting ostiola. The perithecia are sometimes valsoidly clustered.

Diaporthe marginalis, *n. sp.*

Pustules numerous, covered by the epidermis which is somewhat elevated ; perithecia valsoid, 8 to 15 in a pustule, nestling in the inner bark with no circumscribing line, the ostiola slightly emergent, black, usually surrounding the margin of the whitish pulveraceous erumpent disk; asci subcylindrical, .0025 to .003 in. long, .0004 to .0005 broad; spores crowded or biseriate, uniseptate, obscurely apiculate at each end, .0008 to 0009 in long, .0002 to .00025 broad.

Dead branches of *Alnus viridis.* Elizabethtown. May.

In its external appearance this fungus resembles *Valsa ambiens.* In the larger pustules the ostiola form a marginal circle about the disk as in that species, but in the smaller ones they sometimes emerge centrally and obliterate the disk.

Diaporthe sparsa, *n. sp.*

Perithecia few, minute, scattered, immersed in the wood whose surface is blackened; asci clavate or subcylindrical, .003 to .0035 in. long, .0003 to .0004 broad; spores crowded, oblong or subfusiform, colorless, constricted at the septum, four-nucleate, .0008 to .0012 in. long, .0002 to .00028 broad. Dead branches of *Rhus Toxicodendron.* Saugerties. May.

Didymosphæria bacchans, *Pass.*

Dead branches of grapevines. Saugerties. May.

Leptosphæria Typharum, *Karst.*

Dead leaves of *Typha latifolia.* Adirondack mountains. June.

Leptosphæria Kalmiæ, *n. sp.*

Perithecia subcæspitose, erumpent, .014 to .018 in. broad, subhemisphærical, thick, black, the ostiola pertuse or slightly papillate; asci cylindrical, .004 to .005 in. long, .0003 to .00035 broad; spores uniseriate, oblong or subfusiform, triseptate, sometimes slightly constricted at the middle septum, colored, .00065 to .0008 in. long, .00025 to .0003 broad; paraphyses filiform.

Dead stems of sheep laurel, *Kalmia angustifolia.* Adirondack mountains. June.

Generally there are two to four perithecia in a cluster, but sometimes they are single and occasionally laterally compressed. The epidermis usually ruptures longitudinally. The species is related to *Leptosphæria vagabunda.*

Zignoella diaphana, *Sacc.*

Decaying wood. Adirondack mountains. June.

Our specimens have the perithecia depressed and smaller than in the type.

Pyrenophora relicina, *Sacc.*

Dead leaves of quack grass, *Triticum repens.* West Albany and Helderberg mountains. May.

Cryptospora Tiliæ, *Tul.*

Dead branches of basswood, *Tilia Americana.* Helderberg mountains. May.

Hypocrea fungicola, *Karst.*

Decaying Polyporus. Caroga. July. The species was formerly confused with *H. citrina,* which it very closely resembles.

Pleonectria Berolinensis, *Sacc.*

Dead stems of currant, *Ribes rubrum.* Albany. April.

(D.)

REMARKS AND OBSERVATIONS.

Ranunculus repens, *L.*

A beautiful double flowered Ranunculus was found growing in a wet place by the road side in the village of Bergen. Its creeping stems and other characters connect it with *R. repens,* and especially with that form of it which was described by Dr. Beck as *R. Clintonii.* Whether the plant with its double flowers was a spontaneous development or whether it had escaped from cultivation in some garden is not known.

Actæa alba, *Bigel.*

A form with long slender pedicels was found at Karner growing with *A. rubra.* The latter sometimes has thick pedicels, so that the color of the fruit remains as the most reliable character for distinguishing these species.

Barbarea vulgaris, *R. Br.*

This plant is very abundant on the low lands between Utica and Rome. It takes possession of pastures and cleared lands and rivals the common yellow buttercups in profusion. Its vigorous and abundant growth give it the appearance of an introduced plant and make it worthy of classification among our noxious weeds. Variety *arcuata* occurs along shaded streams in Sandlake.

Arabis lyrata, *L.*

The usual habitat of this plant is on rocks and precipices, but fine specimens were found growing in a sandy field near Albany.

Camelina sativa, *L.*

Abundant in wheat fields near Bergen. June. An introduced and troublesome weed.

Viola cucullata, *Ait.*

A peculiar form of this very variable species grows in Bergen swamp. The leaves are very small, about half an inch broad, the peduncles are elongated and the lateral petals are whitish at the base.

Prunus serotina, *Ehrh.*

The black cherry is very abundant about Southfield, Orange county, where it blossoms profusely even when a mere shrub in size. The choke cherry is also common here. It blossoms two or three weeks earlier than the black cherry.

Cephalanthus occidentalis, *L.*

The leaves are usually opposite or ternate, but sometimes there are four in a whorl.

Crantzia lineata, *Nutt.*

Specimens of this rare plant were sent from Wading River by *E. S. Miller.*

Epilobium hirsutum, *L.*

This introduced plant is gradually spreading. It is in North Greenbush, *G. W. Clinton,* and at Dunsback Ferry, near Cohoes. *H. C. Gordinier.*

Petasites palmata, *Gray.*

This rare species has been found in a sphagnous marsh in Sandlake. *Gordinier.* It also occurs sparingly in a marsh near Guilderland Station, in Albany county, but here it is in danger of extermination as the marsh will probably be soon cleared for cultivation.

Senecio aureus, *L.*

Variety *Balsamitæ* was found in dry rocky places at Southfield.

Vaccinium Pennsylvanicum, *Lam.*

The black-fruited form, variety *nigrum,* is not rare in the town of Day, Saratoga county. In one locality on the top of a mountain it was found producing berries of unusual size. Many of them were found by actual measurement to be fully a half inch in diameter. They were sweet and agreeable to the taste and grew in close clusters of three to six berries. This form would be a most desirable one to introduce into cultivation if it can be made to thrive as well in other localities as it does in its native one. The same variety, bearing more abundant though smaller fruit, was found growing in a marsh in the same town. This would indicate its adaptability to a variety of soils.

Clethra alnifolia, *L.*

The sweet pepper bush or white alder is abundant about Spruce pond near Southfield; also on Skunnemunk mountain. In the former locality, a plant of *Leucothoë racemosa* was also observed.

Menyanthes trifoliata, *L.*

Spruce pond near Southfield. The flowers are dimorphous. On some plants the stamens are longer than the pistils, on others shorter.

Apocynum androsæmifolium, *L.*

There are two forms of our common dogbane, in one of which the flowers are nearly twice as large as in the other.

Celtis occidentalis, *L.*

Near Saugerties. The hackberry is not rare in the lower part of the Hudson river valley, but northward and westward it is seldom found. I am informed that a tree of this species growing in the Mohawk valley, near Sprakers, is such a novelty that it has received from the inhabitants the name of "the unknown tree."

Nyssa multiflora, *Wang.*

Abundant on Skunnemunk mountain where it forms a tall tree and has a trunk twelve inches or more in diameter at the base.

Betula nigra, *L.*

The red birch was admitted into the New York Flora by Dr. Torrey, on the authority of Dr. J. Carey, who gave Saugerties as its locality. No specimens were placed in the Herbarium. Desiring New York specimens, I visited Saugerties and found several trees growing along the banks of the Æsopus river south of Saugerties. The species is easily known by its rough bark, curved branches and long drooping branchlets. The bark of young trees is smooth and whitish or reddish-white and such trees might easily be mistaken for the paper birch or poplar leaved white birch.

Alnus viridis, *D. C.*

Plentiful on Cobble hill, also along the road between Elizabethtown and Keene.

Arisæma triphyllum, *Torr.*

The apex of the spadix of the Indian turnip is generally obtuse. A specimen was found near Albany, in which the spadix was abruptly contracted near the top and prolonged into a slender subulate point, thus showing a tendency to approach, in form, the spadix of *A. Dracontium.*

Symplocarpus fœtidus, *Salisb.*

A specimen occurred near West Albany of which the spathe was double, or rather there were two spathes one smaller, partly within the other and facing it. The smaller interior one contained the spadix.

Orontium aquaticum, *L.*

Abundant at Spruce pond, Orange county. The spadix or club is at first greenish, then bright yellow, finally green again. In the yellow or flowering state it is erect and the scape for a short distance below the spadix is a pure white. After flowering the spadix is thrust beneath the surface of the water by the bending of the scape and both it and the upper part of the scape gradually assume their final green color. The flowers are protogynous and their odor is similar to that of chestnut blossoms. The plants sometimes grow among the sphagnum and sedges of the low quaking shores, and then their leaves are erect. The root is so deeply and firmly fixed in its place, that it is exceedingly difficult to obtain an entire plant.

Cypripedium candidum, *Muhl.*

In Bergen swamp the white lady slipper is associated with the larger and smaller yellow lady slippers. This is its only New York locality known to me, and it grieves me to know that it is here sometimes collected unsparingly merely for hand bouquets. By such treatment it is in danger of extermination. Such a rare and beautiful plant should be gathered sparingly and preserved in its native locality as long as possible.

Trillium grandiflorum, *Salisb.*

The variety *variegatum* has again been collected in the Jamesville locality where it presented the same characteristics as last year. Mrs. Goodrich writes that no specimen with sessile leaves had variegated petals. The petioled leaves and petals striped with green are thus far constantly associated. Of some plants transferred to her garden all reproduced the petioled leaves, and the single one which blossomed had its petals marked with green. One plant occurred in which the flower was borne on one stem and the leaves on another, both rising from the same rootstock. Miss Overacker found a monstrosity in which the flower had nine petals and twelve stamens; also another in which all the parts of the flower were in fours, even the ovary being four-celled. Rev. Mr. Beauchamp also found near Baldwinsville a specimen whose flower had six long sepals and eighteen shorter petals. Under proper cultivation this plant would probably produce double flowers and numerous varieties very readily.

Carex sterilis, *Willd.*

The typical form in which the spikes are often all or nearly all staminate is abundant in Bergen swamp. In the eastern part of the State the plants almost uniformly bear pistillate spikes, and an abundance of fruit. *C. sterilis* and *C. flava* are the prevailing species in Bergen swamp. Among the interesting and rare species are *C. gynocrates*, the typical form, and *C. vaginata*.

Agaricus melleus, *Vahl.*

An abortive form of this Agaric sometimes occurs. It resembles the abortive form of *A. abortivus*.

Agaricus serrulatus, *Pers.*

This species is quite variable. An Agaric was found in the Adirondack wilderness which I was at first inclined to regard as an undescribed species, but have concluded that it is a variety of *A. serrulatus*. The pileus is grayish or whitish-gray and the stem is destitute of the blackish points which belong to the typical form. It may be distinguished as variety *pallida*.

Lactarius resimus, *Fr.*

The plant which we have referred to this species as variety *regalis* was observed in Day. Its glabrous margin and glabrous stem remain constant. The pileus was obscurely zonate and the stem spotted. It might, at first sight, be mistaken for *L. insulsus*, but the change in the color of the milk would correct such a mistake.

Russula fœtens, *Fr.*

Variety *granulata* has the cuticle of the pileus rough with small granular scales.

Gymnosporangium macropus, *Schw.*

Plentiful on red cedar trees about Highland Mills, Orange county, and also about Schoharie.

Septoria mirabilis, *Pk.*

This should be referred to the genus Glœosporium.

Septoria corylina, *Pk.*

Variety *permaculata* differs from the typical form in having the spots large, brown or reddish-brown with an arid paler center. Living leaves of *Corylus rostrata*. Day.

Cenangium deformatum, *Pk.*

If the genus Cenangium be limited to such species as have simple colorless spores, this species must be transferred to the genus Karschia.

Hypoderma Desmazieri, *Duby.*

Specimens were found on leaves of pitch pine, *Pinus rigida*, while they were yet on the tree and green at the base. This would indicate that the fungus sometimes attacks and kills the leaves.

Spathularia flavida, *Pers.*

Variety *rugosa* has the club rugose. It was found in the Adirondack region growing in a circle about fifteen feet in diameter. All the plants in the circle had the club or receptacle rugose. Some of the plants were affected by *Hypocrea alutacea.* The stems were quite as velvety as in the form described as *Spathularia velutipes,* C. & F.

Sphærotheca pannosa, *Lev.*

Variety *Ribis* occurs on the stems, fruit and leaves of wild gooseberry, *Ribes cynosbati.* Bergen. June. It forms a dense felty stratum of mycelium, which is white at first but soon becomes brown. In the form on roses the mycelium, so far as I have observed, remains white. I have received from Prof. Scribner specimens of the same variety which were found on gooseberry in Colorado.

Hypoxylon Morsei, *B. & C.*

Dead branches of poison sumach, *Rhus venenata.* Guilderland station. May. If *H. Blakei* be united to this species, which union some advocate, then *H. Morsei* is an inhabitant of alders, willows, poplars and sumach.

Sordaria coprophila, *C. & D.*

In the early and immature condition of this fungus, the perithecia are thinly clothed with a minute cinereous flocculent villosity or tomentum, and the spores are cylindrical flexuous and colorless and very unlike the elliptical colored appendaged spore of the mature state.

Sphæria taxicola, *Pk.*

The spores in this are .0008 to .0009 in. long, .00016 to .0002 broad, triseptate and colorless. Therefore the species should be referred to the genus Metasphæria of the Saccardoian system.

(E.)

NEW YORK SPECIES OF PLEUROTUS, CLAUDOPUS AND CREPIDOTUS.

PLEUROTUS, *Fr.*

Stem eccentric, lateral or none. Spores white.

The species of this genus grow chiefly on decaying wood. A few grow on the ground or are attached to mosses. They are very diverse in size and general appearance. For instance, there is little resemblance between *P. ulmarius* and *P. striatulus,* the one a large species with a stout stem and thick fleshy pileus, the other a very small one with no stem and a thin membranous pileus. Yet both are included by the generic description. By reason of the lateral or eccentric stem and of the tufted mode of growth of some species, the pileus is often very irregular and unsymmetrical. Some of the species are also very variable in color, and among the small, at first resupinate forms, the young plant is often, in appearance, very unlike the reflexed mature plant. These variations make it difficult to accurately describe the species and to satisfactorily identify them from the published descriptions. Some of them, by reviving under the influence of moisture and by the tenacity of their substance, indicate an affinity with the genus Panus and its allies. Some of the larger stout-stemmed species occasionally have the stem nearly or quite central in which case they might be taken for species of Tricholoma, though their lignatile instead of terrestrial habitat would be an indication of their real affinity, but not a wholly reliable one, since some species of Tricholoma grow on wood. By their white spores they are separated from the otherwise similar Claudopodes and Crepidoti. Two species, *P. sapidus* and *P. euosmus* have pale lilac-tinted spores, but these can scarcely justify the removal of these plants to any genus having colored spores, since they would harmonize no better there than here. Indeed there is room for doubt if either of these supposed species is more than a variety of *P. ostreatus*. Several species have valuable esculent qualities. Fries has divided the genus into three sections, which for convenience we have adopted in the arrangement of our New York Pleuroti. He names them respectively, EXCENTRICI, DIMIDIATI and RESUPINATI.

Synopsis of the Species.

Stem eccentric pileus entire or marginate behind	1
Stem none or short, pileus sessile or not marginate behind	7
1. Lamellæ adnate or emarginate, not decurrent	2
1. Lamellæ distinctly decurrent	4
2. Lamellæ white	3
2. Lamellæ yellow	*P. sulphureoides.*
3. Odor farinaceous, spores elliptical	*P. lignatilis.*
3. Odor not farinaceous, spores globose	*P. ulmarius.*
4. Pileus slightly areolate	*P. subareolatus.*
4. Pileus not areolate	5
5. Spores dull lilac	*P. sapidus.*
5. Spores white	6
6. Lamellæ anastomosing at the base	*P. ostreatus.*
6. Lamellæ distinct at the base	*P. salignus.*
7. Pileus never resupinate, generally with a short lateral stem or stem-like base	8
7. Pileus at first resupinate, generally sessile	11
8. Pileus viscid when young or moist	*P. serotinus.*
8. Pileus not viscid	9
9. Lamellæ gray, subdistant, stem not compressed	*P. tremulus.*
9. Lamellae white, crowded, stem compressed	10
10. Plant growing on the ground	*P. spathulatus.*
10. Plant growing on decaying wood	*P. petaloides.*
11. Pileus white	12
11. Pileus not white	13
12. Pileus one inch or more long	*P. porrigens.*
12. Pileus small, less than one inch long or broad	*P. septicus.*
13. Lamellæ white or yellowish	*P. atrocæruleus.*
13. Lamellæ cinereous, livid-brown or blackish	14
14. Pileus even or slightly striate on the margin	*P. atropellitus.*
14. Pileus plicate-striate, black	*P. niger.*
14. Pileus striate, cinereous or livid-brown	*P. striatulus.*

Pileus entire or with a thin margin on one side, stem distinct, eccentric or lateral.

Pleurotus ulmarius, *Fr.*

Elm Agaric.

Agaricus ulmarius, Bull.

Pileus fleshy, compact, convex or nearly plane, glabrous, moist, sometimes tinged with reddish, yellowish or brownish hues and marbled with livid spots, becoming darker and shining when old, flesh pure white ; lamellæ broad, emarginate or rounded behind, *adnexed*, moderately close, *white or whitish ;* stem stout, *solid*, straight or curved, glabrous or partly or wholly tomentose, whitish ; spores *globose*, .0002 to .00025 in. broad.

Pileus 3 to 6 in. broad, stem 1 to 3 in. long, 6 to 10 lines thick.

Trunks of elm trees. Albany and Trenton Falls. September to December. Edible.

Variety *acericola*. Plant smaller, cæspitose.

Trunks and roots of maple trees. Adirondack mountains. September.

Variety *populicola*. Plant subcæspitose, stem wholly tomentose. West Albany.

This is one of our largest Pleuroti. It is variable in size and appearance. The stem is often thickened either above or below, and it may be glabrous or entirely tomentose, or only at the base or apex. Sometimes it is longitudinally rimose. On the elms of Albany it usually grows from places where branches have been cut away. It persists as a conspicuous object for many days. In very wet weather the disk is apt to crack either in a radiate or reticulate manner.

Pleurotus sulphureoides, *Pk.*

Pale-yellow Agaric.

Pileus fleshy, rather thin, convex, umbonate, glabrous or slightly squamulose, *pale-yellow ;* lamellæ moderately close, *rather broad*, slightly emarginate or rounded behind, *pale-yellow ;* stem firm, equal, slightly fibrillose, *stuffed or hollow*, generally curved and eccentric, rarely central, slightly mealy or tomentose at the top, yellowish or pallid; spores elliptical, .0003 to .00035 in. long .0002 to .00025 broad.

Pileus 1 to 2 in. broad, stem 1 to 1.5 in. high, 2 to 3 lines thick.

Decaying prostrate trunks. Catskill mountains. October. Rare. This species has not been detected since its discovery. It becomes paler in drying. The minute scales are brown, but sometimes are wanting. I have separated this Agaric from *A. sulphureus* because of its eccentric stem, woody habitat and squamulose pileus.

Pleurotus lignatilis, *Fr.*

Wood-inhabiting Agaric.

Agaricus abscondens, Pk.

Pileus compact, convex, sometimes slightly depressed or umbilicate, flocculose-pruinose or glabrous, *white ;* lamellæ thin, *narrow, crowded*, emarginate or adnate, *white ;* stem unequal, rather slender, curved, stuffed or hollow, whitish, sometimes tomentose at the base; spores *minute, elliptical*, .00016 to .0002 in. long, usually with a shining nucleus; odor distinct, farinaceous.

Pileus 2 to 3 in. broad, stem 1 to 2 in. long, 2 to 4 lines thick.

Decaying wood. Griffins, Delaware county, September.

Our specimens, by their pure white color, emarginate adnexed lamellæ and glabrous stem, did not well agree with the published description of *P. lignatilis*, and they were, therefore, described in the Thirty-first Report as a distinct species. But *P. lignatilis* is very variable according to Fries, and as our plant is scarcely more than a variety of it we have united it thereto.

Pleurotus subareolatus, *Pk.*

Slightly-areolate Agaric.

Pileus compact, convex, *whitish tinged with brownish pink*, usually *cracking in small maculiform areas;* lamellæ rather broad, loose, decurrent, whitish becoming tinged with yellow in drying; stem eccentric, subvertical, short, curved, firm, solid, sometimes compressed, white; spores oblong, .0005 to .0006 in. long, about .0002 broad.

Pileus 3 to 4 in. broad, stem 6 to 12 lines long, 4 to 6 lines thick.

Trunks of elm trees. Bethlehem. October.

This plant has occurred with us but once. It differs from *P. tessulatus* by its strongly decurrent lamellæ which form slightly elevated lines far down on the stem.

Pleurotus sapidus, *Kalchb.*

Sapid Agaric.

Plant generally cæspitose; pileus eccentric or lateral, rarely sessile, irregular, convex or depressed on the disk, glabrous, variable in color, whitish, yellowish, grayish-brown, lilac-brown or smoky-brown, flesh white; lamellæ rather broad, subdistant, decurrent, distinct or anastomosing at the base, whitish; stem firm, solid, straight or curved, white or whitish, often united at the base; spores oblong, *pale lilac*, .00035 to .00045 in. long, .00016 to .0002 broad.

Pileus 2 to 5 in. broad, stem 1 to 2 in. long, 3 to 8 lines thick.

Decaying wood of elm, beech, birch, horse-chestnut, etc., sometimes on buried sticks. Common. June to November. Edible.

This is a very variable species, closely allied to *P. ostreatus*, with which it is sometimes confused, and from which its short-stemmed subsessile forms with anastomosing lamellæ can scarcely be distinguished except by the peculiar color of the spores. These, when caught on white paper, have a dull, pale-lilac hue, inclining to lavender color. If they fall on a dark or brown surface they appear whitish. By reason of the colored spores of this fungus and of *P. euosmus*, W. G. Smith proposed the transfer of these plants to Claudopus, but this arrangement was not adopted by Fries, because their real affinities were evidently with the Pleuroti. He says that the species is so variable that its characters are indicated with difficulty, and that on the same trunk specimens sometimes occur that are white, tawny-brown and umber. In the typical form, the lamellæ are not described as anastomosing, but a form is mentioned in which the stem is reticulated by anastomosing veins. In our plant the lamellæ frequently anastomose at the base, just as in *P. ostreatus*. Its stem, also, is sometimes as short or obsolete as in that species. It occurs both in woods and in open places. It is more abundant in autumn, but occasionally appears as early as June. It is no less valuable than the next species for its edible qualities. A stew made of it is a very good substitute for an oyster stew.

In Hungary, according to Dr. Kalchbrenner, it is not only eagerly sought for food in the woods but is also cultivated in gardens by frequently moistening the elm trunks on which it grows.

In drying, the specimens roll up in an annoying manner, unless kept under pressure. The dried specimens are very liable to the attacks of insects.

Pleurotus ostreatus, *Fr.*

Oyster Agaric. Oyster Mushroom.

Agaricus ostreatus, Jacq. *Agaricus dimidiatus,* Bull.

Pileus fleshy, two to four inches broad, soft, convex or slightly depressed behind, subdimidiate, often cæspitosely imbricated, moist, glabrous, whitish cinereous or brownish, flesh white; lamellæ broad, decurrent, subdistant, *anastomosing at the base,* white or whitish; stem, when present, very short, firm, lateral, sometimes strigose-hairy at the base; spores oblong, *white,* .0003 to .0004 in. long, .00016 broad.

Decaying wood and trunks of trees. June to November. Edible.

With us this species is much less frequent than the preceding one. Specimens, nearly white when fresh, but yellowish when dried, were collected on oak trunks in Orange county. The spores were clearly white on white paper, but in other respects the plants might readily be taken for a whitish subsessile form of the preceding species.

Pleurotus salignus, *Fr.*

Willow Agaric.

Agaricus salignus, Abb. d. Schw. *Agaricus brumalis,* Scop.

Pileus fleshy, two to six inches broad, firm, spongy, convex or nearly plane, sometimes depressed and slightly hairy toward the base, nearly dimidiate, horizontal, whitish, dark-cinereous or ochraceous; lamellæ decurrent, some of them branched, eroded on the edge, *distinct at the base,* whitish; stem, when present, very short, lateral, tomentose; spores oblong, .00036 in. long, .00015 broad.

Decaying wood, especially of willows. Sandlake.

I have admitted this species with some hesitation, for our specimens, though apparently belonging to it, are not in good condition and hence doubtful. Fries says it is distinguished from *Panus conchatus* by its soft, not coriaceous, substance, but Gillet characterizes its substance as coriaceous when old.

Pileus definitely lateral, neither margined behind nor at first resupinate, sessile or attached to a very short lateral stem or stem-like base.

Pleurotus serotinus, *Fr.*

Late Agaric.

Agaricus serotinus Schrad. *Agaricus serotinoides,* Pk.

Pileus fleshy, one to three inches broad, compact, convex or nearly plane, *viscid when young and moist,* dimidiate reniform or suborbicular, solitary or cæspitose and imbricated, variously colored, *dingy-yellow, reddish-brown, greenish-brown or olivaceous,* the margin at first involute; lamellæ close, determinate, whitish or yellowish; stem very short, lateral, thick, yellowish beneath and minutely tomentose or squamulose with blackish points; spores *minute, elliptical,* .0002 in. long, .0001 broad.

Dead trunks of deciduous trees. Catskill and Adirondack mountains. Buffalo. *G. W. Clinton.* Autumn.

The late Agaric occurs especially in the hilly and mountainous districts of the State. It rarely makes its appearance before September and is sometimes found as late as December. It varies considerably in color but is easily recognized by its peculiar stem and determinate lamellæ. When viewed from above it appears to be stemless or attached by a mere basal prolongation of the pileus, but the lower surface of this prolongation, being differently colored and definitely limited by the basal termination of the lamellæ, has the appearance of a very short but distinct stem. In our plant the surface of the pileus is sometimes adorned with a minute brown or blackish fibrillose tomentum, which gives it a somewhat punctate or scabrous appearance. I find no notice of this character in the descriptions of the European plant. Such specimens with the lower surface of the stem, merely tomentose, were published in the Twenty-third Report as *Agaricus serotinoides,* but they do not appear to me to be any thing more than a mere form of the species. Sometimes the pileus is distinctly tomentose toward the base.

Pleurotus tremulus, *Fr.*

Tremulous Agaric. Gray Pleurotus.

Agaricus tremulus, Schæff.

Pileus thin, eight to twelve lines broad, obovate or reniform, plane or depressed on the disk, tenacious, glabrous, *livid-gray or grayish-brown* when moist, pale-gray when dry; lamellæ determinate, linear, subdistant, *gray or grayish;* stem marginal, short, distinct, nearly terete, ascending, villose at the base; spores *globose,* .0003 in. broad.

Ground among or attached to mosses. Poughkeepsie. October. *W. R. Gerard.*

The stem in our specimens is lateral, as required by the description and the place assigned to the species in the Friesian arrangement, but in Mycological Illustrations, Pl. 242, it is represented as eccentric.

The stem is sometimes wanting, and then the pileus is attached by fibrils. The species is easily known by its gray color and place of growth. It is apparently very rare with us, having been found in our State but once.

Pleurotus spathulatus.

Spathulate Agaric.

Agaricus spathulatus, Pers. *P. petaloides* v. *spathulatus,* Fr.

Pileus rather thin, one to two inches broad, ascending, *spathulate,* tapering behind into the stem, glabrous, convex or depressed on the disk and there sometimes pubescent, *alutaceous* or *brownish tinged with gray, red or yellow;* lamellæ crowded, linear, decurrent, whitish or yellowish; stem compressed, sometimes channeled above, grayish-tomentose; spores *elliptical*, .0003 in. long, .00016 to .0002 broad; *odor and taste farinaceous*.

Ground. Sandlake. June. Edible.

It grows singly or in tufts and is an inch or more in height. The margin is thin and sometimes striatulate and reflexed. Toward the base the flesh is thicker than the breadth of the lamellæ. The cuticle is tough and separable. The flesh is said by Gillet to be tender and delicate. Persoon describes the disk as spongy-squamulose, but in our specimens it is merely pubescent or tomentose.

The species was united as a variety to *P. petaloides* by Fries, and is described by Gillet under that name, but it seems to me to be sufficiently distinct in its habit, habitat, color and spores to be regarded as a species.

Pleurotus petaloides, *Fr.*

Petal-like Agaric. Petaloid Pleurotus.

Agaricus petaloides, Bull.

Pileus rather thin, eight to twenty lines broad, *cuneate or spathulate*, tapering behind into the short compressed generally villose-tomentose stem, convex or nearly plane, glabrous or with a minute grayish pubescence or tomentum toward the base, sometimes striatulate on the margin when moist, *whitish pale-alutaceous or brownish;* lamellæ crowded, linear, decurrent, whitish or yellowish; spores *minute, globose*, .00012 to .00016 in. broad.

Decaying wood. Buffalo. *G. W. Clinton*. East Worcester, Karner, Catskill and Adirondack mountains. July and August.

This is closely allied to the preceding species, with which it is united by most writers, but the striking difference in the size and shape of the spores indicates that they should be kept as distinct species. With us the petal-like Agaric is much more frequent in its occurrence than the spathulate Agaric.

In shape and general appearance it closely resembles *Crepidotus applanatus*, from which it may be distinguished by its paler lamellæ, smaller white spores and more colored pileus.

Pileus at first resupinate, then reflexed, sessile; lamellæ radiating from an eccentric point.

Pleurotus porrigens, *Fr.*

Prolonged Agaric. Pine Pleurotus.

Agaricus porrigens, Pers.

Pileus rather thin, at first resupinate and suborbicular, then reflexed and prolonged, obovate subelliptical or ear-shaped, often longer than broad, one to three inches long, sessile, *glabrous or villose-tomentose toward the base, pure white*, the margin involute when young, sometimes lobed in large specimens; lamellae *narrow, linear*, thin, *crowded*, sometimes slightly forked or anastomosing at the base, white; spores subglobose, .00025 to .0003 in. broad.

Much decayed wood of pine and hemlock. Buffalo. *G. W. Clinton*. Karner, Catskill and Adirondack mountains. Autumn.

The prolonged Agaric is a fine species, easily known by its pure white color, sessile pileus, and its lamellæ forking or even anastomosing near the base in large specimens.

I find no good characters by which to distinguish *Agaricus nephretus*, Ellis, from this fungus. The spores in this, as well as in *P. striatulus*, *P. niger* and some others, have a slight depression on one side, which makes them broader in one diameter than in the other, and gives them a slightly curved appearance when viewed edgewise.

Pleurotus septicus, *Fr.*

Wood-rotting Agaric. Thin Pleurotus.

Agaricus pubescens, Sow.

Pileus *small*, thin, three to six lines broad, nearly plane, *pubescent or subpulverulent*, sessile or with a short white pubescent stem or stem-like base, *pure white;* lamellæ *rather broad, subdistant*, white; spores subglobose, .00016 to .0002 in. broad.

Decaying wood. Ballston and Adirondack mountains. August.

The clear white color of *P. porrigens* is seen also in this species, which may be easily distinguished by its smaller size, nearly pubescent pileus, subdistant lamellæ and smaller spores.

Pleurotus atrocæruleus, *Fr.*

Dark-blue Agaric. Blue-black Pleurotus.

Agaricus alneus, Schæff.

Pileus fleshy with an *upper brownish gelatinous stratum*, one to two inches broad, convex or nearly plane, reniform dimidiate or obovate, rather tough and flexible, sometimes cæspitosely imbricated, sessile, *villose-tomentose*, dark-blue, blackish, grayish or tawny-brown, flesh soft, whitish; lamellæ rather broad, close, *whitish or yellowish;* spores *elliptical*, .00025 to .0003 in. long, .00016 to .0002 broad.

Decaying trunks and branches of beech, alders and poplars. Karner. September. Buffalo. *G. W. Clinton.*

I have seen no American specimens with the dark-blue or indigo color shown in the published figures of the European plant, but Fries himself says that the pileus is sometimes brown, so that we have no doubt of the specific identity of our plant. The pileus is covered with a grayish or cinereous villosity, which in small specimens forms a thin uniform velvety pubescence, but in large specimens it is more dense and somewhat tufted. Sometimes it is much thinner on the margin than toward the base of the pileus, and in such specimens the real color of the pileus is best seen on the margin. This, in large specimens, is often wavy or somewhat lobed. Small, blackish forms frequently resemble large forms of the next species, but are distinguishable by the paler color of the lamellæ. The plant readily revives on the application of moisture.

Pleurotus atropellitus, *n. sp.*

Black-skinned Agaric.

Pileus very thin, three to eight lines broad, rather tough, flaccid, resupinate or reflexed and lateral, convex or nearly plane, suborbicular obovate or reniform, *villose-tomentose except on the margin*, sessile or prolonged at the base into a short grayish-tomentose stem, *blackish-brown or black,* the tomentum grayish or cinereous, the thin margin slightly striate when moist; lamellæ rather broad, *close, blackish-brown or black,* whitish on the edge; spores *subelliptical;* .0003 to .00035 in. long, .00016 to .0002 broad.

Decaying wood and bark, both of frondose and acerose trees. Fort Edward, *E. C. Howe.* Buffalo. *G. W. Clinton.* Maryland, Helderberg and Adirondack mountains. June to October.

Our plant is closely related to *Pleurotus applicatus,* and it is with some hesitation that I have described it as distinct. But unless the figures and descriptions of that species are erroneous, our fungus is easily distinguished from it by its larger size, darker color and closer blackish lamellæ. *P. applicatus* is described as dark cinereous, cupular, two to three lines broad, villose at the base, sessile or attached by a prolongation on the back and with the lamellæ distant and paler than the pileus. In the American plant these characters do not hold good. The pileus is often clearly attached by a lateral stem or stem-like base and the villosity is found everywhere except on the margin, and the lamellæ are always, so far as I have seen, as dark as or even blacker than the pileus. The plant is flexible and revives on the application of moisture, thus indicating an affinity with the genus Panus. I have seen no description of the spores of *P. applicatus.*

Pleurotus niger, *Schw*

Black Agaric.

Pileus submembranous, two to four lines broad, subresupinate, pulveraceous, *black, plicate on the margin;* lamellæ broad, radiating, *black,* cinereous on the edge; spores subglobose, .0002 to .00025 in. broad.

Decaying wood. Helderberg mountains, June. This apparently rare fungus has been found in our State but once. The pileus is attached by a tuft of black hairs, and in the largest specimens these extend to the disk and there have a pulverulent appearance. The black color, black villosity and more coarsely striate or plicate margin distinguish this species from the next, which it otherwise closely resembles.

Pleurotus striatulus, *Fr.*

Slightly-striate Agaric.

Agaricus membranaceus, Scop. *Agaricus striato-pellucidus,* Pers.

Pileus membranous, very delicate, two to four lines broad, resupinate or subcupular, then reflexed, sometimes obconic and pendulous, sessile, slightly *striate* when moist, strongly striate or corrugated when dry, flaccid, *glabrous,* scattered or gregarious, persistent, *cinereous or brown;* lamellæ few, distant, *whitish or cinereous;* spores subglobose, .0002 to .00025 in. broad.

Much decayed wood of pine and hemlock. Fort Edward. *E. C. Howe.* Buffalo. *G. W. Clinton.* Greenbush and Adirondack mountains. July and October.

This is the smallest of our Pleuroti. Like the three preceding species, it revives on the application of moisture, and with them it forms a peculiar group worthy of distinction and separation from the others. The pileus is attached by a grayish villosity. In drying it sometimes becomes nearly black. It is then so small and shriveled that it is easily overlooked.

CLAUDOPUS, *Smith.*

Pileus eccentric, lateral or resupinate. Spores pinkish.

The species of this genus were formerly distributed among the Pleuroti and Crepidoti, which they resemble in all respects except in the color of the spores. The genus at first was made to include species with lilac-colored as well as pink spores, but Professor Fries limited it to species with pink spores. In this sense we have taken it. The spores in some species are even, in others rough or angulated. The stem is either entirely wanting or is very short and inconspicuous, a character indicated by the generic name. The pileus is often resupinate and attached by a dorsal point when young, but it becomes reflexed with age. The species are few and infrequent. All inhabit decaying wood.

Synopsis of the Species.

Pileus yellow.... ....*C. nidulans.*
Pileus white or whitish 1
1 Spores even .... *C. variabilis.*
1 Spores angulated..*C. depluens.*
Pileus gray or brown.................. 2
2 Pileus striatulate when moist..............................*C. Greigensis.*
2 Pileus not striatulate ....*C. byssisedus.*

Claudopus nidulans.

Nestling Agaric.

Agaricus nidulans, Pers.

Pileus one to three inches broad, sessile or rarely narrowed behind into a short stem-like base, often imbricated, suborbicular dimidiate or reniform, *tomentose*, somewhat strigose-hairy or squamulose-hairy toward the margin, *yellow or buff color*, the margin at first involute; lamellæ rather broad, moderately close or subdistant, *orange-yellow;* spores even, slightly curved, .00025 to .0003 in. long, about half as broad, delicate pink.

Decaying wood. Sandlake, Catskill and Adirondack mountains. Autumn.

This fungus was placed by Fries among the Pleuroti, and in this he has been followed by most authors. But the spores have a delicate pink color closely resembling that of the young lamellæ of the common mushroom, *Agaricus campestris*. We have, therefore, placed it among the Claudopodes, where Fries himself has suggested it should be placed if removed at all from Pleurotus. Our plant has sometimes been referred to *Panus dorsalis*, Bosc., but with the description of that species it does not well agree. The tawny color, spathulate pileus, paler floccose scales, short lateral stem and decurrent lamellæ ascribed to that species are not well shown by our plant. The substance of the pileus, though rather tenacious and persistent, can scarcely be called coriaceous. The flesh is white or pale yellow. The tomentum of the pileus is often matted in small tufts and intermingled with coarse hairs, especially toward the margin. This gives a squamose or strigose-hairy appearance. The color of the pileus is often paler toward the base than it is on the margin.

Claudopus variabilis, *Fr.*

Variable Agaric.

Agaricus variabilis, Pers. *Agaricus sessilis*, Bull. *Agaricus niveus*, Sow.

Pileus thin, one-half to one inch broad, at first resupinate, then reflexed, sessile or with a very short stem, tomentose, white; lamellæ rather broad, thin, radiating from a lateral or an eccentric point, distant, white becoming pink; spores *even*, elliptical, .00025 to .0003 in. long, about half as broad.

Decaying wood and dead branches. Adirondack mountains. July to October. Buffalo. *G. W. Clinton.*

A small and not common species. The thin pileus is often attached to its place of growth by white tomentose filaments, and the point to which the lamellæ converge is also sometimes tomentose.

Claudopus depluens, *Fr.*

Rainy Agaric.

Agaricus depluens, Batsch.

Pileus thin, one-half to one inch broad, at first resupinate, then reflexed, variable in form, sessile or with a short stem, slightly silky-tomentose especially toward the base, white or whitish, sometimes slightly tinged with pink; lamellæ broad, subdistant, whitish, becoming pink; spores *angulated*, .0004 to .00045 in. long, .0003 broad, usually containing a single large nucleus.

Decaying wood. Catskill mountains, Gansevoort and Sterling. July and August.

This species, like the preceding one, which it closely resembles and from which it is separated by the character of the spores, is very variable. In our specimens the pileus is white, but it is sometimes described as tinged with red or gray. It is also said to grow upon the ground and on mosses, but our specimens grew upon decaying wood. In both these particulars they agree with the figure of the species in Mycological Illustrations.

Claudopus Greigensis, *Pk.*

Greig Agaric.

Pileus very thin, convex, five to ten lines broad, hygrophanous, grayish-cinnamon color and *striatulate* when moist, silky-fibrillose when dry; lamellæ subdistant, *scarcely reaching the stem*, grayish becoming dingy-pink; stem short, about one line long, solid, curved, fibrillose below, with an abundant white radiating mycelium at the base; spores angulated, .00035 to .00045 in. long, .0003 broad, usually containing a single large nucleus.

Much decayed wood. Greig. September.

This species is intermediate between the preceding and the following one, but it is more closely related to the latter, from which it is distinguished by the striatulate pileus and free lamellæ.

Claudopus byssisedus, *Fr.*

Fibril-attached Agaric. Little Claudopus.

Agaricus byssisedus, Pers.

Pileus very thin, four to ten lines broad, at first resupinate, then reflexed, nearly plane, glabrous or merely pruinose with a slight grayish villosity, gray, grayish-brown or brown; lamellæ rather broad, *subdecurrent,* grayish, then tinged with pink; stem short, lateral or eccentric, generally curved, with white radiating byssoid fibrils at the base; spores angulated, .0004 to .00045 in. long, .0003 broad.

Decaying wood. Sterling and Adirondack mountains. August and September.

CREPIDOTUS, *Fr.*

Veil wanting or not manifest. Pileus eccentric, lateral or resupinate. Spores ferruginous.

The Crepidoti correspond in shape and habit to the smaller Pleuroti and the Claudopodes, but they are distinguished from both by the ferruginous color of their spores. These are globose in several species, in others they are elliptical. In some there is a depression on one side which gives them a naviculoid character and causes the spore to appear slighly curved when viewed in a certain position. In consequence of the similarity of several of our species, the character of the spores is of much importance in their identification, and it is unfortunate that European mycologists have so generally neglected to give the spore characters in their descriptions of these fungi. In most of the species the pileus is at first resupinate, but it generally becomes reflexed as it enlarges. It is generally sessile or attached by a mass of white fibrils or tomentum. For this reason it is usually somewhat tomentose or villose about the point of attachment, even in species that are otherwise glabrous. In several species the pileus is moist or hygrophanous and then the thin margin is commonly striatulate. This character is attributed to but one of the dozen or more European species. The large number of New York species is noticeable, and future investigation may show that mere varieties have in some instances been taken for species. Their mode of growth is usually gregarious or somewhat loosely imbricated, in consequence of which the pileus, which in most species is white or yellowish, is often stained by the spores, and then it has a rusty, stained or squalid appearance. The species occur especially on old stumps, prostrate trunks and soft much-decayed wood in damp, shaded places. The name Crepidotus is derived from two Greek words *κρεπις*, a shoe or slipper, and *ους*, an ear.

Synopsis of the Species.

Pileus viscid when moist .... *C. hærens.*
Pileus not viscid 1
1. Pileus with a distinct stem 2
1. Pileus sessile or with an indistinct stem 3
2. Stem thickened at the base .... *C. haustellaris.*
2. Stem not thickened at the base .... *C. tiliophilus.*
3. Pileus glabrous or only slightly villose at the base 4
3. Pileus not glabrous 6
4. Lamellæ narrow and decurrent .... *C. applanatus.*
4. Lamellæ broad, not decurrent 5

Crepidotus hærens, *Pk.*

Sticky Agaric.

Pileus thin, four to twelve lines broad, convex, sessile, cuneiform or dimidiate, glabrous, or slightly squamulose, hygrophanous, *viscid* and striatulate on the margin when moist, white or whitish when dry; lamellæ moderately close, narrow, tapering toward each end, subcinereous, then brownish; spores *elliptical,* pale-ferruginous, .0003 in. long, .0002 broad.

Decaying wood. Albany. September.

The elliptical spores and viscid pileus are the distinguishing characters of the species. I know of no other viscid Crepidotus. The pileus is watery white or gray when moist, and white when dry, unless stained by the spores. The margin is very thin and the pileus is attached to the matrix by white filaments. The species is rare, having been observed but once.

Crepidotus haustellaris, *Fr.*

Kidney-shaped Agaric.

Pileus thin, four to ten lines broad, lateral or eccentric, reniform or suborbicular, plane, moist, slightly tomentose when dry, alutaceous or pale-ochraceous; lamellæ broad, subdistant, rounded behind, slightly adnexed or nearly free, pallid, then brownish-cinnamon; stem short, distinct, solid, *bulbous thickened at the base,* whitened with a slight tomentose villosity; spores elliptical, .00035 to .0004 in. long, .0003 broad.

Dead bark of poplars. Thurman, Warren county. October. Rare.

Our specimens differ from the European plant in being smaller and of a paler color. The pileus is also sometimes eccentric, though Fries describes it as "exactly lateral" in the European plant. The dimensions of the spores are taken from our specimens, no spore characters being given in any description of the species to which we have had access. Fries remarks that the species is "small, regular, not cæspitose, especially marked by the subconic stem and almost free lamellæ."

Crepidotus tiliophilus, *Pk.*

Linden-loving Agaric.

Pileus moderately thin, six to twelve lines broad, convex, minutely pulverulent, hygrophanous, watery-brown and striatulate on the margin when moist, dingy-buff when dry; lamellæ rather broad, subdistant, rounded behind, adnexed, colored like the pileus, becoming ferruginous-cinnamon; stem two to four lines long, about one line thick, solid, often curved, pruinose, with a white pubescence at the base; spores subelliptical, brownish-ferruginous, .00025 to .0003 in. long, .00016 to .0002 broad.

Dead trunks and branches of basswood, *Tilia Americana*. East Berne, Albany county. August.

This plant is closely related to the preceding one from which I have separated it because of its larger size, smaller spores and stem not thickened at the base. The individual plants are also sometimes so closely crowded that they appear cæspitose. It is possible that intermediate forms may yet be found that will connect these.

Crepidotus applanatus, *Fr.*

Flattened Agaric.

Pileus very thin, six to twelve lines long, four to ten broad, variable in shape, suborbicular, reniform, cuneiform or spathulate, plane or convex, sometimes slightly depressed behind, sessile or prolonged behind into a short compressed white-tomentose stem-like base, glabrous, hygrophanous, watery-white and striatulate on the margin when moist; white when dry; lamellæ *very narrow, linear, crowded, decurrent*, white, becoming cinnamon; spores globose, .0002 to .00025 in. broad.

Old stumps and much decayed wood. Common. July to September.

It is very variable in the shape of the pileus, but it is commonly either cuneate or spathulate. It closely resembles *Pleurotus petaloides* in this respect as well as in the narrow crowded lamellæ and flattened stem-like base. As in that species and others of this genus, the pileus quickly becomes convolute in drying, unless it is placed under pressure. The striations of the thin margin are often retained in the dried plant. In the 26th Report, our specimens were erroneously referred to *C. nephrodes*, B. & C., from which they differ in the glabrous pileus and crowded linear lamellæ. This last character distinguishes it from all our other Crepidoti. It is gregarious and the pileus is often stained by the spores.

Crepidotus malachius, *B. & C.*

Soft-skinned Agaric.

Pileus thin on the margin, thicker behind, eight to twenty-four lines broad, varying from reniform or suborbicular to cuneate or flabellate, nearly plane, sometimes depressed behind, sessile or prolonged behind into a short white tomentose rudimentary stem or tubercle, glabrous, hygrophanous, *watery-white or grayish-white* and striatulate on the margin when moist, *white* when dry; lamellæ close, *subventricose, rounded behind, white or whitish*, becoming brownish-ferruginous; spores *globose*, .00025 to .0003 in. broad.

Variety *plicatilis*. Pileus coarsely plicate on the margin.

Decaying wood in damp shaded places. Common. June to September.

This resembles the preceding species in color and habit, but it is easily distinguished by its broader pileus and much broader lamellæ rounded behind. In drying, the moisture is retained longer by the thin margin than it is by the thicker disk. The striations are sometimes retained in the dried specimens. By neglecting the spore characters, squalid spore-stained specimens of this species were erroneously referred, in the 24th Report, to *C. mollis*, a species not yet found in our State, though it has been reported from North Carolina, Ohio and Massachusetts.

Crepidotus croceitinctus, *n. sp.*

Saffron-tinted Agaric.

Pileus eight to twelve lines broad, convex or nearly plane, sessile, *glabrous*, sometimes with a white villosity at the base, moist, *yellowish ;* lamellæ moderately broad, rounded behind, whitish, becoming *dull saffron-yellow*, then ferruginous ; spores ferruginous, *subglobose or broadly elliptical*, .0002 to .00025 in. long.

Decaying wood of poplar and beech. Adirondack mountains and Day, Saratoga county. July.

This species is separated from *C. dorsalis* by its glabrous pileus and its less globose spores, and from *C. crocophyllus* by its larger size, yellow color and the absence of squamules from the pileus. Its spores are of a brighter ferruginous color than in most of our other species.

Crepidotus putrigena, *B. & C.*

Rotten-wood Agaric.

Pileus thin, convex, subreniform, often imbricated, sessile, *slightly tomentose with a more dense white villosity at the base*, moist, striatulate on the margin, whitish or yellowish-white; lamellæ rather close, broad, rounded behind, whitish, becoming ferruginous; spores *globose*, .00025 to .0003 in. broad.

Decaying wood. Brewerton. September.

This species is perhaps too closely allied to *C. malachius*, from which it scarcely differs, except in the villose-tomentose pileus. The lamellæ are three or four times broader than the thickness of the flesh of the pileus.

Crepidotus herbarum, *Pk.*

Herb-inhabiting Agaric.

Pileus thin, two to five lines broad, resupinate, suborbicular, clothed with a white, downy villosity, incurved on the margin when young, sometimes becoming reflexed, sessile, dimidiate and less downy ; lamellæ rather narrow, subdistant, radiating from a naked lateral or eccentric point, white, then subferruginous; spores elliptical, .00025 to .0003 in. long, .00014 to .00016 broad.

Dead stems of herbs and dead bark of maple. North Greenbush and Adirondack mountains. August and September.

Crepidotus versutus, *Pk.*

Evasive Agaric.

Pileus four to ten lines broad, at first resupinate, then reflexed, reniform or dimidiate, sessile, white, clothed with a soft, downy or tomentose-villosity, incurved on the margin; lamellæ rather broad, subdistant, rounded behind, radiating from a lateral or eccentric point, whitish, then ferruginous; spores subelliptical, .00035 to .0004 in. long, .00025 to .0003 broad.

Decaying wood, bark, etc., in damp, shaded places. Common. June to October.

This species, and *C. herbarum* appear to run together, and but for the marked difference in the size of their spores I should have united them. The latter is not limited in its habitat to the stems of herbs, and the former sometimes, though rarely, occurs on them. *C. herbarum* is a smaller species with a thinner pileus, nearly always resupinate, and when reflexed, less densely tomentose. Its smaller spores especially distinguish it. Both appear to be closely allied to the European *C. chimonophilus*, which seems to be distinguished by its "oblong elliptical" spores, and its few distant lamellæ attenuated behind.

Crepidotus fulvotomentosus, *Pk.*

Tawny-tomentose Agaric.

Pileus eight to twenty-four lines broad, scattered or gregarious, suborbicular, reniform or dimidiate, sessile or attached by a short, white-villose tubercle or rudimentary stem, hygrophanous, watery-brown and sometimes striatulate on the margin when moist, whitish, yellowish or pale ochraceous when dry, *adorned with small, tawny, hairy or tomentose scales;* lamellæ broad, subventricose, moderately close, rounded behind, radiating from a lateral or eccentric white villose spot, whitish becoming brownish-ferruginous; spores *elliptical* often uninucleate, .0003 to .0004 in. long, .0002 to .00025 broad.

Decaying wood of poplar, maple, etc. Common. June to October.

A pretty species, corresponding in some respects to the European *C. calolepis*, but much larger and with tawny, instead of rufescent scales. The cuticle is separable and is tenacious though it has a hyaline gelatinous appearance. The pileus is subpersistent, and specimens dried in their place of growth are not rare.

Crepidotus dorsalis, *Pk.*

Dorsal Agaric.

Pileus eight to fifteen lines broad, sessile, dimidiate or subreniform, plane or slightly depressed behind, with a decurved substriate margin, slightly *fibrillose-tomentose, reddish-yellow;* lamellæ close, ventricose, rounded behind, radiating from a lateral white villose spot, yellowish, then brownish-ochraceous or subferruginous; spores *globose*, .00025 in. broad.

Decaying wood. Sprakers and Adirondack mountains. June and September. Buffalo. *G. W. Clinton.*

The tomentum of the pileus is more dense and conspicuous about the point of attachment, where it sometimes forms minute tufts or scales.

EXPLANATION OF PLATE 1.

ASCOMYCES EXTENSUS *Peck.*

FIG. 1. A leaf partly killed and discolored by the fungus.
FIG. 2. An ascus containing spores x 400.
FIG. 3. Four spores x 400.

AGARICUS (NOLANEA) BABINGTONII *Blox.*

FIG. 4. One young plant and two mature plants, the two at the left having the pileus moist and striatulate.
FIG. 5. Vertical section of a pileus and the upper part of its stem.
FIG. 6. Transverse section of the stem.
FIG. 7. Three spores x 400.

PESTALOZZIA CONSOCIA *Peck.*

FIG. 8. Part of a leaf with a discolored spot dotted by the fungus.
FIG. 9. Four spores, the one at the left immature x 400.

PESTALOZZIA CAMPSOSPERMA *Peck.*

FIG. 10. A leaf bearing the fungus.
FIG. 11. Four spores x 400.

SPHÆRELLA LYCOPODII *Peck.*

FIG. 12. Two spikes of the host plant bearing the fungus.
FIG. 13. A slightly magnified scale dotted by the fungus.
FIG. 14. An ascus containing spores x 400.
FIG. 15. Four spores x 400.

GODRONIA CASSANDRÆ *Peck.*

FIG. 16. Part of a branch bearing the fungus.
FIG. 17. A receptacle magnified.
FIG. 18. Vertical section of the same.
FIG. 19. A paraphysis and two asci containing spores x 400.
FIG. 20. Three spores x 400.

CLAVARIA CIRCINANS *Peck.*

FIG. 21. Two plants.
FIG. 22. Five spores x 400.

EXPLANATION OF PLATE 2.

DIAPORTHE MARGINALIS *Peck.*

FIG. 1. Part of a branch bearing the fungus.
FIG. 2. A pustule magnified.
FIG. 3. Vertical section of a magnified pustule, showing three perithecia.
FIG. 4. Two asci containing spores x 400.
FIG. 5. Four spores x 400.

DIAPORTHE NEILLIÆ *Peck.*

FIG. 6. Part of a branch bearing the fungus.
FIG. 7. A perithecium magnified, its rostrum piercing the epidermis.
FIG. 8. Two asci containing spores x 400.
FIG. 9. Four spores x 400.

LEPTOSPHÆRIA KALMIÆ *Peck.*

FIG. 10. Part of a branch bearing the fungus.
FIG. 11. A piece of the bark with two perithecia magnified.
FIG. 12. A perithecium more highly magnified.
FIG. 13. A paraphysis and an ascus containing spores x 400.
FIG. 14. Four spores x 400.

LÆSTADIA ÆSCULI *Peck.*

FIG. 15. Part of a petiole bearing the fungus.
FIG. 16. A perithecium magnified.
FIG. 17. Two asci containing spores x 400.
FIG. 18. Four spores x 400.

MONILIA PECKIANA *S. & V.*

FIG. 19. A leaf partly discolored and its petiole frosted by the fungus.
FIG. 20. Two chains of spores x 400.
FIG. 21. A single spore x 400.

M. PECKIANA var. ANGUSTIOR *S.*

FIG. 22. Part of a raceme with four of its young fruits frosted by the fungus.
FIG. 23. Two chains of spores x 400.
FIG. 24. Two spores x 400.

REPORT

OF THE

STATE ENTOMOLOGIST

TO THE

REGENTS OF THE UNIVERSITY OF THE STATE OF NEW YORK,

FOR THE YEAR 1885.

CONTENTS.

REPORT.

Office of the State Entomologist,
Albany, *January* 7, 1886.

To the Honorable Board of Regents of the University of the State of New York:

Gentlemen — I beg leave to present the following report in relation to my Department, and of some of the work during the past year:

The progress made in Economic Entomology within the last decade has been without a parallel in its previous history, and not surpassed, we believe, in any other department of Natural History. This has been attained through the careful and successful studies prosecuted, of the habits and life-histories of our various insects, and of insecticides available in the destruction of the injurious species, together with methods and appliances by which they can be most conveniently and economically employed.

A large proportion of the noxious species which for so long a time have imposed their onerous annual tax upon the products of the field, the orchard, and the garden, are now controllable, through means which the economic entomologist is prepared to recommend, and it only remains that such recommendations be faithfully carried out. With other species, not yet entirely within our control, much may be done toward a material mitigation of their hitherto unchecked depredations.

So marked have been the results attending the use of the remedial and preventive measures above referred to, that nothing more is needed to commend them than a knowledge of what they may accomplish. Thus, to illustrate: An orchard protected by Paris green spraying from the attack of the codling-moth, and as the consequence, yielding its thousand bushels of uninjured fruit — contrasted with a similar but uncared-for orchard adjoining, and proving an entire failure — furnishes as strong an argument as could be possibly presented in favor of the study of applied entomology.

The appreciation in which the work of this department is being held by the agricultural community of our State and of other States, is unmistakably shown in the calls made upon it for information and aid. During the past year such calls have been largely in excess of previous years, although no special insect attack of unusual severity has prevailed over a large extent of territory.

While it is undoubtedly true that insect injuries are annually increasing with us, through the stimulation of insect fecundity through special crops cultivated in larger and larger areas — in the introduction from abroad of European pests of bad reputation, and the acquisition of new habits of feeding and new food-plants by our native species — yet no inconsiderable part of this apparent increase must be chargeable to the greater attention now being given to insect attacks, before unnoticed. They are no longer accepted as evils that must be borne, but the intelligent farmer recognizes them as invasions that should be repelled if possible — that experience has shown may be successfully repelled, and are, therefore, to be met with the best possible means of resistance. If the enemy presents himself in a new form, then aid is to be sought of those competent to give advice and direction.

It has been my pleasure as it has been my duty, to make faithful examination during the past year of the many forms of insect attack to which my attention has been called, and to return the best advice that I was prepared to offer. Some of them have been quite new and of unusual interest to me. So numerous have been these calls that I am never left without some special subject of investigation, and in but few instances has the time at my command sufficed for the study that their importanee seemed to demand. If, therefore, the replies from this department are not always as satisfactory as may be desired, they are the best that the Entomologist, unaided by assistants, under the pressure of his duties, is able to return.

A few of the insect attacks that have come under my notice during the year, and personal observations made, are presented in the following pages. A number of others, including some of the more interesting ones which would require considerable labor in their preparation, would have been introduced, but for the time that has been demanded in the supervision of the printing of the Second Report of the Entomologist to the Legislature, during the close of the year. This report had unavoidably been long delayed, and it seemed of great importance that it should be issued as soon as it was practicable to do so. It has been printed as a State document, and the edition ordered for the Legislature awaits the completion of the index.

The readiness of the Legislature to order as large editions of the reports of the Entomologist as it has been thought proper to ask for, may properly be regarded as an evidence of appreciation of the work of this department, by the representatives of the people of the State. Of the first report, a second edition was ordered by the last Legislature for its use, which has during the year been printed and distributed to the members. The edition ordered of the second report, although conspicuously larger than several other of the reports issued by State authority, is still very far short of affording the means of placing a copy in the hands of many of those for whose interests it was specially prepared, and to whom it could not fail of being serviceable. Were the distribution of the entire edition limited to the State of New York, and confined to those engaged in farming pursuits, it could only reach one in every sixty of the farms of the State.

In addition to publications through leading agricultural journals, to be hereafter referred to, I have endeavored to promote the objects of my department, through special papers and addresses upon entomological subjects. During the year the following societies have been addressed by me:

New York State Agricultural Society.
Troy Scientific Association.
Entomological Club of the American Association for the Advancement of Science.
National Academy of Science.
Massachusetts State Board of Agriculture.
Albany Institute.

My office duties have compelled me to decline several requests for papers from societies with whom I would have esteemed it a privilege to co-operate. In addition to the above, opportunities have been embraced to commend the interest, importance and benefit of the study of the insect world to pupils in our common schools and other minor institutions of learning.

PUBLICATIONS.

In accordance with the custom in former reports I herewith append a list of publications for the year past, for convenience of reference, and as a portion of the work of the Department.

On some Rio Grande Lepidoptera. (Papilio, iv, Nos. 7-8, September-October, 1884, pp. 135-147.) [Published February, 1885.]

Gives an annotated list of collections made by Messrs. Sennett and Webster, in 1877 and 1878, viz.: in Rhopalocera, 52 species (*Kricogonia Lunice* and *Apatura Cocles* being new species); in Sphingidæ, 4 species (*Sphinx insolita* n. sp.); in Ægeridæ, 2 species; in Bombycidæ, 3 species (*Ecpantheria Sennettii* n. sp.).

Scale-Insect Attack upon Ivy. (Country Gentleman, for February 26, 1885, L, p. 169, c. 2—22 cm.)

Ivy leaves (*Hedera helix*) received from Watervliet, N. Y., and infested on both surfaces and the stem also by *Aspidiotus nerii* Bouché—a scale insect which infests the cherry, plum, currant, maple, oleander, etc., throughout most of the United States. Remedies recommended under different conditions are scraping, a soap solution, and a soap and kerosene emulsion made in accordance with the formula given. [Printed also in this Report, see page 113.]

The Owl Beetle — Alaus oculatus. (Country Gentleman, for April 9, 1885, L, p. 307, c. 4—14 cm.)

The beetle, received alive in May, from Aiken, S. C., is described and its habits given. [Proves upon later examination to be *Alaus myops* (Fabr.).]

Remedies for the White Grub. (The New England Homestead, for May 16, 1885, xix, p. 205, c. 2—28 cm.)

The remedies usually recommended for the beetle, insufficient; the grubs may be destroyed by starvation; crops of buckwheat and mustard recommended for repelling the grubs; how and when salt may be used with benefit.

Cut-Worms. Read before the N. Y. State Agricultural Society, at the Annual Meeting, January 21, 1885. (Forty-fourth Annual Report of the New York State Agricultural Society, for the year 1884 [May], 1885, pp. 56–80, figs. 1–20.) (Separate, with cover and half-title [June, 1885], pp. 25, figs. 20.)

The subject is treated of under the following heads: What are Cut-worms? — Their Appearance — Their Habits — Habits of the Moths — Natural History — Conditions Favorable to Cut-worms — Their Food-plants — Abundance of Cut-worms — Literature of the Cut-worms — List of Species — Natural Enemies — Parasites — Preventives and Remedies — Two Preventives Specially Commended — Conclusion.

A Potato-bug Parasite. (The New England Homestead, for June 6, 1885, xix, p. 237, c. 2—34 cm.)

Some Colorado potato-beetles received from Middlesex county, Mass., badly infested with a mite which were killing the beetles, were identified as *Uropoda Americana* Riley. Description is given of it, its peculiar connecting filament remarked upon, habits of the family of *Gamasidæ* to which it belongs, noticed, together with the importance of the attack, and recommendation of distribution of the serviceable parasite. [Printed also in this Report, see page 116.]

The Visitation of Locusts. (The Argus [Albany], June 7, 1885, p. 4, c. 5—33 cm.)

The announced co-appearance of the 17-year locusts and the 13-year locusts will not occur in New York; why "locust" is a misnomer; not 221 years, as stated, since the two forms of Cicadas concurred, but only 30 years, also 39 years ago; no ground for alarm, as the Cicada injures fruit trees only, and those usually not seriously; notice of the brood of 17-year Cicadas to appear about the present time in New York, at Brooklyn and Rochester.

The Pear-blight Beetle. (Country Gentleman, for June 18, 1885, L, p. 517, c. 2, 3—46 cm.)

Xyleborus pyri (Peck), infesting the trunks of young apple trees and killing them, at Annapolis, Md., are identified; description of the beetle; origin of its common name; its two forms of attack; the burrows in the limbs and in the trunk described; the latter ascribed to a second brood but are probably made by the mature insect for food and shelter; remedy for the limb attack, cutting off and burning with the insect; for the trunk attack, not yet known. [Printed also in this Report, see page 107.]

The Canker-worm. (Country Gentleman, for June 18, 1885, L, p. 519, c. 2, 3—20 cm.)

Spread of the Canker-worm *Anisopteryx vernata* (Peck) in the State of New York; notice of its presence in large numbers at Loudonville, Albany county; the attack is controllable at the outset, and should not be allowed to extend. The preventives and remedies are, bands, etc., to prevent the ascent of the wingless female, spraying with Paris green water to kill the larvæ, and working the ground beneath the trees to crush the pupæ.

Insect Eggs on Strawberries. (Country Gentleman, for June 25, 1885, L, p. 537, c. 3—21 cm.)

The eggs do not indicate an attack that need impair our enjoyment of the fruit. Their presence is unusual and probably accidental. They are the eggs of some hemipterous insect, belonging probably to one of the larger plant-bugs. Description is given of them. The nauseous taste imparted to raspberries by the presence of a small bug, known as *Corimelæna pulicaria*, is referred to, and the insect described. This same insect attacks the blossoms and the stems of strawberries.

Plant-Lice, Elm Beetles, etc. (New England Homestead, for July 4, 1885, xix, p. 269, c. 1–2—15 cm.)

Identification of *Schizoneura Americana* as injuring leaves of elms at West Stockbridge. The insect reported as stripping the leaves of the elms, is probably the elm-leaf beetle, *Galeruca xanthomelæna*, although not known before to extend so far into Massachusets. May-flies perhaps mistaken for mosquitoes.

The Apple Tree Bark-louse. (New England Homestead, for July 4, 1885, xix, p. 269, c. 4–5—20 cm.)

Scales on bark of an apple tree sent are those of *Mytilaspis pomorum* of Bouché (*M. pomicorticis* Riley). Directions for destroying the insect, by scraping the scales and by spraying kerosene emulsions.

The Cut-Worm and Onion Maggot. (Country Gentleman, for July 9, 1885, L, p. 574–5, c. 4, 1—20 cm.)

For the arrest of cut-worm ravages reported from Globe Village, Mass., the inquirer is referred to remedies given in the paper published in the 44th Rept. N. Y. St. Agricul. Society. For controlling *Anthomyia brassicæ* and *Phorbia ceparum*, the remedies are removing the plants with the soil containing the larvæ, and killing the pupæ with gas-lime or plowing and harrowing repeatedly. Preventives are, strong-smelling substances and not planting in infested ground.

Peach and Cherry Borers. (Country Gentleman, for July 9, 1885, L, p. 575, c. 1—18 cm.)

Peach trees in Annapolis infested by *Phlœotribus liminaris*. It attacks the elm also. The cherry trees are probably infested by *Scolytus rugulosus* Ratz., recently introduced from Europe; see an interesting article upon this species in the Canadian Entomologist for September, 1884. The injuries of *P. liminaris* seem to be rapidly increasing in localities in the State of New York.

The Fig-eater — Allorhina nitida. (Country Gentleman, for July 9, 1885, p. 575, c. 2–3—15 cm.)

The species identified from Madison, N. J., and briefly described; its fondness for juicy fruits; is not known to occur in New York; the larva is one of the white grubs, and is quite injurious to the roots of grass; its abundance in Washington; the beetle is a pollen feeder and sometimes occurs in great numbers, as in an instance cited. The "trim flower-chafer" might be a better common name for it.

The Round-headed Apple-tree Borer — Saperda candida (Fabr.). (Country Gentleman, for July 16, 1885, L, pp. 590-1, c. 4, 1 — 33 cm.)

Borers in hawthorns [in Westchester Co., N. Y.], are probably the *Saperda candida;* its burrows and method of destroying the grubs with a strip of flexible steel; recommendation by Dr. Fitch of cutting out the grub; discovering the location and crushing the egg; killing the eggs by application of lye; benefit of mounding about the tree; washing with soap, and soap placed in the forks of the trees for preventives; principal publications upon the insect.

Entomological. (Country Gentleman, for July 16, 1885, L, p. 592, c. 2-3—20 cm.)

Paris green recommended for killing the potato-beetle infesting egg-plants; road-dust may prevent their attack. For the injuries of the rose-bug, at Waddington, N. Y., to apples and cherries, beating them from the trees recommended; to the former, Paris green might be applied. The abundance of this insect upon fruit trees at times, cited.

The Cause of Black-knot. (Country Gentleman, for July 23, 1885, L, p. 607, c. 1, 2—26 cm.)

It is not, as is popularly believed, of insect origin, but is produced by a fungus, originally named *Sphæria morbosa*, but recently transferred to the genus *Plowrightia*. There are not "three distinct species," but the same one attacks *Prunus domestica, P. Americana, P. cerasus, P. Virginiana, P. Pennsylvanica* and *P. serotina* — two plum trees and four cherry trees. Six species of insects have been bred from the black-knot. The remedy is to cut off and destroy attacked twigs and branches early in July. [Printed also in this Report, see page 120.]

The Cucumber Moth. (Country Gentleman, for July 23, 1885, L, p. 607, c. 2, 3—28 cm.)

The borer attacking a melon patch in Carp, Tenn., is, from the description sent, probably the larva of *Phakellura nitidalis* (Cramer), popularly known as the "pickle-worm." In New York and the Eastern States the squash-vine borer *Melittia cucurbitæ* takes its place. The appearance and the habits of the pickle-worm are described. The moth is also described. For remedies, destroy the bored melons, sprinkle with London purple or Paris green water while the moth is ovipositing. Figures of the insect are referred to. The borer may possibly be *P. hyalinatalis,* of which the habits are different.

Apple Insects and the Rhinoceros Beetle. (Country Gentleman, for July 30, 1885, L, p. 623, c. 2, 3—25 cm.)

Of apple insects sent from Coffee, Va., one is *Orgyia leucostigma,* and the other had spun up in cocoon [subsequently emerged and proved to be *Acronycta.* ————]. The information sent of the *Dynastes Tityus,* that the beetle comes from the ground among the ash trees where its larva had probably been feeding on living vegetable matter, is a new and interesting fact. The record of the manner in which the beetle eats the bark of the ash is also interesting, as also the mention of their being very destructive to tobacco plants, killing all that they attack.

Another Potato Pest. (New England Homestead, for August 8, 1885, xix, No. 32, p. 309, c. 3.)

Macrobasis unicolor (Kirby), one of the blister-beetles,— identified as the insect injurious to the foliage of potatoes, in Furnace, Mass. Beating the insects into a basin of water and kerosene oil, or if very abundant, sprinkling with Paris green or London purple in water, is recommended.

Rœstelia aurantiaca. (Country Gentleman, for August 13, 1885, L, p. 661, c. 3–4—10 cm.)

Determination of the above fungus occurring on quinces received from Charlton, Mass. It has usually been found associated with insect attack, as in this instance, where the fruit has been burrowed by probably the apple-worm of the codling moth.

The False Chinch-Bug. (Country Gentleman, for August 13, 1885, L, p. 661, c. 4—26 cm.)

Insects described (but no examples sent) and reported as injurious to radishes, turnips, horseradish, strawberries and raspberries, in Boulder, Col., are, without much doubt, the *Nysius angustatus* of Uhler. It had not previously been known to injure ripe strawberries, but had, according to observations of Prof. Forbes, been quite injurious to the foliage of strawberries in Illinois. Kerosene oil emulsions or pyrethrum could be used to destroy the bug when upon strawberries, until the fruit is about half-grown.

The Bag-Worm — Thyridopteryx ephemeræformis. (Country Gentleman, for October 1, 1885, L, p. 801, c. 4—20 cm.)

To an interesting account of the habits of a "worm" destroying arbor-vitæ hedges in Franklin Park, N. J., and request for information in regard to it, reply is made of its name as above, and the best method for checking its injuries, viz.: application of Paris green, and hand-picking and destroying the cases of the female moth. A figure illustrating the several stages of the insect is also given.

The Red Spider — Tetranychus telarius (Linn.). (Country Gentleman, for October 8, 1885, L, p. 821, c. 3–4—38 cm.)

Mites infesting various garden plants, at Utica, N. Y., are this species, which, standing at the head of the Acarina, approaches near to the spiders. It spins webs on the under side of the leaves, for shelter, while sucking the juices of the various plants upon which it occurs; those upon which it was noticed at Utica are mentioned. It has this summer been discovered in an injurious attack upon a quince orchard near Geneva, N. Y. Kerosene emulsions, soap solution with sulphur mixed, and quassia infusions may be used for killing it. It was the cause of the yellow discoloring of the leaves of a nasturtium in the garden of the writer. [Printed also in this Report, see page 118.]

The Thirteen-year Cicada. (The Argus [Albany], for October 11, 1885, p. 4—32 cm.)

A paper, read before the Albany Institute, containing remarks upon the exceptional long life-period of the *Cicada septendecim;* the number of broods occurring in the United States and in the State of New York; notice of a thirteen-year brood, and that its occurrence only in the Southern States may be the result of hastened development through higher temperature; Professor Riley's experiments in transferring the two forms from one region to another; and record of the planting of the eggs of a thirteen-year brood at Kenwood, near Albany. [Printed also in this Report, see p. 111.]

The Elm-Leaf Beetle. (Country Gentleman, for October 15, 1885, L, p. 841, c. 3-4—23 cm.)

The inquirer, from Bordentown, N. J., of methods for killing the insects destroying the foliage of his elm trees, is referred to a notice of this insect, *Galeruca xanthomelæna*, in the Country Gentleman for Oct. 12, 1882 (p. 805), and to Bulletin No. 6 of the Division of Entomology of the U. S. Agricultural Department. Of the arsenical insecticides recommended, London purple is preferred, in the proportion of one-half pound to three quarts of flour and a barrel (40 gals.) of water. Directions are given how to mix the preparation, and the advantages of its use are stated.

The Clubbed Tortoise Beetle. (Country Gentleman, for October 15, 1885, L, p. 841, c. 4—12 cm.)

Remarks upon *Coptocycla clavata* (Fabr.), its appearance, habits and food-plants. Reference to its occurrence upon the potato, tomato and egg-plant.

A Leaf-mining Insect. (Home Farm [Augusta, Me.] for October 15, 1885, p. 1, c. 6—20 cm.)

A leaf-miner, reported in Maine, and in the vicinity of Boston, Mass., is identified as one of the Anthomyians, and probably *Chortophila betarum* Lintn., which has distribution in New York and Connecticut. The approved methods for meeting its attack, are prevention of egg-deposit by the use of counter-odorants, and burning the infested leaves.

The Death-Watch, Clothilla pulsatoria. (Country Gentleman, for October 22, 1885, L, p. 861, c. 3-4—21 cm.)

A supposed parasite found in cow-stalls in Warren, O., is this insect, a figure of which is given. The habits of the Psocidæ are briefly stated, and the reason why this species has received the name of the "death-watch." It has previously occurred in immense numbers, in barn refuse after threshings, and in straw-packings in a wine cellar.

Eggs of a Katydid. (Country Gentleman, for October 29, 1885, p. 881, c. 4—23 cm.)

Eggs sent from Lexington, Va., arranged in two rows upon the opposite side of the back fold of a copy of the *Country Gentleman*, are those of *Microcentrus retinervus*, an insect common in some of the warmer States of the Union, and classed by some writers with the katydids, although strictly, the name of katydid would belong only to *Platyphyllum concavum*. The eggs are described, and reference made for the illustration and life-history of the species to the 6th Missouri Report.

A New Insect Foe to the Cut-worm. (New England Homestead, for October 31, 1885, xix, No. 44, p. 405, c. 3-4—19 cm.)

A correspondent from Winsted, Ct., sends for information a fly hatched from some cabbage cut-worms kept in confinement. The fly is a species of *Gonia* belonging to the *Tachinidæ*, the parasitic habits of which are given. Caterpillars bearing upon their body the white eggs or the egg-shell of these flies should not be destroyed, but permitted to furnish food for the beneficial larvæ that are feeding within them. The cabbage cut-worm was probably *Mamestra trifolii*.

Saw-Fly on Fruit Trees. (Country Gentleman, for November 12, 1885, L, p. 921 c. 3-4—25 cm.)

In answer to an inquiry from Edinburg, Scotland, of some small, thin, nearly transparent objects nearly half an inch long and looking like a leech, which for several years had nearly destroyed the leaves of plum, pear, and cherry trees, answer is made that it is the larva of some species of saw-fly, and probably of *Eriocampa adumbrata*. Its ravages may be prevented by means of powdered hellebore, to be obtained pure, and applied to the foliage by the hand or by a bellows. Its efficacy is illustrated by an account of its use in the Hammond Nurseries at Geneva, N. Y. Directions are given for using the hellebore mixed with water.

CONTRIBUTIONS.

The following contributions have been made to the Department during the year:

Larvæ, pupæ and imago of *Isosoma nigrum* Cook. From Prof. A. J. Cook, Lansing, Mich.

"Flaxseeds"—the puparia of the Hessian-fly, *Cecidomyia destructor*, in wheat, between the 1st and 2d joints, from North Huron, Wayne Co., N. Y. From A. F. Dowal, North Huron.

Numerous larvæ of *Cecidomyia leguminicola* Lintn., from a second cutting of clover, at Milleville, Orleans Co., N. Y. From D. M. Linsley, Milleville.

Egg-deposit of *Agrotis saucia* (Hübn.), on apple-twigs, May 7th, from trees of Mr. A. Oberndorf, Jr., Centralia, Kansas. From P. Barry, Rochester, N. Y.

Larvæ of the Spring Canker-worm, *Anisopteryx vernata* (Peck), from apple trees at Loudonville, N. Y. From David M. Knickerbocker, Albany, N. Y.

Examples of the cherry-tree Tortrix, *Cacœcia cerasivorana* (Fitch). From Prof. A. J. Cook, Lansing, Mich.

Cocoons of the apple-tree Bucculatrix, *Bucculatrix pomifoliella* (Clemens), from apple trees; the white flower-cricket, *Œcanthus niveus* Harris, taken while ovipositing in apple trees. From Isaac Bussing, Bethlehem Centre, N. Y.

Cocoons of a Lepidopterous larva, species unknown, working within the stored fruit of the black walnut, *Juglans nigra*, at Central Park, New York. From E. B. Southwick.

Larvæ and puparium of *Mallota* sp.? from Western New York. From Prof. L. M. Underwood, Syracuse University, N. Y.

Larvæ of *Anthomyia brassicæ* Bouché, infesting cauliflowers, near Albany. From D. M. Seeley, Albany, N. Y.

Larvæ of *Helophilus similis* Macquart, from a watering-trough at North Adams, N. Y. From Dr. R. M. Morey, Old Chatham, N. Y.

A Tachanid fly, *Gonia* sp., reared from a cabbage cut-worm. From BENJAMIN WHITE.

A section of cedar, *Thuja occidentalis*, showing the burrowing operations of *Phlœosinus dentatus* (Say). From WARREN KNAUS, Salina, Kansas.

Larvæ of *Attagenus megatoma* (Fabr.) and *Anthrenus varius* Fabr. From J. F. ROSE, South Byron, N. Y.

Burrows in apple-tree trunk and imago of *Xyleborus pyri* (Peck); also the peach-tree Scolytus, *Phlœotribus liminaris* (Harris), from a peach tree. From GEORGE W. DUVALL, Annapolis, Md.

The Colorado potato-beetle infested with a Gamasid mite, *Uropoda Americana* Riley. From SAMUEL G. SYMMES, Winchester, Mass.

Larvæ of the clover-leaf weevil, *Phytonomus punctatus* (Fabr.) coiled about stems of grass, and killed by an undescribed fungus. From Dr. E. L. STURTEVANT, State Agricultural Experiment Station, Geneva, N. Y.

Hylesinus opaculus Le Conte, boring under the bark of apparently healthy cedars, *Arbor vitæ*. From PROF. C. H. PECK, N. Y. State Botanist, Albany.

Allorhina nitida (Linn.), the fig-eater, from a rose-house. From ALICE M. GREENE, Madison, N. Y.

Silpha Americana (Linn.). From H. M. STODDARD, Stevensville, N. Y.

Larvæ and pupæ of the four-lined leaf-bug, *Pœcilocapsus lineatus* (Fabr.), feeding on sage, *Salvia officinalis*, at the State Agricultural Experiment Station. From E. S. GOFF, Horticulturist of the Station.

A cluster of eggs of a plant-bug, *Euschistes variolarius* Beauv., on a ripe strawberry. From Miss A. GOODRICH, Utica, N. Y.

Cosmopepla carnifex (Fabr.), feeding injuriously upon currants, causing them to fall. From Prof. D. P. PENHALLOW, of McGill University, Montreal, Can.

Zaitha fluminea, in the pupal stage. From F. E. WOOD, Phœnix, Mich.

Lecanium (nov. sp.) on *Ostrya Virginica* at the Albany Rural Cemetery. From Hon. G. W. CLINTON, Albany, N. Y

Oviposition of the white flower-cricket, *Œcanthus niveus* Harris, in peach-tree twigs. From O. WILSON, Keuka, Chemung Co., N. Y.

Atropos divinatoria (O. Fabr.), from a bed-room infested by them. From MORELL COON, East Edmonton, N. Y.

Mites—*Tyroglyphus siro* (Linn.), from smoked ham received from Ohio. From C. H. WESSELS, New York city.

Mites — *Tetranychus telarius* (Linn.), infesting a quince orchard, near Geneva, N. Y. From Prof. J. C. Arthur, State Agricultural Experiment Station.

Mites — *Gamasus* sp., infesting a burying beetle, *Necrophorus tomentosus* Web. From Dr. S. A. Russell, Albany, N. Y.

Eggs of a katydid, *Microcentrus retinervis* Riley, deposited on a shoot of a peach-tree in Coffey Co., Kansas. From James Buckingham, Zanesville, Ohio.

Sitodrepa panicea (Linn.), infesting a package of white carrot seed, in the pupæ, and emerging as imagines December 3, at the Agricultural Experiment Station. From E. L. Goff, Geneva, N. Y.

Seven examples of flies (*Muscidæ*), found July 21st, dead and closely packed within a stem of red elder, *Sambucus pubens*, without any visible cavity leading to their location. Apparently *Lucilia* and *Pollenia* sp.

Examples of *Macrodactylus subspinosus* (Fabr.); *Cicindela sexguttata* Fabr.; *Silpha noveboracensis* (Forst.); *Aphodius fimetarius* (Linn.); *Otiorhynchus ligneus* Le Conte; *Osmoderma eremicola* (Knoch); *Orthosoma brunneum* (Forst.); several species of minute fungus beetles, undetermined. *Cimbex Americana* Leach; *Diapheromera femorata* (Say), and a number of others, as yet unexamined insects.

From Hon. George W. Clinton, Albany, N.Y.

COLLECTIONS.

About three weeks in the month of August were devoted to collections in the Adirondack region, at Long lake, in the northern part of Hamilton county. The altitude of the lake is 1632 feet above tide. This elevation is too great to admit of an abundance of insect life, while it fails to reward the collector with the rare forms which are to be met with at higher elevations — at and above 2,500 feet. Very little is known, as yet, of the insect fauna of this interesting portion of our State. As I have previously written, "The enthusiasm of the entomologists of an adjoining State has led them to explorations of a peculiarly interesting field lying beyond the limits of their own State — the White Mountains of New Hampshire. For successive years the members of the Cambridge Entomological Club have established a midsummer encampment upon the slope of Mt. Washington, during which, through their protracted sojourn of weeks, and opportunity for collecting crepuscular and nocturnal forms, they have been able to enrich their cabinets and those of their correspondents with many rare boreal species, to accumulate much valuable biological information, and to present local lists of Lepidoptera, Coleoptera and Orthoptera, which have been received as special contributions to science.

"Meanwhile, the extensive Adirondack Region, with its numerous lofty mountain peaks, its deep gorges, its hundreds of lakes — perhaps second only to the White Mountains in point of interest to the entomologist of any locality in the United States east of the Rocky Mountains — has been permitted, year after year, to bury within itself its entire entomological wealth. Previous to the collections noticed in this paper [Lepidoptera of the Adirondack Region*], hardly an insect had been drawn from it. At the present, nothing has been reported of its mountain insect fauna. Many new species are undoubtedly to be discovered there, and the first comparison of its fauna with that of other elevated and more northern regions is yet to be made.

"It is sincerely to be hoped that, from the growing interest manifested in entomology, the numerous accessions to the number of its students, the facility for study afforded by recent publications and in several extensive classified collections, the reproach resting on the entomologists of New York may speedily be removed. And while the thorough exploration of any locality can scarcely fail of bringing to light much new material, the ambitious student may have for his incentive the assurance that in the Adirondack Mountains there is open to him an unexplored field where faithful search will assuredly yield him a most abundant return."

The locality of Long lake and the season offered but few flowering plants for the attraction of insects. The collections, therefore, were nearly confined to golden rods (*Solidago*) and the hardhack (*Spiræa tomentosa*), which were freely visited by Hymenoptera, Diptera and Coleoptera for the pollen that they afforded.

Of the Hymenoptera, the flowers were especially prolific in *Apidæ*, *Crabonidæ*, *Eucmenidæ* and *Andrenidæ*, whilst also yielding some desirable *Ichneumonidæ*.

In Diptera, several species of the gaily-colored *Syrphidæ* (flower flies) were abundant, of which, perhaps, the most interesting form was *Spilomyia fusca* Loew — a large fly, so singularly mimicking in size, form, color and markings the common "bald-faced hornet," *Vespa maculata* Linn., as to be easily (and generally by other than entomologists) mistaken for it. The species had never come under my observation before, nor has it been recorded as occurring in the State of New York. Its first capture was made on the 11th of August. It continued to increase in number, in both sexes, and the day prior to my departure from the locality (23d inst.) it was more abundant than before. Over forty examples of the species were taken. Nothing, I believe, is known of its larval stage. Several examples of a *Conops*, undetermined species, were also captured on the *Solidago*. A large, globose-bodied Tachinid fly, *Echinomyia* sp., having its tegulæ and basal portion of wings of a dull yellow, which I had in former years observed abundantly in Essex county, N. Y., was also a common visitor to the blossoms of the golden rod.

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*Seventh Annual Report of the Topographical Survey of the Adirondack Region of New York, 1880, pp. 375–400.

The collections in Lepidoptera were not large, the locality not being favorable to the multiplication of insects of this order. But few species of butterflies were seen.* *Danais Archippus* (Fabr.) and *Pyrameis Atalanta* (Linn.) were so abundant in a field of buckwheat that three or four individuals could be taken in a single sweep of the net. Associated with them were numbers of one of the most brilliant and beautiful of our moths, *Plusia mortuorum* Guen — a decidedly upland species. Its quick rise from the blossoms of the buckwheat, its rapid flight for a short distance, sudden dropping to the ground and running away to shelter, made it a difficult insect to capture. The elegantly marked *Homohadena atrifasciata* Morr., of which the first example taken in the Adirondacks in the year 1876, commanded in exchange with an enthusiastic lepidopterist, other insects of the value of $50, was taken from flowers of *Eupatorium purpureum.*

Coleoptera were not numerous. Several species of pretty Lepturians were found upon the golden rods, and a single example of "the large and elegant *Leptura scalaris* Say," as characterized by Dr. LeConte (p. 313 of Classification of the Coleoptera of North America), now the type and only species of the genus *Bellamira*, was driven up in a Solidago bordered road and taken upon the wing. It was seen under the same circumstances in other instances, and when in flight, and displaying the golden sericeous hairs clothing the tip of its abdomen, it resembled so closely a similarly tipped Asilus fly that it was mistaken for it. *Dicerca manca* Lec. (apparently not *tuberculata* of L. & G. — see Trans. Amer. Ent. Soc., ix, p. 235) — a rare Buprestrid, was captured on the floor of the piazza of the Sagamore hotel.

Neuroptera, which should abound in the lake region, were few in number. The only species observed in abundance were the common *Polysteochotes punctatus* (Fabr.), of which hundreds could be seen resting on the parlor walls, and a species of *Ephemeridæ*, on the slats of the window blinds and edge of the clapboards of the hotel — *Pentagonia vittigera* Walsh.

About one thousand insects were collected, mounted and labeled with locality and date of capture. Probably the more interesting and valuable forms taken are among those for which there has not yet been found the opportunity for study and determination.

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*The following species only, were observed: *Colias Philodice* and *Pieris rapæ*, not abundant; *Danais Achippus*, abundant; *Argynnis Cybela*, *A. Aphrodite* and *A. Atlantis*, all in poor condition; *Argynnis Bellona* not abundant; *Pyrameis Atlanta*, abundant; *Satyrus Nephele*, rare; *Chrysophanus Americana*, very abundant, and frequent on golden rods; *Lycæna pseudargiolus*, rare, one example; *Vanessa Milbertii*, a few.

No examples were seen of *Papilio, Grapta, Thecla, Pomphila* or *Nisoniades*.

INSECT ATTACKS AND MISCELLANEOUS OBSERVATIONS.

EGGS OF A CUT-WORM ON AN APPLE-TREE.

From Mr. P. Barry of the Mount Hope Nurseries at Rochester, N. Y., some apple twigs containing an egg-deposit from which the larvæ were emerging, were received on May 7th. The eggs had been sent to him for name, from Centralia, Kansas.

The general appearance and the arrangement of the eggs resembled the figure given by Prof. Riley in the *Report of the Commissioner of Agriculture* for the year 1884, plate 3, fig. 2, of the eggs of one of our common cut-worms, *Agrotis saucia* Engr., identical with the *Agrotis inermis* of Dr. Harris. The moth was known to deposit its eggs upon fruit-trees.

The twigs bearing the eggs were quite small, not exceeding one-sixth of an inch in diameter. The eggs were closely and symmetrically arranged in a single layer in regular rows joined to one another, forming an unbroken patch. In one example there were seven rows of about sixty eggs in each, extending over about an inch and a half of the twig. The eggs, upon the point of hatching, were of a lavender color. They were round, with about forty sharp and prominent longitudinal ribs, which were connected somewhat irregularly with numerous transverse lines.

The larvæ of some of the clusters had left the eggs when received. They had but three pairs of prolegs, and looped in walking, after the manner of the *Geometridæ*. In dropping from the twig, they hung suspended by a thread that they gave forth. When disturbed they would often twist their head and several segments over their back, holding to the surface upon which they rested by their last two pairs of prolegs.

Grass was offered them of which they readily ate and with apparent relish. Some tips of apple-twigs being given them, a few of them fed sparingly upon them, eating small holes into one surface of the unfolding leaves, but much the larger portion continued their feeding upon the grass.

On the 14th of May some of the caterpillars were observed to have undergone their first molting, and to have acquired in the operation an additional pair of prolegs. Four days later the second molting commenced, developing another pair of prolegs, and giving the normal number of five pairs belonging to the *Noctuidæ*.

Subsequent to this molt and onward to maturity, the brood was fed on plantain leaves (*Plantago major*), for which they manifested a great fondness. They were not easily disturbed in their feeding when brought under observation. Their manner of curling up in a ring when withdrawn from their food, taken in connection with their general appearance, gave evidence of their being cut-worms.

A third and a fourth molting occurred on the 21st and 25th of May. Descriptions of the larva in each of its five stages were taken, and will be given hereafter.

By the 30th of May many of the larvæ had ceased feeding and had evidently matured. The following day they were transferred to a box of earth upon which a layer of plantain leaves had been placed. When examination was next made on the 3d June, a little feeding had been done. Four-fifths of the larvæ were found above ground, and the rest had buried themselves at different depths — some just beneath the surface, showing a slight contraction in length, indicating progress toward pupation. A few that had been transferred to a separate box, with food, were still feeding on June 4th.

On the 5th of June, three newly disclosed pupæ were found beneath leaves on the surface of the ground, of which description was taken.

The first moths — eight in number — emerged from their pupæ on the 24th of June, and on the following day, eighteen others made their appearance. The insect was found to be *Agrotis saucia.* The last were disclosed June 30th. About one hundred and fifty were carried through to their perfect stage. The species proved to be very easy to rear, unlike most of the cut-worms — hardly any fatality attending any of the several transformations. The moths displayed a remarkable absence of timidity upon being disturbed. With hardly any motion beyond the necessary readjustment of their legs, they could be lifted from the ground upon which they rested or from the sides of the box to which they were attached, by slipping a piece of paper underneath them, from which they could be quietly dropped into the cyanide bottle. If alarmed, they attempted escape by running rather than by flight.

Desiring to learn more of the occurrence of the eggs, I addressed a request for the information to Mr. A. Oberndorf, Jr., of Centralia, Kansas, from whom the eggs had been sent to Mr. Barry. The following communication was sent to me in reply, under date of May 20th :

Up to the 17th inst. I have found the eggs on the *twigs* and *bodies* and *branches* of young apple, pear and peach trees, but have found none on old or bearing trees. I found the eggs in batches, on twigs, in narrow strips from one inch to three inches long, and about three-sixteenths of an inch broad; on branches, in broader strips from one inch to two and one-half inches long and from one-fourth to three-eighths of an inch broad; on the bodies of trees, usually about in this shape and size [diagram given], and the eggs as close together as possible. I destroyed every nest that I could find, but concluded last Sunday to leave two nests in a little tree to see what they would do after being hatched. On Monday one half of the cluster had changed from a light tan to a slate color, and yesterday evening that portion had hatched, and a number of little caterpillars, about one-eighth of an inch long, were wriggling about, but were gradually being carried away by the wind.

THE CANKER-WORM — ANISOPTERYX VERNATA *Peck.*

It really seems that the canker-worm is becoming an annual pest of the orchards of the State of New York. While the New England orchards have been for many years ravaged by it, and the noble elms, so long the boast of eastern villages, destroyed, and it has also been very destructive in several of the Western States, our own State, for some reason, has been almost exempt from its depredations. Within the last few years, occasional instances of its occurrence have been reported. Last year they were received by me from Poundridge and Pleasantville in Westchester county, where they inflicted damage to the apple crop to the amount of thousands of dollars (*Country Gentleman* of July 10, 1884, p. 577). The present year, report is received of serious injuries from them in Wayne county. A gentleman writes:

"The orchards are all being destroyed in this part of the State by the canker-worm. Thrifty orchards were cut down last winter, and there will be a good many more sacrificed if there cannot be found some way to stop the havoc."

Early in June their presence in the vicinity of Albany was reported, where I had not previously heard of their occurrence. Examples of the caterpillar were brought to me by Mr. David M. Knickerbocker, of Albany, that I might see if they were, as he believed, the veritable canker-worm. They were found upon his apple-trees at Loudonville, in "millions," and were rapidly consuming the foliage. He had also heard of their presence in other orchards in his neighborhood. The examples of the larvæ brought were nearly full-grown (on June 9th), having almost attained their maximum length of one inch. As usual, they differed greatly in their markings and colors, some being almost without stripes and of a uniform black.

The folly and the criminality of permitting this destructive pest to obtain a permanent footing within our State cannot be too strongly censured. It is an extremely local pest, and, at the outset, can be easily controlled. Often one tree only in an orchard is infested, or a portion of an orchard, or a single orchard in a township, while others are wholly free from it. The female moth has no wings with which to distribute herself, and can only, upon coming out from her pupation in the ground underneath the tree in the early spring, climb up the trunk, meet her winged mate, and deposit her eggs upon the branches.

Preventives and remedies.—The preventives and remedies that should be used against this insect are simple. First, the females should be prevented from ascending the tree, by the application around the trunk of bands of tar or printers' ink, or by some of the mechanical appliances which have been so frequently given in our agricultural journals and entomological reports. Second, when the larvæ are upon the tree and rapidly eating up the young leaves, they should be killed by spraying the tree with Paris green water, as in directions so often published. Third, if the caterpillars have been permitted to feed to maturity upon the trees, and thereafter to enter the ground immediately beneath for their transformation, the soil under the trees to the depth of from four to six inches should be thoroughly worked over so as to crush the tender pupæ.

Either one of the above measures, if properly used, will be effectual in arresting the attack. If all are employed, immediate success would be insured.

The Apple-Leaf Bucculatrix.

Through Dr. Sturtevant, of the N. Y. Agricultural Experiment Station, a communication was received from Mr. Malcom Little, of Malcom, Seneca county, N. Y., stating that the apple orchards in that vicinity were infested upon the branches and the fruit with objects such as sent upon some twigs. They had not been seen before, and it was asked what they were, and if they would probably prove injurious. Answer to the following effect was returned:

The twigs received were thickly covered on one side with the cocoons of the apple-leaf Bucculatrix—*Bucculatrix pomifoliella* Clemens. A piece of twig an inch and a quarter in length, and one-eighth of an inch in diameter, had upon it thirty-three of the cocoons. From the small size and the general appearance of the cocoons they are often mistaken for insect eggs. They are white, about one-fourth of an inch long, as thick as an ordinary pin, and show upon their exposed surface five or six prominent longitudinal ribs.

The insect is an injurious one. Where it abounds, the caterpillars consume such an amount of the foliage as seriously to interfere with the production of the fruit. It displays a remarkable facility for increase, and every proper means should, therefore, immediately upon its discovery, be resorted to, that its spread may be arrested.

The parent is a small moth belonging to the *Tineidæ*—that division of the Lepidoptera that embraces the smallest species of the order. There are two annual broods of the insect. The cocoons sent to me are of each brood. Some of them were spun in July, and have given out the insect, leaving only the empty pupa-case within the cocoon. The moths that emerged from them laid eggs from which caterpillars were hatched, which might have been observed feeding upon the leaves in September, if attention had been given to the eaten foliage. The caterpillars make their cocoons during October, and upon opening those that are the freshest-looking and unbroken, their pupæ may be found, which are destined, if not meanwhile destroyed through parasitic or atmospheric agency, to remain in that state throughout the winter, and to give out the moth in the month of May next.

Remedies.—This injurious pest is most vulnerable in either its caterpillar stage or after the cocoons have been made. In large orchards the cocoons may be most easily attacked by means of a mixture of kerosene oil and soap, sprayed upon them with a force-pump. This emulsion which is quite as effectual as, and easier to make than the milk emulsion formerly recommended, may be made by dissolving four pounds of common bar soap in a gallon of water, with heat, and then gradually stirring in a gallon of kerosene. This, upon cooling, will form a thick, gelatinous mass, containing 50 per cent of kerosene, which will have to be reduced by the addition of water before it can be applied with a force-pump. If diluted with ten gallons of water, giving a mixture of about 10 per cent of kerosene, it should give a strength sufficient to destroy the pupæ within the cocoons, but the proper strength had better be first ascertained by experiment upon a few of the cocoons.

If the infested trees are not very numerous this liquid might be applied to the branches by means of a stiff bristle-brush, which would remove the cocoons, and serve to show thereafter if there is a continuance of the attack in the deposit of fresh cocoons.

When the caterpillars are found in abundance feeding on the trees in July or September, by suddenly jarring the branches, numbers will drop and hang suspended by their threads, when they may be swept down by brooms or branches and destroyed. Showering the trees with Paris green and water would poison all the larvæ eating the poisoned foliage.

A notice of this insect, with figures of the moth and of the cocoons upon a twig, and further information upon it may be found in my "First Annual Report on the Insects of New York, pages 157–162."

In the above publication, the presence of this insect had only been reported, in New York, in Monroe and Chemung counties. As would naturally be expected, it seems to be extending its range. It has since been received by me, from an orchard of Mr. J. S. Roys, Lyons, Wayne county. A piece of twig two and one-half inches long contained twenty-two of the cocoons. It has also been sent to me by Mr. J. C. Wolf, of Waterloo, Seneca county. It is reported as present, in small numbers as yet, in Lagrange, Wyoming county. It also occurs in South Byron, Genesee county.

I had previously written of this insect, that as yet in its New York distribution, it was apparently confined to the western portion of the State, but the present year it has been brought to me from an orchard at Bethlehem Centre, five miles south of Albany, on the Hudson river. Mr. Isaac Bussing, with whom it occurred, reports that he has observed it upon his trees for the past few years, in limited numbers, but does not think that it has inflicted serious harm.

In the *Second Report of the Department of Entomology of the Cornell University Experiment Station*, 1883, Mr. A. E. Brunn has published his studies upon the life-history of this insect (with illustration of some of its stages) which adds materially to our previous knowledge of it (*l. c.*, pp. 157–161, pl. 6, figs. 2–20). An abstract of the above observations has been given by Professor J. H. Comstock, in the *Proceedings of the Western New York Horticultural Society*, at its 28th Annual Meeting in January, 1883 (pp. 20–23).

Ephestia Kühniella as a Pest in Mills.

The following correspondence was had in relation to a Tineid moth which was infesting flouring mills in Germany, and was supposed to have been introduced from the United States:

Imperial German Consulate General,
New York, *February* 2, 1885.

To Prof. J. A. Lintner, *State Entomologist :*

Dear Sir.— A very destructive insect has been recently introduced into Germany. It is a moth, imported with wheat or Indian corn, and capable of reproducing itself rapidly. The appearance of this insect has caused great alarm, especially among the millers, because in some instances it has become necessary to suspend work in order to free the bins and machinery which were choked by the lodgment in them of myriads of the pest. Mr. Zeller, the well-known entomologist, has classified this small moth, the worm of which only lives upon flour or meal, as of the family *Phycidæ*.

You will confer a great favor by kindly informing me of what is known to you about the existence of the mentioned insect in this country, and the means which are employed in order to destroy it.

With best thanks in advance for the desired information,

Very respectfully yours,

A. SEIGEL,

Consul-General.

Reply to the above communication was made, under date of February 11th, to the effect that no American insect was known having the habits above stated. If Prof. Zeller, in his study of the insect, had given it a scientific name, could its name be communicated to me? If the name was unknown, then, if examples of the insect in as many of its four stages as could be obtained, together with specimens of the infested grain, could be sent, it would probably give the means of identifying the species and of indicating the best means for its destruction.

To the above inquiry, answer was returned, by the Consul-General under date of February 16th, that the insect referred to was named *Ephestia Kühniella* Zeller.

This was answered in a brief note, acknowledging the reception of the name of the insect, stating that none of our entomologists knew it as a native species, and having learned where it had been described and an account been given of its habits by Prof. Zeller, in a German periodical, it was hoped that, as soon as access could be had to this publication, suggestions for some efficient means for meeting the injuries of the pest could be made.

The following letter was subsequently sent:

STATE OF NEW YORK:
Office of the State Entomologist,
Albany, *April* 4, 1885.

Mr. A. Seigel, *Consul-General, etc.:*

Dear Sir — In further reply to yours of the 2d of February, J. N. 628.85, I beg leave to state:

Since my communication of February 28th, I have learned what I could of the insect of which inquiry is made, *Ephestia Kühniella*.

There is no knowledge of it as an American insect. If it exists in the United States, it is as yet unknown to us, and no such habits have been manifested in any of our flouring mills, by any species akin to *E. Kühniella*. We have a species very closely allied to it, viz., *Ephestia interpunctella* (the *Tinea zeæ*, of Fitch), of which it was thought that the former might be a variety; but after close examination, it is accepted as distinct. *E. interpunctella*, although quite annoying and injurious at times in bakeries, has never infested our flouring mills.

The peculiar habits of *E. Kühniella* will render it a difficult insect to contend with, as the fruitless efforts thus far made in Germany for its destruction have clearly shown. In order to give the best advice, it will be required to be studied on the spot. With no personal knowledge of it, or of any insect of identical habits, I can only offer, at present, the following suggestions:

1. Wherever the larva constructs its cases for pupation, in angles, corners, crevices, etc., of bins or apartments, under such conditions that the vapor of bisulphide of carbon can reach it, the proper use of that material would probably kill the larva or pupa.

2. As it is probable that the insect is the most vulnerable in its final stage of a moth — at the time of its greatest abundance (noting even the hour of the day when it is observed to be the most active on the wing), close the mill as tightly as possible and burn brimstone therein.

3. Catch the moths in hand-nets and destroy them. If they be found, like many of our *Tineidæ*, to take wing toward twilight, that might be the most favorable time for the chase.

4 See if the moths can be attracted to vessels of water mixed with vinegar and molasses, to be caught therein and drowned.

The above are the best suggestions that I am prepared to offer, with my present knowledge of the insect. Hoping that they may prove to be of value,

Very truly yours,
J. A. LINTNER.

The Clover-Seed Midge — Cecidomyia leguminicola *Lintn.*

A large number of the larvæ of the clover-seed midge were received October 12th, through Dr. E. L. Sturtevant, from Mr. D. M. Linsley, of Orleans county, N. Y., with the statement that they were from a second crop of clover, cut for hay, which had been placed on a scaffolding above the barn floor. Four or five days thereafter the larvæ were observed in large numbers upon the floor under the clover. Mr. Linsley was desirous of knowing if they would attack any other grain or plants. Answer was made that the attack of the clover-seed midge, so far as known, was confined to clover seed. From the abundance of the larvæ reported by him, it was quite important, as a means toward diminishing the attack of the coming year, that the larvæ falling upon the floor should be frequently swept up (if the floor was a tight one) and burned. If in the sweeping the larvæ were liable to fall through the floor-joinings, it would be advisable to kill them as they lay on the floor, by sprinkling from time to time with kerosene oil.

The following extracts are from a letter received later from Mr. Linsley in reply to the request made for additional information of the them occurrence of the larvæ:

They came wholly from the second cutting of the clover, cut about the 20th of September. They began to make their appearance about four days after it was drawn into the barn. They came out in such numbers that they looked like red sand upon the floor. This continued for about two weeks, since which time I have not noticed any of them. I destroyed what I could collect from the floor, but the greater part of the hay being put into a mow, they were, of course, out of reach for the most part. * * * *

It is said that these weevils do not work in the Alsike, or large pea-vine clover. This may be due to the fact that in these varieties the first growth or cutting is used for seed, so that the seed matures too early for the insect. But these varieties are far inferior to the Medium clover and cannot well supply the place of it. The destruction of the crop of Medium clover-seed is a very serious loss to the agricultural interest in this portion of the State, amounting to from twenty to forty dollars per year on every farm of a hundred acres, according to the market price of the seed.

Sciara sp.? Occurring on Wheat.

Examples of a small fly were received October 2d, from Dr. E. L. Sturtevant, which "had appeared upon wheat" at the Experiment Station.

In our present limited knowledge of the species of this genus, a generic determination only could be made of it.

From what is known of the larval habits of the few species of *Sciara* that have been studied, and of their associated *Mycetophilidæ*, it is not probable that the species sent was injurious to wheat. The larvæ, as a class, are not regarded as injurious, as many of them are known to occur beneath the bark of felled trees, in decayed wood, in vegetable mould, in fungi, etc.

From their frequent occurrence in boleti and fungi, Latreille had arranged the *Mycetophilidæ* in his group of *Fungivores* — one of the five into which he divided the *Tipulidæ*. A noted fungivorous species is the *Sciara Thomæ* Linn., of Europe, known as the "snake or army-worm." The larvæ are remarkable for assembling in immense numbers and hanging together by means of a viscid moisture in a long mass resembling a snake or rope, sometimes several feet in length, and two or three inches in breadth. Processions of these larvæ have been observed, massed in a breadth of three inches and one or two inches in thickness, and extending thirty yards in length. Individually they are but about five lines long and a third of a line in diameter. M. Guerin-Méneville has given interesting details of some of these assemblies observed by him, as quoted in Figuier's *Insect World*, pp. 46, 47.

That some of the species of the genus may possess injurious habits appears from the mention by Prof. Westwood, that Olivier had reared three species of *Sciara* from wheat, of which account is given in *Prem Mém. sur quelques Insectes qui attaquent les Céréales*, Paris, 1813.

Sciari pyri, of Europe, is said to injure the blossoms and fruit of the pear, causing them to fall; while of other European species, *S. fucata* lives in decaying potatoes, turnips and other vegetables; *S. quinquelineata* breeds in diseased potatoes and is supposed, by some, to cause the "scab;" *S. tilicola* produces a gall on the leaves of young linden trees; and *S. Giraudii* has been bred from stems of *Malva* and *Althæa*.

One of our American species, at least, is known to be injurious, viz, *Sciari mali* (Fitch), the larvæ of which destroy the interior of apples by burrowing through them, while the fair exterior shows no indication of the concealed attack. (*1st and 2d Report Insects N. Y.*, p. 254.)

HELOPHILUS SIMILIS *Macquart.*

From Dr. R. H. Morey, of old Chatham, Columbia county N. Y. seven examples of the larva of one of the flower-flies (*Syrphidæ*), of the group known from their long anal appendage as "rat-tailed larvæ," which he had taken from a watering-trough at North Adams, Massachusetts, were received on the 5th of July. He had previously given me, on July 2nd, two examples of the same, taken from many that were seen by him at that time. Upon his second visit to the place, for additional specimens, only the above seven examples could be obtained. Most of them had evidently left the trough and sought other quarters for pupation.

The larvæ were placed in a glass of water with an inch of ground and dead vegetable matter at the bottom. They hid themselves in the ground, with their tail extended upward to the surface for respiration, to an extent of two inches, except when disturbed, when the respiratory organ would be withdrawn from the surface and partly contracted.

Within the following week, some of the larvæ were found floating upon the surface of the water. As this condition was believed to indicate approaching pupation, they were transferred to a box of dampened saw-dust, into which they buried themselves.

At this time they presented the following features: The body, subcylindrical, narrowing somewhat anteriorly, and one-half of an inch in length by one-eighth of an inch broad; beneath, whitish, pale brown above, becoming darker toward the tail; the several segments show six divisions (as wrinkles or folds) above, of which the front one is the broadest: on segments 2 to 7 apparently (the posterior ones not being separable) are six pairs of tubercle-like feet, which, when protruded, show each a short black spine. The head bears anteriorly two brown, slender, blunt projections, so short as to be barely visible without a magnifier. The first two joints of the dark brown tail are corrugated, and measure seven-tenths of an inch in length, with the terminal black-tipped extensile joint projecting from them one-fourth of an inch.

Other larvæ were transferred for pupation July 16th, 18th, and the last on the 25th.

On the 18th the first imago appeared, determining the species as *Helophilus similis* of Macquart — a species not at all uncommon in the State of New York, and having an extended distribution from Canada to Georgia, and in the Western States. It is readily recognizable from the four large yellow spots on its abdomen, and the three broad black stripes upon its pale yellow thorax. I have taken the fly early in August upon the flowers of tansy and elsewhere.

On the 25th of July, a second example emerged from the pupa, and two others later — date not noted. The pupal stage is probably of about ten days continuance.

In the *American Entomologist*, ii, 1870, p. 142, an allied species, *Helophilus latifrons* Loew, bearing five stripes on its thorax, is figured. From the text accompanying the figure, it appears that the fly was bred by Mrs. Mary Treat from a larva, which she had taken with several others that were feeding upon plant-lice infesting some chrysanthemums. This must be an error, for its larva cannot be otherwise than aquatic, and entirely unfitted for feeding upon plant-lice.

The Cabbage-fly — Anthomyia brassicæ *Bouché*.

A severe attack of this insect upon young cauliflower plants was reported by Mr. D. W. Seeley, of Albany, and examples of the plants badly eaten and having the larvæ within and upon their roots, were brought to me on June 8th. Mr. Seeley had made several applications of popular remedies for the arrest of the attack, without avail, and had nearly determined upon taking up the entire crop and destroying it, although it would be at a loss of about a thousand dollars — estimated value of the matured crop. The application of bisulphide of carbon was recommended to him before an abandonment of the crop.

Some of the above larvæ, apparently full-grown, were placed in a box with ground when received. Sixteen days thereafter, June 24th, they gave forth the perfect fly.

The Hessian-fly — Cecidomyia destructor *Say*.

Wheat infested between the first and second joints with the Hessian-fly, was sent for examination, June 12th, by Mr. A. F. Dowd, of North Huron, Wayne Co., N. Y. On stripping the sheaths from the stalks, four or five of the puparia or "flaxseeds," as they are popularly called, would be found in company, showing the attack to be a severe one.

The perfect insects failed to emerge from these puparia. Under natural and favorable conditions they would probably have emerged in the month of July.

The fly had been more injurious in Western New York the preceding year (1884) than usual. The following statement in relation to its operations, and containing some good suggestions for controlling the insect, is from a gentleman in Monroe county, which joins Wayne county on the west:

A considerable part of the wheat of 1884 was injured by the Hessian-fly, which crinkled the straw so that the heads of wheat were cut off too short to be gathered in harvest. On some fields this scattering wheat would make, if evenly distributed, a sufficient seeding. I am afraid this self-sown wheat will prove a detriment to the crop, as the Hessian-fly will lay her eggs on these early plants.

The fly works until frosts check it. Rolling the ground, or dragging with the smoothing harrow, and then rolling, is probably as good a preventive of injury from the Hessian-fly as can now [late in September] be applied. These operations both cause the wheat to stack more, making a mass of small leaves rather than one or two tall ones from each plant. As the fly lays her eggs in the fold of the leaf [at the crown of the root], she finds less place than where the leaves are unchecked in growth. Besides, many of the eggs and newly-hatched worms are destroyed by crushing and contact with soil brushed against them. — W. J. F., Monroe county, N. Y. *Country Gentleman* for October 9, 1884.

A Lady-bug Attack on Scale-insects.

A number of Austrian pines, *Pinus Austriaca*, were observed, on October 9th, as having been very nearly killed by an attack of the pine-leaf scale insect, *Chionaspis pinifoliæ.* Millions of the peculiar white scales of this destructive species had attached themselves to the leaves almost as thickly as they could find place, to the extent of whitening the tree and almost hiding its natural green. Hundreds of scales could be counted upon a single one of its slender leaves.

The species of lady-bug, *Chilocorus bivulnerus* Muls., which seems to be specially commissioned to feed upon the eggs of this and other scale-insects, was present upon the trees in great abundance. Its larval stage had already passed, and it was now occurring in its pupal and perfect stages. The larval cases, split longitudinelly upon their back and disclosing the pupal-case within, were quite numerous; as many as ten of these could be seen upon a single leaf. The larger number of pupæ had given out the pretty beetle, with its shining black wing-covers, bearing centrally upon each a blood-red spot — the two spots suggesting the common name that it bears of "the twice-stabbed lady-bird." A few of the beetles were still emerging, with pale ochraceous-colored elytra, and without the least indication of the two red spots which are gradually developed later with the darkening of the wing-covers. In a few minutes' time, about one hundred and fifty of the beetles were collected from the leaves and branches of a pine — most of them from the branches, where they were found quietly resting.

An examination of the scales upon the more badly infested trees showed that most of them had been eaten into and their contents destroyed. From pupæ collected and taken to my office, the beetles continued to emerge for about ten days thereafter.

Oviposition of Saperda candida *Fabr.*

The following notes, condensed from a communication made by E. W. Junkins, of Carroll Co., N. H., to the *New England Homestead*, of January 3, 1885, are of value as an addition to our knowledge of the habits and life-history of the destructive round-headed apple-tree borer, *Saperda candida:*

A part of a trunk of an apple-tree that had been killed by the borers and taken within doors in the early spring, showed, through a crack opened by drying, a pupa of the beetle, on May 20th. On June 8th it had changed to the beetle [indicating a pupal period of at least nineteen days]. Four other specimens that afterward emerged were inclosed in a large glass jar containing wet sand at the bottom, into which were thrust some shoots of an apple-tree. The beetles fed upon the tender bark. On June 15th one of the four females was seen depositing an egg. "She first made an incision in the bark close to the sand; then turning head upward, with her ovipositor she placed the egg under the bark nearly a quarter of an inch from the incision, the bark having been started from the wood. July 7th a young borer, three-sixteenths of an inch long, made its appearance. July 11th, the sticks near the sand were full of eggs, and the beetles were depositing their eggs higher up on the sticks. July 18th, one of the borers, three-eighths of an inch long, had worked an inch and a half downward. August 7th, the last beetle died, but would have lived longer with better care."

On the 26th of August a beetle was captured among the branches of an apple-tree, in the trunk of which eight young borers were found. The beetle was kept alive for several days and deposited an egg.

The above observations of Mr. Junkins are of considerable importance, as they extend the period of oviposition of the beetle much beyond the period heretofore assigned to it, and consequently the time during which the application of soap to the trunk of the apple-tree to protect it from the egg-deposit is to be made will also require the same extension.

Prof. Riley has stated :

> The female deposits her egg during the month of June, and the young worms hatch and commence boring into the bark within a fortnight afterward. * * * Keep the base of every tree in the orchard free from weeds and trash, and apply soap to them during the month of May, and they will not likely be troubled with borers. (*First Report on the Insects of Missouri*, pp. 43, 45.)

Dr. Fitch states as follows in his account of this insect given in his *First Report on the Insects of New York:*

The beetle makes its appearance every year early in June. * * * In the course of this and the following month the female deposits her eggs (page 13).

Commonly, here in Washington county, they begin to be found upon trees about the 20th of June, from which time until the close of the month they appear to be more numerous than they are afterward (page 17).

In all orchards where the borer is present this measure [soap application] should invariably be resorted to the latter part of May, or in more northern localities, where the beetle will be somewhat later in appearance, early in June (page 22).

Referring to Mr. Junkins' observations of the first egg deposited after the middle of June, many after July 11th, and oviposition continued after August 7th, it would seem advisable that the use of the soap application should, in Northern New York, not be delayed longer than the 15th of June, and should be continued *through the month of July*, and perhaps later.

Mr. Charles G. Atkins, of Bucksport, Maine, in a paper read before the Maine State Pomological Society at its last annual meeting, confirms the above observations upon the late oviposition of *Saperda candida*. He has found the egg-laying to begin (at his farm in Kennebec county) soon after the middle of June, and to continue until late in August, and had met with unhatched eggs after the 1st of September.

Mr. Atkins offers the suggestion that relief from this apple-tree borer may be better sought through remedial than preventive measures. With young trees having a smooth bark he would prefer mounding the base to a height of six inches or more with sand, thus compelling the beetle to place her eggs where they, or the young larvæ emerging from them and entering the bark, may easily be discovered by proper inspection, and destroyed. (*Home Farm*, March 5, 1885.)

THE CLOVER-LEAF WEEVIL DESTROYED BY A FUNGUS ATTACK.

During the latter part of May, some larvæ were received from Dr. Sturtevant, of Geneva, N. Y., which had evidently been killed by fungus attack. The larvæ were found attached to, and coiled around, the tips of blades of grass, dead, stiffened, shrunken, and partly covered with a whitish fungus. From a careful examination of the larvæ, it seemed probable that they were immature forms of the punctured clover-leaf weevil, *Phytonomus punctatus*.

Other examples of the same larva were received from the same source, on November 3d, in the same condition with those previously sent. Not being positive of my determination of the species, request was made for living examples, to be sought for buried beneath the surface of the ground, or while feeding at night, but they could not be obtained. Some of the material was, therefore, sent to the Entomological Division of the Department of Agriculture at Washington, where it was compared with alcoholic specimens, and was found, from the structure and markings of the head of the larva, to be, beyond doubt, that of *Phytonomus punctatus*.

Dr. Sturtevant having suggested the possibility that the fungus attack may have been the result of the fertilizer used at the station, the fungus was shown to Prof. Peck, State Botanist. It was pronounced by him, in all probability, an undescribed species, allied to the well-known fly-fungus, *Empusa muscæ*.

Upon mentioning the above facts to Hon. G. W. Clinton, he expressed his belief that the fungus may have been communicated in the manner suggested by Dr. Sturtevant, if fish-remains entered into the composition of the fertilizer, from the fact that a common fungus found infesting fishes is the *Saprolignea ferax*, which is believed to be but the aquatic form of the *Empusa muscæ*.

The above was communicated to Dr. Sturtevant, with an inquiry of the nature of the fertilizer that had been used. Answer was returned that he had obtained from the manufacturers the formula of its composition, and that "the nitrogenous material was supplied by *acidulated fish-skins*, dried ground horse-meat and western blood."

If, as seems not improbable, that the death through fungoid attack of the larva can be clearly traced to the use of the fertilizer, through the discovery of the same fungus in the fertilizer, or better still, by experiments with healthy larvæ — the mortality of the larvæ observed at Geneva, by Dr. Sturtevant, will certainly be an event of unusual interest. It would appear to give us the means of destroying a pest which up to the present it has not been possible to control, and at the same time stimulating the crop and thereby enabling it the better to resist all other forms of insect attack. Nor would its efficacy be limited to this particular species, but it would be doubtless available against many other insect enemies, especially those that burrow in the ground after the manner of the *Phytonomus*.

The fungus has been studied by Prof. J. C. Arthur, of the Experiment Station, and it is understood that his report upon it, together with experiments made therewith, and the history of the attack, is to appear in the forthcoming Annual Report of the Station.*

The Pear-blight Beetle — Xyleborus pyri (*Peck*).

The two communications given below from Mr. G. W. Duvall, of Annapolis, Md., are acceptable contributions to our knowledge of the habits and operations of one of the borers of our fruit-trees which, at times, has proved quite injurious in some of the New England and Middle States, although not a common insect in the State of New York. It was first described and figured by Professor W. D. Peck, of Harvard University, in 1817, as *Scolytus pyri*; later, it has been briefly noticed by Dr. Fitch in his 3d Report on the Insects of New York; and more fully, in the Harris Reports as *Tomicus pyri* — the "blight beetle."

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*Since published — in 4th *Ann. Rept. N. Y. Agricul. Stat.*, pp. 258–262, as *Entomophthora Phytonomi* Arthur.

"Please find inclosed a few bugs for identification. They are very injurious to young apple-trees. I noticed a few days ago, sap running profusely from the bodies of many of my young apple-trees, whose trunks averaged from one to two inches in diameter, and, on examining, found punctures or round holes extending horizontally and perfectly straight, less than one-sixteenth of an inch in diameter, and extending to the center and often beyond, and one of these bugs sticking out of the entrance of each, with tail pointing out, completely filling the entrance on a level with the bark. On attempting to hook them out, they would run into their holes toward the center. Around the entrance, there was also a slight ring of excrementitious matter, or extremely fine wood-dust made from boring. I found as many as eight in a very small tree, which have so depleted it from loss of sap, as to check the expanding buds. These holes are several inches apart, commencing just above the ground, and running irregularly up the trunks to the first limbs. I detected more on the limbs. I inclose also a small piece of bark, with the perforation and the dead bug that was in it."

"Please find inclosed a section of a limb of one of the trees killed by these bugs. This piece contained one live bug, and I wrapped it up in several thicknesses of common newspaper. In one night it cut through all, and I thought it was gone, but after splitting I found it still in the burrow; so I thought it best to kill it. You will find the dead bug still in the burrow. I found that these do not always run horizontally to the center and there end, as I supposed, but extend much farther, and at different angles, so that the bug is enabled to turn itself; in fact they also run in different directions, in the shape of a Y, and it is only at these divergences that they can turn, in the same manner as a locomotive. I have about a dozen trees badly injured, and half of them will probably die. I caught a good many bugs, but they are so small that they would blow or drop out of my hand, and I never could find them on the ground after dropping. The leaves of the infested trees are small, one-tenth of their natural size, and look as if they had been scorched. Many buds are only half opened, and beginning to dry. The greatest injury seems to be in the loss of sap, in early spring, when the sap becomes sufficiently warm to get there and run."

The beetles first sent were crushed in pieces, but the fragments were identified as *Xyleborus pyri* (Peck). The second sending of the beetle, within its burrow, was in good condition, and confirmed the identification.

The beetle is described by Harris as of a deep brown color, with the antennæ and legs of the color of iron-rust. The thorax is short, very convex, rounded and rough before; the wing covers are minutely punctured in rows, and slope off very suddenly and obliquely behind; the shanks are widened and flattened toward the end, beset with a few little teeth externally, and end with a short hook, and the points of the feet are slender and entire. It measures one-tenth of an inch in length.

In addition to the apple it attacks the pear, the plum and the apricot.

It was discovered about seventy years ago, infesting the twigs of pear-trees by boring into them, and causing the sudden withering and dying of the leaves, fruit and the twigs, about the middle of summer. Hence it came to be named the *pear-blight beetle*.

At the present time, the insect is known under two forms of attack. The first, under which it was first discovered, is that in which the larva, upon hatching from the egg deposited upon the bark, penetrates the sap-wood at the root of a bud, and following the course of the eye of the bud toward the pith, burrows around it and partially into it. By this means the ascent of the sap is arrested, and the death of the twig beyond this point follows.

The second mode of attack is that of the trunk, as stated in the above communication. Dr. Fitch, has described the burrows occurring in the trunk of an apple-tree of ten inches in diameter, as running in a straight line through the bark and with the wood three-fourths of an inch, with three lateral galleries of the same size traveling off from this at right angles upon one side, and one upon the opposite side — these galleries, which were 0.06 of an inch in diameter, running up and down parallel with the grain of the wood.

In the piece of the apple trunk containing the beetle sent by Mr. D., the burrow extends to its center, curving slightly downward (or toward what is apparently its lower end), where it turns and runs upward for a half inch, and also downward to an indeterminable extent, as its lower end extended into the portion not sent. .

From these two differing forms of attack, Dr. Fitch inferred that there were two generations of this insect each year, the first one maturing in the trunk, early in the season, because the new shoots at the ends of the limbs are not sufficiently advanced at that time to accommodate the insect.

It seems more probable, to me, that the species is single brooded, and that the summer attack of the twigs is by the larva, which there matures and emerges as a beetle, while the burrows in the trunk are made by the mature beetle for shelter (hibernation perhaps), and for feeding purposes.

The number in which these beetles were found in the trunks of apple-trees of Mr. D. seemed to offer an excellent opportunity of learning more of the life-history of the insect. The locality, Annapolis, Md., being rather remote for me to visit conveniently, I was desirous that ample material might be sent me for study. From my omitting to accompany my request with the intimation that I would willingly pay express charges, the material needed has not been received, and the opportunity has been lost for the present.

For the attack on the twigs, cutting off and burning those affected is the proper remedy. For that in the trunk, we are not prepared to offer a preventive, until it may be known if the perforations are made, as I suspect them to be, by the beetle from the outside, and at what season of the year they are cut.

Instead of the apple trunks requested, Mr. D. has recently sent me sections of a peach-tree, which died last summer from borings (ten to twenty to the square inch), which he supposed were those of the *X. pyri*. The beetles from these sections are now emerging, in my office, in large numbers, and prove to be those of the peach-tree Scolytus, *Phlœotribus liminaris* (Harris) — an insect long known to be very destructive to young peach-trees, and at one time believed to be the cause of that fatal disease, "the yellows."

ATTACK ON YOUNG PEARS BY A PLANT-BUG.

Messrs. Ellwanger and Barry, of the Mount Hope Nurseries at Rochester, N. Y., have sent me under date of June 19, 1884, some specimens of young pears, blotched and injured, together with insects taken upon them.

Some of the pears, of about one-half inch in diameter, show as many as forty blotches from an eighth of an inch in diameter downward. From the minute puncture originally made, the juice as it has escaped has become hardened and granulated, and with its increase has split the skin in different directions, often in a triangular form, or one wound running into another. The more seriously injured pears would be rendered unfit for sale from their knotted surface, even if after such a drain upon them they should continue upon the tree, which is not at all probable.

The insects taken upon the injured fruit were the tarnished plant-bug, *Lygus lineolaris*. Although they were not actually observed feeding upon the juices, there can be no reasonable doubt of their being the authors of the injury. This form of attack (upon the fruit) has not been previously recorded, yet their fondness for the blossoms of the pear is known, and they are also known to be destructive to the fruit of the strawberry.

In the attack above recorded, the insect has apparently shown a preference in the variety of pear it has selected. Messrs. Ellwanger and Barry write: "The whole of the fruit in one of our orchards on the Duchesse d'Angouleme trees is affected; while on the Beurre d'Anjou and other varieties, we find nothing of the kind."

PŒCILOCAPSUS LINEATUS (*Fabr.*).

Mr. E. S. Goff, of the N. Y. Experiment Station, sends me, June 1st, 1885, some Hemiptera in their larval and pupal stages, feeding in the garden of the Station upon sage, *Salvia officinalis*.

The larvæ were broadly ellipsoidal. Head testaceous; eyes black; first joint of the antennæ testaceous, second joint pale basally, and the others pale at the joints. Thorax testaceous anteriorly, with two black spots on its hind margin, separated by a pale mesial line, wing-pads black. Abdomen red, with eight transverse dorsal lines, broken mesially by a pale line. Legs pale; femora darker above; tibiæ brown spotted.

Pupæ.—Wing-pads more than one-half as long as the abdomen, shining black, with a broad whitish longitudinal line from their base, but not reaching the tip near their outer margin; this line continued in yellow upon the thorax, dividing each lateral black spot into two — the outer one being simply a marginal line. A yellowish dorsal line from the thorax over the abdomen; segments black except on their posterior margins and at their sides; femora with two black rings.

The imago from the above appeared on June 13th, in three examples, and proved to be the species named above, and commonly known as the "Four-lined leaf-bug." They were the variety *b*, described by Dr. Fitch as wanting the black dot at the end of the outer black stripe on the wing-covers, on the triangular piece marked off by a suture before the membranous tip. As the three examples were females, it was thought that the absence of the black spot might be a sexual feature, or possibly certain broods might be thus characterized. In accordance with a request made to Mr. Goff, a number of examples from the garden at the Experiment Station were sent to me. It was found from them that the spot gave no special indication, as of the thirteen males received seven were without the spot, and of the seven females, two.

Mr. Goff states that for the past three years, this insect has appeared in very nearly the same place in the garden, but in somewhat greater numbers the present season. Last year (in 1884) it made a serious attack upon gooseberry bushes at the Experiment Station, depleting the tips of the young growth, so that they shriveled, wilted down and died. It was also received from Batavia, N. Y., as injuring sage in a garden.

While so abundant and destructive in my own garden in 1881 (see 1st Rept. Insects N. Y., p. 267), it has not been injurious since.

An Experiment with the Thirteen-year Cicada.

The following paper was read before the Albany Institute at its meeting on October 6, 1885, with a view of making record of the planting of a brood of the "thirteen-year locust," at Kenwood, near Albany, and of the request that observations be made of the appearance of the winged insect at the time that its development may be expected.

It is probably known to all the members of the Institute that notwithstanding the rapidity of multiplication in the insect world — very few of the species requiring more than a year for their life-cycle, and many having several generations in the year — one species requires seventeen years for its development from the egg to the perfect insect, viz.: the seventeen-year Cicada, or the *Cicada septen-*

decim. That so exceptional a life-period is still doubted by some is not strange, in view of the fact that the Cicadas are seen to appear at shorter intervals than seventeen years — indeed, almost every year witnesses their appearance in some part of the United States. But this admits of easy and satisfactory explanation. There are a number of distinct broods occurring within the United States — no less than twenty-one are known — having each its geographical limits, sometimes overlapping one another, but each ever true to its seventeen-year period. Within the State of New York we have five of these broods, one of which made its appearance upon Long Island during the past summer, in immense numbers, and another will appear also on Long Island in 1889.

Besides this seventeen-year Cicada, Prof. Riley has also discovered the existence of a thirteen-year Cicada.

No specific differences in appearance between these two forms can be discovered, for which reason the latter is not accepted as a distinct species, but is regarded only as a form or race. The thirteen-year Cicada is a southern form, which in its northern extension does not reach further than into the southern part of Illinois. We do not have it in the State of New York.

In the possibility that this short-period southern form may, in the lapse of time, have been developed from the normal seventeen-year race, as a consequence of the higher temperature of the Southern States hastening its development, Prof. Riley has, the present year, undertaken to test the effect of climate on the permanency of the two races, by transferring them from one region to the other. He thinks it possible that a southern brood brought northward might fail to appear at the expiration of thirteen years, and a northern brood taken south, might appear in a less time than seventeen years.

Offering to him my assistance in the interesting experiment, he sent to me a quantity of apple twigs from Mississippi, filled with the eggs of the thirteen-year Cicada, with the request that I would place them in an orchard where the result of the experiment could be observed at the proper time, and that I would also have proper record made of the same.

I, therefore, ask place in some publication of the Institute, for the statement that the orchard of Mr. Erastus Corning, at Kenwood, was selected for the planting of the eggs, from the considerations that it was a young orchard, that it promised permanency for the desired time, and that no other brood of Cicada would occur there with which this could be confounded. The tree beneath which the eggs (they were hatching at the time when the twigs were placed about the base of the tree, and tied to its branches) was marked with a zinc label, bearing this inscription:

"Thirteen-year brood of Cicada (Riley's Brood, No. VII) — eggs from Oxford, Mississippi, planted July 4th, 1885."

Additional eggs from a second sending were placed beneath the same tree on July 21st, and also some in a wood adjoining, a few rods toward the south, to serve as a food supply in the event of the death or destruction of the orchard.

As I may not hope to see the result of this experiment, may I beg of some of the members of the Institute who are interested in Natural History, that *in the month of June*, 1898, they will make examination of the labeled tree, and trees adjoining, for the pupa cases of the Cicada that should be found upon the trunks, and for the insects in the vicinity, which should easily be discovered, if present, by their well-known song, which would readily reach the ear. Should they fail to appear at the time designated, then the search for them should be renewed the following year, and for successive two or three years, until their appearance.

The result of the observations should be communicated to the Entomological Division of the Department of Agriculture at Washington, unless it should be known that full examination had already been made by an agent delegated for the purpose from the Department.

In the planting of the eggs I was assisted by Mr. William Grey, gardener of Mr. Erastus Corning, who has been requested to communicate to others upon the farm the location of the tree in order that there may be no difficulty in finding the locality at the desired time.

In addition to the above, other transfers of the eggs of the thirteen-year Cicada from Mississippi, have been made, to Ithaca, N.Y.; Boston, Mass.; Kittery Point, Me.; Brunswick, Me.; and Ames, Iowa, as noticed in *Entomologica Americana*, for August, 1885, vol. 1, p. 96. Similar transfers, under direction of Prof. Riley, of eggs of the seventeen-year Cicada, have been made the present year from Indiana, Michigan and Pennsylvania, to localities in Alabama, Georgia, Mississippi and Missouri.

[For a subsequent notice of the above series of experiments, see Prof. Riley's report to the Department of Agriculture, for the year 1885, pp. 254–257.]

Scale-Insect Attack on Ivy.

The following note of inquiry in relation to a quite common insect attack of the ivy has been received from a lady in Watervliet, N. Y.

"Inclosed please find a leaf of ivy. Will you please inform me of the cause of its peculiar appearance, and also the remedy, if any? The leaf and stem are alike infected, and the whole is in an unhealthy condition."

Reply was made that the leaf sent for examination showed upon both surfaces, clustering about the veins and more thinly distributed elsewhere and upon the leaf-stalk, many whitish, rounded, slightly convex spots, varying in size from almost microscopic to nearly as large as the head of a common pin. Examined under a lens, their peculiar elevated centers show them to be a species of scale-insect, known as *Aspidiotus Nerii* Bouché. It is quite a common species upon the oleander, from which its specific name has been taken. It is figured by Prof. Comstock in his *Second Report in the Department of Entomology of the Cornell University Experiment Station*, 1883, pl. 2, figs. 2 and 2 *a*, and noticed on page 63 of the report, where it is said to be generally distributed throughout the United States, and to occur upon the cherry, plum, currant, English ivy, maple, upon lemons from the Mediterranean, etc. These scale-insects are very injurious to the ivy when they attack it, for multiplying rapidly, their immense number make such a draft upon the juices of the plant that it can not long withstand the drain. Upon the first notice of the scales, their spread should be checked, if possible. If the plant is small, each leaf should be separately treated, by scraping the scales from them, or washing them with a strong soap solution, or a kerosene oil emulsion.

To larger plants, the application would have to be made by sprinkling, or by spraying with a force-pump.

By far the best time to attack the insect is when the young are first hatched and have crept out from beneath the sheltering scales. From their minuteness, this could only be ascertained by the aid of a magnifying glass, under which they would appear as small dots slowly moving over the surface of the leaf. At this stage they could be killed by a solution of one pound of soap (strong rosin soap) in two gallons of water.

If not convenient to wait and watch for this phase of the insects' life, they may be killed at any time while in the egg stage beneath the scales, by a kerosene and soap emulsion, prepared as follows:

Dissolve one pound of rosin soap with heat in one quart of water; add gradually one quart of kerosene, with constant stirring. The result will be a gelatinous compound consisting of fifty per cent of kerosene. This emulsion diluted, when used with two gallons of water, would give a solution containing ten per cent of kerosene, which, if properly distributed so as to reach all of the scales, should be of sufficient strength to destroy the eggs without injury to the plant.

The season at which the young insects would hatch upon in-door plants would depend upon the temperature of the room, but would ordinarily be during the latter part of winter.

THE CHEESE-MITE INFESTING SMOKED MEATS.

From C. H. Wessels, provision broker, New York city, some pieces of smoked ham were received in June, which were infested with myriads of a small white mite. Inquiry was made of their nature and origin, and for some safe and effectual method of dealing with them. No attack of the kind had previously come under the observation of Mr. Wessels, or of those engaged in the same trade with whom he had conferred.

Upon critical examination they were found to be identical with the common cheese-mite, *Tyroglyphus siro* (Linn.) — a species which, although frequently occurring in vast numbers in cheese, has long been known to thrive equally well on several other articles of food. It is not at all uncommon in flour, and when observed therein by Linnæus, he presumed it to be a distinct species, and named it *Acarus farinæ.* When the same insect came under his notice in milk, it was designated by him as *Acarus lactis.* From some individual features presented in some examples, it was named and figured by De Geer (vol. 7, pl. 5, fig. 15) as *Acarus domesticus*, when he had found it occurring in meal, sugar, and smoked meats.

This insect had not been previously known as infesting meats in this country, although a closely allied species, *Tyroglyphus longior* Gervais, as identified by Professor Riley, had been found in a pork-packing house in a western city, forming a layer of half an inch thick in places, beneath sacks of fertilizing material piled upon the floor, composed of livers, lungs and kidneys, after they had been cooked and dried by steam (*American Naturalist*, xvi, 1882, p. 599). This latter species is distinguishable from the cheese-mite (according to Murray) by its more rapid movements, larger size, longer and more cylindrical body, and more shining hairs sticking out on every side. The habits of the two are said to be much the same; and it is of interest that in a small bit of the infested ham received by me that was sent to Prof. Riley, he identified an example of *T. longior* associated with *T. siro.* The two have been also found in association on old cheese, but *T. longior* in by far the smaller proportion — in but eight per cent upon some Roquefort cheese, and only one per cent on Septmoncal. It is this species which, about half a century ago, enjoyed for a time the notoriety of having been brought into being as a human creation through the electrical experiments of Mr. Cross — named at the time as *Acarus horridus*, before its identity with *T. longior* had been ascertained.

As the origin of the mites occurring upon the ham could not be readily answered, inquiry was made of Mr. Wessels, of the source of the meat, its method of curing, and for any other information that might be pertinent to the question. The following communication was returned:

Replying to yours of the 10th of June, we would state that the hams in question are cured in the western part of Ohio, and in a brine made of salt, saltpetre, and sweetened either with sugar or syrup. They are packed fresh from the animal in tierces, the brine poured in and the package closed — the meat being then left to cure, a process requiring from forty to sixty days, although they are left in this condition from one to twelve months. They come east in that shape and are here taken out of pickle as they are wanted, and smoked. The dipping of which you inquire, is never done to packed hams, but only to bagged or canvassed hams; and is done that the coating may protect them from the deposit of eggs by flies. The smoking that we gave them was not to exterminate the pest, but to prepare them for market. It had, however, no effect upon the insect except to make it more easily discernible. The attack seems to be increasing rapidly through germination or some other process.

From the above statement, it seems probable that the mites had their source in the establishment in which they were packed — an infested pork-packing house, as in the instance above cited. As a remedy, simple, inexpensive and probably effectual, recommendation was made to Mr. Wessels of dipping the meat in a weak mixture of carbolic acid and water. Used in the proportion of one part of the acid to one hundred parts of water, it would, with scarcely a doubt, destroy the mite, not injure the meat for food, nor would the creosotic odor of the carbolic acid impart a disagreeable smell to it.

Before venturing to recommend the above wash for a meat which is sometimes partaken of in an uncooked state, the opinion of Dr. Willis G. Tucker, of the Albany Medical College, distinguished as a chemist, was asked, and the following answer received:

Yours, concering use of carbolic acid for destroying flour-mites on ham, is at hand. The internal dose of the acid is about one grain (or one drop of the diliquesced crystals) for an adult. In large enough quantity or a sufficiently concentrated state, it is a caustic, escharotic, and violent poison. It must be used with care, and I would suggest the possibility of its affecting the salableness of the hams, for its odor, slightly different from creosote, might prove objectionable. It is soluble in twenty parts of water. A strength of 1 to 500 is said to instantly destroy vegetable mould, both plant and spores, and to operate with equal destructiveness upon microscopic animalculæ. Hobbescyler says that all inferior organisms perish in a solution of 1 to 100. It is used at about this strength to kill the itch-insect, body-lice, etc. I would suggest trying a solution of this strength (1 to 100) or say an ounce to a gallon (1 to 128). If this should be effectual, I do not see how it can hurt the meat, and it certainly would be perfectly safe. If this does not kill the mites, then I would try double the strength.

A Parasitic Mite Attacking the Colorado Potato-Beetle.

From a gentleman in Middlesex county, Mass., some live potato-beetles were received, to which were attached numbers of "bugs or lice," with the statement that he had found many of the dead beetles thus infested and only a few live ones that were not attacked, and it seemed as if the beetles would all be killed.

The supposed lice proved to be a very interesting parasite which has been known for several years past to attack the Colorado potato-beetle, and, as in the present instance, to render valuable service in reducing the numbers of this pest. Its principal interest, perhaps, is in the fact that, up to the present, only two or three true parasites of this beetle have been discovered among its thirty or more known natural enemies.

As an aid in the recognition of this parasite, it may be stated that they are quite minute forms, as five of them placed closely together would not exceed in surface that of the head of an ordinary pin. Their color is yellowish-brown, and in general shape they resemble many of the lady-bugs (*Coccinellidæ*), being oval, flat beneath and convex above. When examined with a microscope, they are found to possess eight legs, and this feature, of course, removes them from the lice and all other true insects, which have but six legs.

Their scientific classification places them among the Arachnoidea, in which are included scorpions, spiders and mites. As their body consists of but one piece, instead of being made up of several segments, they fall in the last-named order, the mites, *Acarina.* This order embraces a large number of greatly differing forms that have been arranged in several families to include, as follows: the spinning and the harvest mites (*Trombididæ*), the snouted mites (*Bdellidæ*), freshwater mites (*Hydrachnidæ*), parasitic mites (*Gamasidæ*), the ticks (*Ixodidæ*), the beetle mites (*Oribatidæ*), the cheese mites (*Tyroglyphidæ*), itch mites (*Sarcoptidæ*), gall and bud mites (*Phytoptidæ*), and others. The particular family to which this potato-beetle parasite belongs is the *Gamasidæ*, nearly all the species of which in their wide distribution, live parasitically upon mammals, fishes, birds, and insects. The common "chicken-louse," *Dermanyssus avium*, which is also found on caged canary-birds, is a well-known species of this family.

From examples taken from some Colorado potato-beetles in Ohio, in 1873, this little Gamasid mite was described and named by Professor Riley as *Uropoda Americana.* It was found to be closely allied to a species that had long been known to infest beetles in Europe — the *Uropoda vegetans*, having the same habit of attaching itself to its host by a cord or filament, one end of which was fastened to the anal end of the mite and the other to the beetle. Many had been the surmises of the nature and object of this singular attachment in the European species. Some of the old writers had regarded it as a kind of umbilical cord through which the mite drew its sustenance from its host, and others, that it was a silken thread spun by the mite to serve to fasten it and to prevent its being brushed off by the motions of the limbs of the beetle. Close examination showed, however, that it had no organic structure, that it was fragile and became easily detached; and finally, a French naturalist, M. Dugés, ascertained that it consisted simply of the viscous and dried excrements of the mite, which could be removed and replaced at every new excretion.

The discovery of this parasite in Massachusetts in such abundance is gratifying. There is scarcely a doubt that the dead beetles reported covered by the "lice," were killed by the attack. The same attack has in former years come under my observation, near Albany, where the beetles were so infested that every portion of their surface, including their legs, was so covered as to leave room for no additions unless they could be superimposed. Although still upon the potato leaves they were not feeding, but were evidently greatly debilitated and near their end. The occurrence of the parasite so early in the season (May) is also favorable, for every beetle that is now destroyed may serve to lessen the number of the pest later in the year by several hundreds. The present brood of beetles will be followed by at least one other during the year, and each female continues to deposit eggs, from time to time, during the five or six weeks of her natural life, until about a thousand have been deposited.

Our correspondent might render excellent service if he would inform himself if this parasite is to be found in other localities in his vicinity, or in other portions of the State; and if not so found, if he will distribute the infested beetles and so extend the sphere of operations of the serviceable little mite. It would be necessary that they be sent attached to the beetle, as they die very soon after being separated from their host. If some of the potato leaves are put in the box with the beetles when packing them for transportation, there would be less liabilit" of the mites being rubbed from them in transit.

ANOTHER PARASITIC MITE INFESTING A BEETLE.

Dr. S. A. Russell, of Albany, N. Y., has sent to me an example of *Necrophorus tomentosus* Web., thickly infested with a small red mite which runs with great rapidity. Several of them were sent to Professor H. Osborn, who is making a special study of our mites with reference to a catalogue of the known species. At this present stage of his studies, he was only able to refer it to the genus *Gamasus*. He had previously obtained the same form from another species of *Necrophorus*.

[The catalogue — *A Preliminary List of the Acarina of North America*, by Herbert Osborn, of the Iowa Agricultural College, and Lucien M. Underwood, of Syracuse University, has been published in the *Canadian Entomologist*, for January, 1886, xviii, pp. 4–12.]

A MITE ATTACK ON GARDEN PLANTS.

Leaves of various garden plants showing a mite attack upon them were received, in September, from Miss A. Goodrich, of Utica, N. Y., with the following note:

> For two years past I have often found the leaves of the *Calla* covered with fine webs spun by a small mite. Last year garden plants were affected. Leaves turned yellow and flowers did not open. One root of *Spiræa* was almost killed. I put it in a pail of warm suds for the night, and planted it in a new place next day. This year it was not so badly attacked, but the sweet English violets and the *Thunbergia* in my window boxes suffered most. I tried hot water of 120° Fahrenheit, on the violets, with success. I send specimens of the mite.

The mite is that frequent pest of garden plants and conservatories, *Tetranychus telarius* (Linn.), commonly known as the "red spider." It owes its popular name to its habit of spinning a web, and to the brick-red color which it sometimes assumes—the color which so often brings it under the notice of horticulturists. It may, however, present a great variety of shades of green, brown and red, dependent to quite an extent upon its food-plants, although occasionally found to offer different colors upon the same plant.

Although generally known as a spider, it is a true mite. In classification it stands next to the spiders, and at the head of the mites, in the family of the *Trombididæ*, which contains the most highly organized species of the Acarina. A distinction available in separating the mites from the spiders is that the former are without a pedunculated abdomen. The abdomen instead of being joined to a thorax by a narrow joint of attachment is united to the last of the leg-bearing segments without any well-defined groove of separation.

The webs which this species and its associates spin upon the under side of leaves and adhering closely to them, are of an extremely fine and delicate texture. A careless observer would not suspect their true character, but would pass them by as a simple sheen upon the leaf. The separate threads are so fine that they are not to be seen even by the aid of a magnifying glass, but are only visible when combined in an extended web. The silk is secreted from a minute nipple underneath the end of the abdomen. Beneath the web may often be found a large colony of the mites, embracing both old and young, in different stages of maturity, where, under this safe shelter, they are actively engaged in feeding upon the leaf. After biting with the mandibles with which they are provided through the surface of the leaf, they insert the sucking apparatus and imbibe the juices. Small as is each individual wound, the aggregation of the myriads soon tells upon the leaf and plant, which discolors, droops, turns yellow and perhaps dies under the attack.

It is unfortunate that this insect is so general in its food, for scarcely any tender garden plant is free from liability to its attack. In addition to the *Calla*, *Spiræa*, violet, and *Thunbergia* above named, it was also present upon the leaves of *Mitella*, *Tropæolum*, *Adlumia*, and beans, sent with the inquiry. Their examination by Prof. Herbert Osborn, to whom they were submitted, showed the presence upon each of the same insect, in the egg, larval and perfect stages.

This little mite, under favoring conditions, may multiply to an incredible extent, and become very injurious. A notable instance of this has lately been brought to my notice. Leaves of a quince tree infested by this species were sent to me for name, under date of August 11th, by Prof. Arthur of the New York Experiment Station, at Geneva. He reports the attack as occurring in one of the largest quince orchards in the State, about four miles from Geneva. The leaves upon many of the trees were like those received by me, which were nearly destroyed. The attack was rapidly spreading throughout the orchard, and the fruit upon the most seriously infested trees would be an entire loss.

Prof. Arthur was experimenting with the kerosene emulsion to kill the insect, but with what success has not been learned. Properly applied, it could not fail of accomplishing the purpose. A favorite remedy, long used in green-houses, has been syringing with a soap solution in which sulphur is mixed. Quassia has also been thought serviceable when added to the mixture. It is quite important that the liquid be so applied as to reach the under surface of the leaves where the mites occur. It is worthy of note that in the above quince attack most of the mites were observable upon the upper sides of the leaves.

The attack of this little mite is undoubtedly far more frequent than is supposed, for the reason that the creature can hardly be seen with the naked eye, and an ordinary pocket magnifier only shows it as an animated speck. A nasturtium in my garden, which had been for some time showing yellow leaves or yellow blotches upon the leaves without any apparent cause, was found, upon examination for this mite, to show its presence in considerable numbers, in the larval and in the adult stages. As an experiment, one of the infested leaves was dipped in water in which some soap had been stirred, with the result of speedily killing all of the mites upon it.

THE BLACK-KNOT OF THE PLUM-TREE AND ITS GUESTS.

A piece of a limb of a plum-tree having the well-known "black knot" upon it was sent to me in July, with the inquiry of the kind of insect that caused its growth, and if there was any remedy for the attack. The tree from which the piece was taken was wholly free from it in the spring.

It is a very common belief that the black-knot, so common on plum and cherry trees, and which causes annually the death of thousands of these trees throughout the United States, is produced by an insect attack. There is some foundation for this popular belief in the fact that insect larvæ are frequently found within it. These, however, are not the cause of the obnoxious growth, but merely enter it for food or shelter during its early formation.

The common curculio, *Conotrachelus nenuphar*, which is so destructive to the fruit of the plum-tree, has been bred by Dr. Fitch, Mr. Walsh, and others from larvæ inhabiting the black-knot. Mr. Walsh has also bred from it five other species of insects — two of flies, viz.: *Ceratopogon* sp., and *Diplosis septemmaculata* Walsh, and three species of small moths, probably of the genus *Hedya* (*Practical Entomologist*, i, p. 50). Larvæ have on different occasions been taken by me from their cocoons made upon the margin of the black-knot, where it was overgrowing an excision of the preceding year, and the empty pupa-cases of evidently the same moth have been seen protruding from the knot. The moth, unfortunately, was not obtained, but it was probably that of *Ægeria pictipes* Grote-Rob., which is known to infest plum-trees sometimes in great numbers (*North American Entomologist*, i, 1879, pp. 17–21, with plate).

Although it is not many years since the origin of the black-knot was in doubt, for even in 1859, Dr. Fitch pronounced it not a fungus (*Trans. N. Y. State Agricultural Society* for 1859, xix, p. 606), it is now known to be a fungus growth of a species long ago described and named as *Sphæria morbosa* Schw. Quite recently it has been transferred to the genus *Plowrightia*, and this later generic name will probably ere long be generally accepted.

The specimen sent is of a brown color, for it is not until late in July or about the 1st of August that it presents its well-known black appearance, caused by "numerous coal-black hemispherical plates of about the size of the head of a pin, each of which is a distinct fungus."

Professor Riley has quoted Mr. Walsh as having shown that the black-knot fungus infesting the cultivated cherry "was quite distinct from that attacking the cultivated plums." He has also indicated another species occurring upon the "Miner plum," which, may be seen "at a single glance to be essentially distinct from the common black-knot of the plum." He writes: "It would seem to follow that there are three distinct black-knots, originating, respectively, from choke-cherry, from the common wild plum and from the Chickasaw plum" (*American Entomologist*, ii, p. 231).

Those who have studied this fungus the most thoroughly believe in the existence of but one species, which readily tranfers itself from the plum to the cherry, and the reverse. According to Professor Peck, State Botanist, "it is now known to occur on *Prunus domestica*, *P. Americana*, *P. cerasus*, *P. Virginiana*, *P. Pennsylvanica*, and *P. serotina*. Two of these are plum-trees — one introduced, the other native — and the remaining four are cherry-trees, of which the last three are indigenous" (31st *Report of the N. Y. State Museum of Natural History*, 1879, p. 60).

Remedy. — The only remedy, so far as known, of the black-knot is the free use of the knife as early as possible after its discovery. Mr. Walsh has emphasized the following as the remedy that may be relied on: "If the diseased twigs are cut off and destroyed early in July in the latitude of New York, or a little earlier or later according to the latitude, taking care to cut a few inches below the affected part, the black-knot can be checked and probably entirely eradicated; but if this operation is delayed until August, it will be of no benefit whatever."

If the above remedy is resorted to in the early stage of growth, the limb or twig need not be removed, but the fungus can be cut out with a sharp knife while still confined to one side of the branch, permitting, if properly done, the wound to heal in a short time.

NOTES ON VARIOUS INSECTS.

NISONIADES PERSIUS *Scudder*. — Four examples of this very common Hesperian butterfly in the State of New York (two males and two females) were identified by me among the collections made by Dr. H. A. Hagen in the Northern Trans-Continental Survey in 1880, at Yakami river, La Chapples, Washington Territory, July 16; Yakami city, July 2, and ——, July 11th.

SPHINX CANADENSIS *Boisd* — An example of this rare Sphinx (the *S. plota* of Strecker) was captured at light, on a window, at Tannersville, Catskill Mountains, on August 13th, and is now in the collection of Mr. W. W. Hill, of Albany.

Mr. William Grey, of Kenwood, informs me that four examples of the species (one of which is in the collection of Hon. Erastus Corning, of Albany) were taken by Dr. James S. Bailey, upon the skin of a deer hung up to dry in the Adirondack Mountains. The species would seem, from the above collections, to favor high elevations.

MELITTIA CUCURBITÆ (*Harris*). — The following notes on the squash-vine borer have been kindly furnished me by Mr. J. P. Devol, of Petersburg, Va., in consideration of a published request for information upon the life-history of the species:

June 24th, found two vines of Boston marrowfats dying, from which the borers had escaped and entered the ground.

July 3d, dug up a larva from two and a half inches beneath the surface of the ground, at about two inches from the root-stalk.

July 8th, a larva found in a leaf-stalk, two feet distant from the stalk.

TINEA PELLIONELLA *Linn.* — This notorious pest — the common clothes-moth, carpet-moth, fur-moth (different names for the same insect), etc., was first observed in flight in my office, as early as February 13th. During March, and especially toward the latter part of the month, the moths were not uncommon. On April 23d, note was made of their being quite numerous. They were also reported to me as flying in abundance, May 14th, from a bag with hops and pieces of flannel; the flannel was found almost entirely eaten.

The above early appearances of the insect are noted, as Professor Fernald, in his excellent paper discussing the confused synonymy of the species, states that "the moths emerge in June and July, and some even as late as August, yet there is but a single generation" (*Canadian Entomologist*, xiv, 1882, p. 167). Dr. Packard represents the moth as beginning to fly about our apartments in May (*Guide to the Study of Insects*, 1866, p. 346). Dr. Harris states that they lay their eggs in May or June, and recommends early June as the time in which the prudent housekeeper should beat up their quarters and put them to flight or destroy their eggs and young (*Insects Injurious to Vegetation*, 1862, pp. 493, 494).

Probably the nearly uniform day and night temperature of my office during the winter, maintained by the steam-heating arrangements of the Capitol, serve to shorten the period of pupation, when compared with its usual period in our dwellings.

MALLOTA *sp.* — Professor L. M. Underwood, of Syracuse University, sends Jan. 19th, larvæ (3), puparium, and empty puparia (3), taken in Western New York, from between the boards forming the walls of an out-house. They may have been of *Mallota barda*, to which they bore a resemblance, but they could not be positively identified, for unfortunately the examples sent had been put in alcohol, and none had been retained alive for rearing.

ANTHRENUS SCROPHULARIÆ (*Linn.*).— The carpet-beetle occurred abundantly on flowers of Spiræa, in Washington Park, Albany, on June 2d. *Anthrenus varius* was associated with it in about equal numbers.

June 8th, numbers were taken by Mr. William Beuttenmüller, of New York city, on flowers of parsnip.

July 21st, twenty-five of the larvæ, of different sizes, were received from a residence in Schoharie, N. Y., where they abound.

Aug. 9th, Prof. H. M. Seely, of Middlebury College, Middlebury, Vt., sends what he believes to be the carpet-beetle, as it was found in large numbers associated with the *A. scrophulariæ* larvæ when searching for the latter in July. It proved, however, to be *Otiorhynchus ligneus*, which appears of late to have domesticated itself within many dwellings.

Nov. 2d, half-grown larvæ and an imago taken in my house, the latter from a window curtain.

THANASIMUS DUBIUS (*Fabr.*).— Numbers of this insect — one of the *Cleridæ* — were observed upon cut pine timber, at Schoharie, May 13th, dropping quickly to the ground when approached. They had probably been feeding on some of the wood-eating larvæ under the bark. A species nearly allied to this, captured by me upon the summit of Mt. Marcy, at an elevation of 5,300 feet, on August 8th, 1877, has recently been identified by Mr. E. M. Schwarz, as *Clerus ?analis* Lec.

MACRODACTYLUS SUBSPINOSUS (*Fabr.*).— Under date of July 4th, Mr. H. J. Foster, of East Palmyra, N. Y., wrote that the rose-bug had made his cherry-trees leafless the preceding year, and that this year they were eating the leaves of the wild-grape, and the young apples where they occur in clusters.

Chrysochus auratus (*Fabr.*).—Professor S. A. Forbes, State Entomologist of Illinois, has kindly communicated to me a new food-plant for this beetle, discovered in the State of New York. He had received under date of July 7th, from Mr. C. Fred Johnson, of Bayport, Suffolk Co., some "potato-bugs," which he identified as this species. It had "appeared only on a dozen or so of plants, in a field of two acres, but as many as thirty or forty were found on a single plant." It had never before been recorded as occurring injuriously upon any cultivated plant.

Trirhabda canadensis (*Kirby*).—On the 22d of June, at Schoharie, N. Y., found in one locality a large patch of the golden rod, *Solidago Canadensis*, infested with numbers of a shining black larva, about a half-inch in length, and tapering toward each end. Of a number gathered and fed upon the golden rod, a half dozen had changed to the pupa state, ten days thereafter. On the 15th July, the beetles were disclosed, and proved to be one of the *Chrysomelidæ*, viz., *Trirhabda Canadensis* (Kirby). The ochre-yellow stripes of the elytra, at first quite bright, gradually dulled in their drying.

Numbers of the beetles were observed, on September 8th, feeding upon the leaves of the golden rod. When approached, they drop to the ground and lie motionless. Several pairs were in copula, and all of the females had the abdomen enormously distended with eggs. *Diabrotica vittata* (Fabr.) was also very abundant in the blossoms of the plant, where it was feeding upon the pollen.

T. Canadensis has also been observed, abundantly, at Keene Valley, Essex county, N. Y., on golden rods, late in July and early in August.

Hylesinus opaculus *Lec.*—This little bark-boring beetle (determined by Dr. Horn) was found by Prof. C. H. Peck, State Botanist, under the bark of living, and, to all appearance, healthy cedar trees (*Arbor vitæ*). They occurred May 26th, within their main galleries, with eggs laid at intervals, in niches on each side, from which, later, would run the lateral galleries of the larvæ. The beetle has hitherto been recorded only on elm and ash (*Ulmus* and *Fraxinus*).

Phlœotribus liminaris *Harris.*—Numbers of this beetle, designated by Saunders as the elm-bark beetle, although perhaps more frequently occurring in the peach, were emerging in my office June 6th, from sections of the trunk of a young peach-tree, received from Mr. G. W. Duvall, from near Annapolis, Md. The tree had, it was believed, been killed by the insect the preceding year.

Œcanthus niveus *Harris.*—Peach twigs, badly scarred through the oviposition of this insect, the white flower-cricket, were received, in April, from Mr. O. Wilson, of Keuka, Chemung county, N. Y.

Ephemera natata (*Walker*).—Examples of this May-fly were brought to me on June 6th, and reported as having occurred in immense swarms in Middleburgh, N. Y.

Other notices of insects and their attacks together with some studies and observations of the entomologist made during the year, which are, for reasons previously stated, omitted from this report, will probably be given in the next (third) report to be communicated to the Legislature.

Respectfully submitted,

J. A. LINTNER.

ANATOMY OF THE SNAIL.

HELIX THYROIDES.

By George B. Simpson.

I commenced the dissection of *Helix thyroides* with the intention of writing a monograph similar to the one by myself on the *Anodonta fluviatilis*, but other work was so pressing that I have been unable to continue my investigations. I have partially illustrated the pulmonary cavity. Next season I shall continue the work according to the original design.

The lungs consist of a simple cavity communicating with the exterior by an orifice situated on the right side of the body, closed by a sphincter muscle. The cavity is comparatively large and is situated on the outside of the lower two whorls. The position and extent of the cavity is shown on plate 3, figures 2, 3, 4.

In front is the collar, in the right side of which is the pulmonary orifice. The bottom or floor consists of the muscular peritoneum. On the right side is the rectum, and posteriorly the renal organ and heart, which is composed of an auricle and ventricle. The interior of the cavity is lined with a net-work of veins, which frequently anastomose and receive numerous dendritic veins. The veins are most abundant near the pulmonary orifice; they connect with a large vein which, commencing near the orifice, continues backward on a line with the rectum and opens into the auricle. The blood is conveyed to the lungs by aorta proceeding from the ventricle.

When the animal is living the blood vessels can frequently be traced through the shell, presenting a beautiful golden appearance; they might without a knowledge of their character be mistaken for markings of the shell.

The pulsations of the heart can be very distinctly seen; they usually number about fifty in one minute, though sometimes varying from as high as seventy to as low as thirty.

[Originally communicated to the Thirty-second Report of the State Museum of Natural History, pp. 101-128, in 1879.]

ANNELIDA CHÆTOPODA OF NEW JERSEY.

By H. E. Webster.

The Annelida catalogued and described in the following pages, were collected in June and the first half of July, 1878, by the writer and a number of students from Union College, forming the usual summer zoölogical party, or "Natural History School," sent out by the college. The locality was Great Egg Harbor, N. J., our residence and point of departure being Beesley's Point. The harbor is quite shallow, with a narrow channel carrying from ten to fifteen feet of water. Outside of the channel at low water, there is from one to three feet of water, and the bottom is covered for the most part with a dense growth of grass and seaweed. As usual, by far the greater number of species were obtained with the spade, between tides. In collecting and taking care of the annelids, I was very much aided by Mr. James E. Benedict. Mr. Benedict had general charge of the shore work, giving especial attention to the birds, but managed to find time for much good work on the annelids. Mr. C. M. Culver relieved me of much care and responsibility by taking general supervision of the marine invertebrate collecting and collections; while Mr. H. H. Dey Ermand, although acting as Mr. Benedict's assistant in shore work, did good service in marine collecting, from time to time. We were very fortunate in our boatman, Mr. Aaron Clark, of Beesley's Point, and I can heartily recommend him to hunting, fishing and collecting parties. During this winter (1878–79), we have received from him a fine lot of birds in good condition for mounting. I mention this fact, because, in common with others, I have found it very difficult to find men competent to collect and care for birds or other natural history objects, except under direct supervision.

The results of the work on the chætopod annelids may be summarized as follows:

Number of Families represented	23
Genera	50
Species	57

It was found necessary to establish two new genera Streblospio and Paraxiothea; of the species fourteen are believed to be new; one genus, Grubea, has not previously been reported from our coast, although the species is probably not new. The specimens upon which the work is based are in the Museum of Union College, and a nearly complete series has also been deposited in the New York State Museum of Natural History.

Fam. POLYNOIDÆ.

LEPIDONOTUS (*Leach*) *Kinberg*.

Fregatten Eugenies Resa; Zoölogi, ii, Annulata, p. 13.

Lepidonotus squamatus *Knbg.*

Aphrodita squamata Linn. Syst. Nat., ed. x, p. 655. 1758.
Polynoë squamata Savigny. Syst. des Ann., p. 22. 1820.
" " Aud. & M. Ed. Littoral de la France, vol. ii, p. 80, pl. i, figs. 10–16. 1834.
" " Grube. Familien der Anneliden, p. 36. 1851.
" " Quatr. Hist. Nat. des Ann., vol. i, p. 218. 1865.
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" " Webster. Annelida Chætopoda of the Virginian Coast, in Trans. Albany Institute, vol. ix, p. 204, pl. i, figs. 1-5. (Advance copies, Jan. 1879.)

LAGISCA *Malmgren*.

Nordiska Hafs-Annulater, p. 65. 1865.
Annulata Polychæta, p. 133. 1867.

Lagisca impatiens *n. sp.*

Plate (i) iv, figs. 1–7.

Head (fig. 1) broader than long, sides convex, posterior margin concave, slightly depressed along the median line.

Eyes large, lateral, remote from each other, black.

Antennæ covered with minute, cylindrical papillæ, which are a little swollen and lobed at the end; median, cylindrical for inner two-thirds, outer third conical, delicate; basal article large, swollen; in length falling a little short of the palpi; lateral, about one-half as long as the median, fusiform; basal articles cylindrical, a little longer than that of the median antenna.

Palpi smooth, very changeable in form, at rest a little longer than the median antenna, tapering uniformly to near the end, where the diameter suddenly diminishes.

Tentacular cirri with cylindrical basal articles; superior about the length of median antenna; inferior but little shorter than superior; these cirri, together with the dorsal and anal cirri, have the same structure, in all respects, as the median antenna, but the dorsal cirri are a trifle longer than the superior tentacular cirri, and the anal are a little longer than the dorsal.

Elytra, first pair (fig. 5) nearly circular; the rest (fig. 6) reniform; covering the body completely in front, but further back not quite touching along the middle line, leaving a narrow, naked, median space; when magnified, seen to be covered with minute granules, around each of which is a circular depression; outer margin fringed; from two to seven rather stout, cylindrical papillæ arising from the surface, near the posterior margin; last seven segments without elytra.

Feet (fig. 2) of the usual form, margins of both dorsal and ventral rami with flattened somewhat triangular prolongations; ventral cirri arising at about the outer third and projecting a little beyond the foot, sparsely covered with papillæ similar to those found on the superior cirri.

Setæ of dorsal ramus quite stout (fig. 4), numerous, about half as long as the ventral setæ, although the longest dorsal are as long as the shortest ventral; those of the ventral ramus (fig. 3) long, numerous, ending in a single curved point. The dorsal setæ are usually more numerous than in fig. 2, very nearly concealing the prolongation of the ramus.

Color. Head, flesh-color; palpi, brown, with white tips; antennæ and all superior cirri with one or two black rings at about the outer third; elytra extremely variable; they may be white, yellow or flesh-color, with markings varying much both in form and extent, and in color from light brown to very dark brown; on one specimen the elytra were light orange, with transverse linear markings of dark brown, on the anterior segments; body usually white above, without markings, or with transverse lines or spots of black or purple; the last segments have usually black markings; the ventral surface may be white, or white tinged with red or purple.

This species is very fragile, readily breaking up and losing their elytra when disturbed. Middle third widest; last third tapering rapidly; first third slightly tapering.

Length of adult specimens, 25^{mm}; width, $4\text{–}6^{mm}$.

Common, associated with *Lepidonotus squamatus*, and like that species abundant on beds of *Mytilus edulis*.

LEPIDAMETRIA *Webster.*

Annel. Chæt. of the Virginian Coast, p. 209. 1879.

LEPIDAMETRIA COMMENSALIS *Webster.*

Op. cit., p. 210, plate iii, figs. 23–31.

Not common; only three specimens were collected. Lives in the tube of *Amphitrite ornata* VERRILL.

Fam. SIGALIONIDÆ.

STHENELAIS *Kinberg.*

Annulata Nova., etc., Öfvers af Kongl. Vet-akad-Förh. 1855.

STHENELAIS PICTA *Verrill.*

VERRILL. Invert. Animals of Vineyard Sound, etc., p. 582. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 213. 1879.

Not common. Dredged.

Fam. NEPHTHYDIDÆ.

NEPHTHYS *Cuvier.*

NEPHTHYS INCISA *Malmgren.*

Nephthys incisa MGRM. Nordiska Hafs-Annulater, p. 105, pl. xii, fig. 21. 1865.
Annulata Polych., p. 141. 1867.
" *ingens* VERRILL. Invert. An. Vin. Sound, etc., pl. xii, figs. 59, 60. 1874.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 213. 1879.
" *incisa* VERRILL. Check List. 1879.

Not common. Found in sand and mud; low water to fifteen feet.

NEPHTHYS PICTA *Ehlers.*

EHLERS. Die Borstenwürmer, p. 632, pl. xxiii, figs. 9, 35. 1868.
VERRILL. Invert. An. Vin. Sound, etc., p. 583, pl. xii, fig. 57. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 214. 1879.

Fam. PHYLLODOCIDÆ.

ANAÏTIS *Malmgren.*

Nordiska Hafs-Annulater, p. 94.

ANAÏTIS SPECIOSA *n. sp.*

PLATE (I) IV, FIGS. 8, 9.

The outline of the head conforms perfectly to Malmgren's generic description; the middle third of the posterior margin curves suddenly backward, encroaching upon the anterior margin of the first segment, the sides and front are regularly rounded, forming a semicircle.

Antennæ delicate, conical, length about one-half the width of the head ; only the upper pair can be seen from above ; both pairs arise from the lower surface of the head, upper also external and pointing outward, lower directed downward.

Eyes large, circular, lateral, posterior ; first segment prolonged forward as far as the front of the eyes, embracing the sides of the head.

Tentacular cirri arise from short, stout basal articles, are stout at base, regularly and acutely conical ; first and second equal, a little shorter than the third, which reaches back to the front margin of the fourth setigerous segment; the fourth cirrus, or cirrus of the second segment, as long as the third.

Dorsal cirri (branchiæ) broad heart-shaped (fig. 8), with long basal attachment, retaining the same form throughout; feet (fig. 8) cylindrical, bilabiate; ventral cirri with slightly convex lower margin, nearly straight or slightly concave upper margin; apex bluntly rounded, a little shorter than the feet; anal cirri circular, a little thicker than the dorsal.

Setæ (fig. 9) long, slender, with very long and delicate appendix; the stem ends in two sharp curved points, one much longer than the other.

Color: head and first two segments white with brown specks; dorsum generally dark green ; between the segments a narrow spindle-shaped band of umber-brown; eighth and ninth segments umber-brown, giving a well-defined band of the width of these two segments ; dorsal cirri green, not quite so dark as the dorsum, with a central brown spot, extending to their attachment on the segments 3–9 ; after the ninth segment this marking becomes obsolete. Ventral surface light green, growing darker externally, and with reddish-brown lateral markings along the posterior third; feet and ventral cirri dark green at base, growing lighter further out. Anal segment brown. The general color of the body in one instance was reddish-yellow; in another all the markings were very dark-brown, nearly black, in place of the umber-brown. The transverse band on the eighth and ninth segments is still visible, after six months' preservation in very strong alcohol. Body slightly convex above, flattened below ; the first segment is much wider than the second, but shorter; the second is narrower than the head ; the middle third of the body has a uniform width, about double that at either extremity.

Length of adult specimens, 10–12^{mm} ; width, 1.5–2^{mm}.

Found occasionally at low water; quite common on beds of *Mytilus edulis.*

PHYLLODOCE (*Sav.*) *Malmgren.*

MALMGREN. Nord. Hafs-Ann., p. 94.

PHYLLODOCE ARENÆ *n. sp.*

PLATE (II), V, FIGS. 10–12.

Head bluntly rounded in front, diameter increasing backward to the middle line, just back of the middle slightly constricted; margins behind the constriction straight; posterior margin with a deep triangular emargination; lateral lobes broadly rounded.

Antennæ short, conical, rather stout, their length about equal to the anterior diameter of the head.

Eyes situated at posterior third of the head, latero-dorsal, large, circular, dark brown to black.

Tentacular cirri; first and second equal, reaching some distance beyond the head; second and third equal, about double the length of the first, reaching back to the ninth or tenth segment, subulate. On the first segment, in the triangular space between the posterior lobes of the head, there is a small, blunt papilla, its length about equal to the base of the triangle; this papilla is obvious in fresh specimens, but is seen with difficulty in alcoholic specimens.

Dorsal cirri of the anterior segments (fig. 10), broad heart-shaped, from the twenty-fifth segment somewhat quadrangular (fig. 11), and with the inner margin abruptly turned up, presenting a narrow surface nearly at right angles to the larger outer part of the cirrus; the line of union of the two surfaces is thickened and densely covered with long cilia.

Ventral cirri, lower margin convex, upper margin nearly straight in front; they are rounded externally, pointed behind.

Setæ numerous, of one kind only (fig. 12), very long with a flexible capillary termination; the stem is roughened near the articulation by numerous projecting points; the appendix is joined to the stem by a delicate membrane, and is minutely denticulated along its thin margin.

Anal cirri short, conical.

Color: on the dorsum each segment has a dark brown crescent on both its anterior and posterior margin, while the intervening part is green; thus there are transverse, hour-glass shaped green markings, alternating with spindle-shaped brown markings; on the first ten or twelve segments the brown falls a little short of the outer margins of the segments. The dorsal cirri are greenish-white with a large patch of brown at base, not quite so dark as the brown of the dorsum. Back of the middle of the body a second brown spot appears on the outer central part of each cirrus. The ventral surface is light green with a central brown spot on each segment, and a similar spot between the bases of the feet. The head, antennæ and tentacular cirri are white.

Proboscis not seen in full extension, basal portion closely covered with longitudinal series of conical papillæ, except a narrow, naked space above.

Body tapers slightly along the posterior third, but is of nearly uniform diameter throughout.

From the twenty-fifth segment the middle (green) part of each segment is ciliated. Three specimens were found, two of which were colored as described above, while the third had white everywhere replacing the green.

Length, 10^{mm}; diameter, 1^{mm}; diameter including feet, 2.5^{mm}.

Found near low-water mark, in sand.

EUMIDA *Malmgren.*

Nord. Hafs-Annulater, p. 97. 1865.

Eumida maculosa *Webster.*

Annel. Chæt of the Virginian Coast, p. 215, pl. iv, figs. 38–41. 1879.

Very common on shells, etc., from low-water to fifteen feet.

EULALIA (*Sav.*) *Malmgren.*

Malmgren. Nord. Hafs-Annulater, p. 98. 1865.

Eulalia ? annulata *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 291. 1874.

A single specimen, having the anterior portion only, was found, which probably belongs to Verrill's species.

ETEONE (*Sav.*) *Œrsted.*

Œrsted. Annulatorum Dan. Consp., p. 29. 1843.

Eteone alba *n. sp.*

plate (ii), v, figs. 13–16.

Head longer than broad, wide at base, apex bluntly rounded (fig. 13); a slight depression just above the bases of the lower antennæ, and another similar depression just back of the upper antennæ.

Antennæ small, conical; the upper, about equal in length to the width of the apex; the lower, a trifle longer. On the middle line of the head, just back of the eyes, there is a small papilla, which can be seen only with difficulty in living forms, and can hardly be demonstrated in alcoholic specimens.

Eyes small, circular, widely separated, situated at about the posterior fourth of the head; on young specimens, red; on adults, black.

Buccal segment nearly as long as the three following segments taken together.

Tentacular cirri; upper nearly as long as superior antennæ, but more delicate; lower, three times as long as upper, and stouter, but still very delicate.

Dorsal cirri pretty evenly rounded, quite small on the anterior segments (fig. 14), growing larger behind (fig. 15).

Ventral cirri, in front larger than the dorsal, lower margin strongly convex, upper margin straight, apex acute; further back they are larger than in front but smaller than the dorsal cirri, their margins slightly convex, apex bluntly rounded.

Anal cirri short, subulate.

Setæ (fig. 16) numerous, short, stem reaching but little beyond the feet; appendix also short, rather wide at base, termination capillary, one edge minutely denticulated.

Body elongated, in front flattened, further back rounded above, flat below; tapering rapidly along the anterior third, gradually along the posterior third.

Color white, or white with flake-white specks, sometimes with an intestinal brown line showing through.

Length of largest specimens, 45^{mm}; width with feet, 1.5^{mm}.

Rare; low water to fifteen feet.

Eteone limicola *Verrill.*

Verrill. Invert. Animals of Vineyard Sound, etc., p. 294. 1874.

This species, reported by Verrill from Great Egg Harbor, we failed to find.

Fam. HESIONIDÆ.

PODARKE *Ehlers.*

Die Borstenwürmer, p. 190. 1864.

Podarke obscura *Verrill.*

PLATE (II) V, FIGS. 17, 18.

Verrill. Invert. An. of Vin. Sound, etc., p. 589, pl. xii, fig. 61. 1874.
Webster. Annel. Chæt. of the Virginian Coast, p. 216. 1879.

Rare; low water to fifteen feet.

Podarke luteola *n. sp.*

PLATE (II) V, FIGS. 19, 20.

Head very slightly convex in front, posterior margin slightly concave, and a little shorter than the front margin, the sides being directed a little inward; length to width as one to three; angles all bluntly rounded.

Antennæ: Median lost; those in pairs delicate, subulate, without basal articles. Upper pair situated just above the lower, their length about equal to the width of the head; lower pair a little shorter than upper.

Eyes dark red; anterior pair large, circular, latero-posterior; posterior pair a little within the front pair, almost in contact with them; crescentic, concavity directed outward and backward.

Tentacular cirri six pairs, arising from short, cylindrical basal articles, borne on the first three segments, two pairs to each segment; upper cirri as long as the dorsal cirri, or even a little longer; lower about one-half as long as the upper. The first four pairs on each side seem to arise from the sides of the head; this is due to the fact that the first and second segments are not visible from above, except as narrow lateral bands extending forward on the head as far as the anterior eyes; these segments are well defined below; in alcoholic specimens they cannot be seen from above, and even in living forms the line of division between the sides of the head and the lateral prolongations of these segments is not easy to demonstrate.

Dorsal cirri very long, delicate, tapering uniformly, basal articles short, cylindrical (fig. 19).

Feet biramous; upper ramus a stout papilla arising just below the base of the dorsal cirrus; lower ramus stout, elongated, terminating above in a conical process, below which the end of the ramus is bluntly rounded, almost truncate.

Ventral cirri arise from lower outer margin of the ventral ramus, delicate, conical, about one-sixth as long as the dorsal cirri.

Setæ: dorsal very long, slender, capillary, forming a close-set bundle, arising from the summit of the dorsal ramus; ventral (fig. 20) of the form usual in this genus, hardly to be distinguished from the ventral setæ of *Podarke obscura* VERRILL, except that they are longer, and that the stem has transverse markings which I have never been able to see in the setæ of that species. The difference in length between the setæ of the two species is due almost entirely to the elongation of the stem in the setæ of *P. luteola*.

Body slightly convex above and below, widest in front, tapering very gradually. The feet increase in length from the first pair to the middle a little faster than the body narrows, so that the widest part, including the feet, is in the middle.

Anal cirri in all respects similar to the dorsal.

Color: reddish-yellow dorsally; feet green or yellow above, green laterally; ventral surface a shade lighter than the dorsal; antennæ and all cirri white.

Length, 11^{mm}; width, including feet, 2^{mm}; number of segments, 45.

A single specimen was found on an oyster shell at low water.

This species is easily distinguished from *Podarke obscura* VERRILL (the only species of this genus previously described from our coast), by the form of the head—lack of basal articles for the antennæ, apparent origin of the tentacular cirri of the first two segments, great length, and short basal articles of the dorsal cirri, etc.

Fam. SYLLIDÆ.

SYLLIS (*Sav.*) *Ehlers.*

EHLERS. Die Borstenwürmer, p. 222. 1864.

SYLLIS GRACILIS *Grube.*

Syllis gracilis GRUBE. Actinien, Echinodermen und Würmer, p. 77. 1840.
" " CAPAREDE. Glanures Zoötomiques parmi les Annélides de Port-Vendres, p. 75, pl. v, fig. 3. 1864. Annélides Chétopodes du Golfe de Naples, p. 503, pl. xv, fig. 3. 1868.
" " MARION AND BOBRETZKY. Annélides du Golfe de Marseille; in Annales des Sciences Naturelles, 6th series, vol. ii, p. 23, pl. ii, fig. 6. 1875.
" " PANCERI. Catalogo degli Annelide, etc. Atti. Soc. Ital., vol. xviii, p. 520. 1875.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 217. 1879.

Only a few examples of this species were taken, it being far less common than in Virginia.

ODONTOSYLLIS *Claparède.*

Glanures Zoötomiques, etc., p. 94. 1864.
Beobachtungen über Anatomie, etc. 1863.

ODONTOSYLLIS ? FULGURANS *Clpd.*

Odontosyllis fulgurans CLAPAREDE. Glanures Zoötom., etc., p. 95, pl. viii, fig. 1. 1864.
" " QUATREFAGES. Hist. Nat. des Annel., vol. ii, p. 648. 1865.
" " MARION AND BOBRETZKY, in Ann. des Sci. Nat., 6th series, vol. ii, p. 40, pl. iv, fig. 2. 1875.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 220. 1879.

This species was not common. One very large adult male was taken swimming on the surface. Its length was 22^{mm}; sexual setæ began on the 21st segment; existed on forty-two segments, followed by thirty-three with the ordinary setæ only. Other specimens were taken on sandy and shelly bottom, 10–15 ft. For further notes on this form, see Webster, l. c., p. 220.

GRUBEA (*Quatr.*) *Claparède.*

QUATREFAGES. Histoire Naturelle der Annèles, etc., vol. ii, p. 35. 1865.
CLAPAREDE. Annél. Chét. du Golfe de Naples, p. 516. 1868.

GRUBEA TENUICIRRATA *Clpd.*

Sphærosyllis tenuicirrata CLPD. Glanures Zoötom., etc., p. 87, pl. vi, fig. 2. 1864.
Grubea tenuicirrata CLPD. Annél. Chét. du Golfe de Naples, p. 517. 1868.
" " MARENZELLER. Zur Kentniss der Adriatischen Anneliden. Ausdem, lxix. Bande der Sitzb. der K. Akad. der Wissench, p. 29. 1874.

In some respects my specimens agree better with *Grubea dolichopoda* MARENZELLER (l. c., p. 26) than with *G. tenuicirrata* CLPD. This is especially the case in the form of the setæ and of the pharyngeal tooth. According to Claparede's figure, the setæ end in a single point, and with the magnifying power used by him this does seem to be the case; in reality they are bidentate, the teeth being very small, and requiring a high power to bring them out distinctly. On only two specimens was the first dorsal cirrus much longer than the second.

The anal cirri, in the only case where they were seen, were as long as the dorsal cirri, and somewhat swollen at base.

Body colorless; stomach white; intestine colorless; eyes very dark reddish-brown.

The sexual setæ begin on the ninth setigerous segment. All the males had lost the posterior part of the body, but on one specimen the capillary (sexual) setæ existed on nineteen segments. The eggs and young in different stages of development agree very closely with those described by Claparède as belonging to *Syllis pulligera* KROHN (*Syllides pulligera* CLPD.), *Glanures, etc.*, p. 81, pl. vi, fig. 6.

Not common; ten to fifteen feet, on shelly bottom.*

PÆDOPHYLAX *Claparède.*

Annél. Chét. du Golfe de Naples, p. 520. 1868.

PÆDOPHYLAX DISPAR *Webster.*

Annél. Chæt. of the Virginian Coast, p. 230, pl. iv, fig. 49; pl. v, figs. 50–55. 1879.

Male.

Capillary setæ begin on the eleventh setigerous segment, and are found on all following segments except the last 2–4. They are delicate, longer than the width of the body, including the feet.

The body from the eleventh, or sometimes from the sixth, segment, is pure white and much swollen.

Female.

Capillary setæ as in the males, only a little shorter.

Eggs attached to the ventral surface by a peduncle, two to each segment; at first spherical, then becoming elongated; purple with many black specks.

The constriction dividing the head from the body appears first; at this time the eyes are apparent, the antennæ are mere buds, equal in length, the palpi are not united along their outer two-thirds.

The young, when detached from the body of the mother, have a

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* Since writing the above I have had further opportunity of studying this species. I am now satisfied that our specimens belong to *Grubea dolichopoda* MARENZELLER. Langerhaus, however, identifies this with *Grubea clavata* CLPD. (*Zeitschrift für Wissenschaftliche Zoologie*, p. 564. 1879.)

well-formed head with appendages, buccal segment with tentacular cirri, five setigerous segments with feet and cirri, and anal segment with anal cirri which are relatively longer than in the adult; otherwise they do not differ from the adult except, of course, in size and number of segments.

Common on shelly bottom, 10–15 feet.

AUTOLYTUS (*Grube*) *Marenzeller*.

MARENZELLER. Zur Kentniss der Adriatischen Anneliden, etc., Zweiter Beitrag, p. 37. 1875.

AUTOLYTUS HESPERIDUM *Claparède*.

CLAPAREDE. Annél. Chét. du Golfe de Naples, p. 520, pl. xiv, fig. 1. 1868.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 225. 1879.

Male.

No adult males were found, but in one specimen, though not detached, the following modifications of structure had occurred:

Head slightly convex in front; eyes very large, but not quite in contact; lateral antennæ arising from the front margin of the head, just before the anterior eyes, bifurcate at their outer third, swollen at base, three times as long as the head; median antennæ arising back of the eyes, near the posterior margin of the head, one-third longer than the head; buccal segment hardly distinct from head, bearing two pairs of tentacular cirri, of which the upper had about the length of the lateral antennæ, the lower, of the median; second segment with ordinary dorsal cirrus; no sexual setæ.

This species was very common from just below water mark to fifteen feet, living on certain forms of sea-weed. In number of individuals it probably surpassed any other species of Annelid found in the harbor.*

Fam. NEREIDÆ.

NEREIS (*L.*) *Cuvier*.

NEREIS LIMBATA *Ehlers*.

PLATE (III), VI, FIGS. 21, 22.

EHLERS. Die Borstenwürmer, p. 567. 1868.
VERRILL. Invert. Animals of Vineyard Sound, etc., pp. 318, 590, pl. xi, fig. 51. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 235, pl. vi, figs. 70–75. 1879.

Male.

The dorsal cirri of the first seven segments have a peculiar form, which seems to have escaped notice. Near the end they are slightly

* Regarded by Prof. Langerhans as identical with *Autolytus prolifer* GRUBE. (See *Zeitschrift für Wissenschaftliche Zoologie*. p. 574. 1879.)

enlarged (fig. 21), then suddenly become smaller, ending in a delicate, almost filiform appendix. The dorsal cirri of the middle region have one margin crenulated for nearly their entire length (fig. 22); the ventral cirri have a few crenulations near their outer end.

Found living very near high-water mark, and common everywhere in the harbor, except in pure sand.

NEREIS CULVERI *n. sp.*

PLATE (III), VI, FIGS. 23–30. PLATE (IV), VII, FIGS. 31, 32.

Head (fig. 23) emarginate in front; anterior half of lateral margins concave, posterior half slightly convex; posterior margin straight; from the anterior emargination, a deep, triangular depression runs backward to the middle line, so that the front half of the head seems to be divided into two lobes, broadly rounded in front; length to width as two to three.

Eyes: anterior pair elliptical or elongate-oval, on the middle line, lateral; posterior pair circular, a little within the front pair, close to the posterior margin.

Antennæ remote from each other at base, conical, length to length of head as three to four.

Palpi very stout with long terminal arches, in extension reaching beyond the antennæ, in contraction falling much short of them.

Proboscis (fig. 24): it is in the structure of this organ that the chief peculiarities of this species are to be found. There are no paragnathi. At the summit of the maxillary ring are bunches of short, conical, pointed papillæ, arising from low, marginal elevations, with the arrangement as follows: on the middle line above, a small bunch of four or five papillæ; on the latero-dorsal margin a bunch of ten or twelve arranged in a double series; on the latero-ventral margin a bunch composed of the same number of papillæ, but not arranged in series; a median ventral bunch, six papillæ in double series; half way between the last and the latero-ventral, a small bunch, three to five papillæ. The lateral papillæ, above and below, are about one-third as long as the antennæ, the others a little shorter. Aside from these papillæ, the surface of the maxillary ring is quite smooth. On the ventral surface of the basal ring, near the posterior margin, are five small elliptical elevations or calluses, a median and two lateral, equally distant from each other. The notes made on the living forms make mention of a small, median, triangular papillæ, just in front of the antennæ. It cannot be demonstrated in alcoholic specimens.

Jaws (fig. 25): in color varying from light to dark horn-color; about fourteen strong, sharp teeth.

Buccal segment double the length of the second segment, equal to the fourth.

Tentacular cirri (fig. 23) arise from stout and long basal articles; upper posterior cirrus longest, reaching back to the middle of the third segment, or sometimes to its posterior margin; the lower posterior cirrus and the upper anterior equal, from one-fourth to one-third shorter than the longest; lower anterior cirrus shortest; viewed from below, this cirrus is seen to arise much below the others.

The first two setigerous segments have no dorsal rami (fig. 26), but the cirri lingulæ and ventral ramus have nearly the same form as on the segments following. From the fourth to twentieth–twenty-fifth segment (fig. 27), the dorsal ramus, is small, conical, distinct from its lingula; the lingula is longer than the dorsal ramus, broad at base, tapering gradually, apex bluntly rounded, somewhat compressed; the dorsal ramus has two lips, anterior and posterior; anterior small, of uniform diameter, directed upward; posterior larger than anterior, shaped much like upper lingula, but smaller, directed outward; the lower ramus has also two lips, placed one behind the other, stout, bluntly conical, anterior turned outward, posterior a little downward; the inferior lingula is a little stouter at base than the lips of the ventral ramus, otherwise about the same form and size; the ventral cirrus is longer than the dorsal, fusiform, reaches to the middle of its lingula, arising some distance below it.

Further back the basal part of the feet gains in length (fig. 28); the dorsal cirrus becomes shorter; the upper lingula longer, conical, with less diameter; the anterior lip of each ramus becomes gradually smaller, and finally disappears; the lower lingula is greatly reduced in size; the ventral cirrus recedes from its lingula, becoming minute, conical.

On the posterior feet (fig. 29), the dorsal cirrus arises from the base of the upper lingula; the remaining (posterior) lip of the upper ramus becomes delicate, conical, reaching beyond the lingula.

The anal segment (fig. 30) has a slightly crenulated margin; its cirri are delicate, their length more than double that of the longest tentacular cirrus.

Setæ of two kinds; one, with long narrow appendix (fig. 31), one edge minutely denticulated; the other (fig. 32) with short appendix, one margin thickened and rounded, the opposite margin very thin, somewhat coarsely denticulated; those of the second form are found only in the lower bundle of the ventral rami, after the first twenty to thirty segments, from four to six in each bundle, always accompanied by some of the first form.

Color, light flesh-color to reddish-brown; dorsal cirri and superior lingulæ pure gleaming white, other parts of the feet also white; head, especially its posterior half, usually darker than the body.

Body elongate, widest at the eighth segment, diminishing rapidly forward, uniformly but very gradually backward.

This species forms a tough membraneous tube, in color dark reddish-brown, fitting the body very closely.

Length of one specimen (140 segments) 60^{mm}; width with feet 4^{mm}; without feet, 2^{mm}; length of a larger specimen, 75^{mm}; width with feet, 5^{mm}.

Two specimens kept in well-water, not at all brackish, for forty-eight hours, seemed to be in good condition; while specimens of *Nereis limbata* EHLERS treated in the same way stopped all movements in thirty minutes, and in an hour the blood ceased to circulate; the latter were taken at a higher station than that in which the former lived, and where they must often have been exposed to the action of brackish water.

The only place in which this species was found was a few rods above the old wharf, in front of the hotel at Beesley's Point, in coarse sand and gravel, at about half-tide. We looked for them carefully in many other places, where the conditions seemed to be the same, but without success.

Sexual Forms.

Many males and females, apparently adults, were taken, in which no structural changes had occurred except that the eyes had become a little larger; the anterior pair crescentic; the posterior oval; the body and feet being swollen by the contained sexual products.

The color of the female was unchanged; immature males were bright green; adult males greenish white.

This species was first found by Mr. C. L. Culver, at Beaufort, N. C., in the summer of 1877. Mr. Culver was at that time a student in Union College, and attached to the usual summer zoölogical expedition of the college. He brought in two specimens with a lot of *Nereis limbata* EHLERS, taken at low water. The exact station was not known, and though we searched diligently and frequently for additional specimens, none were found.

NEREIS TRIDENTATA *n. sp.*

PLATE (IV), VII, FIGS. 33–40.

Head (fig. 33) deeply emarginate in front, and with a well defined depression carried back to the middle line; behind the middle line the sides are convex; in front of it, strongly concave; posterior margin slightly convex; anterior margin interrupted by the emargination which divides the apex into two bluntly rounded lobes; length to width as two to three.

Antennæ widely separated at origin, conical, length to length of head as two to three.

Palpi very stout, with long terminal articles. Eyes circular, lateral; anterior pair quite large, situated just back of the middle line; posterior about one-half as large as the anterior, and a little within them, very near the posterior margin.

Buccal segment equal in length to the three following segments taken together; much wider than the head.

Tentacular cirri short, tapering but little, arising from stout cylindrical basal articles; upper posterior cirrus reaches to the middle of the third segment, or to the front margin of the fourth; the lower posterior and upper anterior cirri equal, about two-thirds as long as the longest; lower anterior shortest, one-half as long as the longest.

Proboscis (fig. 33) without denticles (paragnathi) on the dorsal surface; my notes make mention of two minute fleshy papillæ situated one on either side of the middle line of the basal ring, but I cannot find them on the alcoholic specimens; ventral surface of maxillary ring also without denticles (fig. 34), while on the basal ring are three small paragnathi, circular or elliptical, flat, corneous, brown.

The jaws are light horn-color with numerous long sharp teeth.

Feet of the first two setigerous segments without dorsal rami, and with the ventral cirrus much swollen at base (fig. 35), in other respects similar to the feet immediately following them.

Anterior feet (fig. 36), dorsal cirrus finger-shaped, longer than its lingula; lingulæ and lips of the two rami tapering but little, nearly cylindrical, very bluntly rounded externally; upper lingula longer than dorsal ramus; dorsal ramus with anterior and posterior lips, anterior shorter than posterior and above it; lower ramus with a long posterior, short anterior lip; lower lingula long, reaching nearly to the outer end of the lower ramus; ventral cirrus delicate, conical, about one-half as long as its lingula.

After the first third the structure of the feet changes gradually (fig. 37); the upper lingula becomes conical, and further removed from the upper ramus; the anterior lips of both rami become much smaller; the lower lingula and the ventral cirrus do not change much; on the extreme posterior feet the dorsal cirrus is longer than elsewhere.

Anal segment simple; anal cirri as long as the last eight segments; filiform.

Setæ of three forms: those of the first form (fig. 38) have the terminal points of the stem in the same plane, appendix very narrow; this is the only kind found in the dorsal rami; they also form the greater part of the upper bundle of the ventral rami, but are not found in the lower bundles; those of the second form have the terminal points of the stem not in the same plane (fig. 39), appendix short, in other respects like the first form; found in both bundles of the ventral rami, but not numerous; those of the third kind (falcate setæ) are short (fig. 40), with a very short appendix, one margin of which is thickened and rounded, the opposite edge thin, and deficient near the apex; a few of this form are found in the upper bundle of the ventral rami, and they form the greater part of the lower bundle.

Body of uniform width along the anterior half, then tapering very slowly.

Color: body light flesh-color; sides of head and bases of antennæ and tentacular cirri dark reddish-brown; one specimen was light orange.

Length of largest specimen, 26^{mm}; greatest width with feet, 3.5^{mm}; number of segments, 105. Length of a specimen with 70 segments, 12^{mm}.

Very rare: 10 to 15 feet, shelly bottom.

Fam. EUNICIDÆ.

DIOPATRA *Aud. and M. Edw.*

AUDOUINE AND M. EDWARDS. Littoral de la France, vol. ii, Annelides, p. 155. 1834.

DIOPATRA CUPREA *Claparède.*

Nereis cuprea BOSC. Hist. Nat. des Vers., vol. i, p. 143. 1802 (teste Claparede).
Eunice cuprea QUATREFAGES. Hist. Nat. des Annelés, vol. i, p. 331. 1865.
Diopatra cuprea CLAPAREDE. Annél Chet. du Golfe de Naples, p. 432. 1868.
" " VERRILL. Invert. Animals of Vin. Sound, etc., p. 593, pl. xiii, figs. 67, 68. 1874.
" ' WEBSTER. Annel. Chæt. of the Virginian Coast, p. 236. 1879.

Quite common on the sand flats at low water, and occasionally dredged at from ten to fifteen feet.

MARPHYSA *Quaterfages.*

Histoire Nat. des Annelés, vol. i, p. 331. 1865.

MARPHYSA SANGUINEA *Quatr*

Nereis sanguinea MONTAGUE. Linn. Trans., vol. xi, p. 20, pl. iii, fig. 1. 1815.
Leodice opalina SAVIGNY. Systeme des Annélides, p. 51.
Nereidonta sanguinea BLAINVILLE. Dict. Sci. Nat., vol. lvii, p. 447. 1828.
Eunice sanguinea AUD. AND M. EDW. Littoral de la France, vol. ii, Annélides, p. 147. 1834.
" " GRUBE. Familien der Anneliden, pp. 44, 123. 1851.
" " " Die Insel Lussin, p. 79. 1864.
" " " St. Malo and Roscoff, pp. 87, 91, 106, 114, 140. 1870.
" " LEIDY. Marine Invert. Fauna, R. I. and N. J., p. 15. 1855.
" " JOHNSTON. Catalogue of British Worms, p. 134. 1865.
Marphysa sanguinea QUATR. Hist. Nat. des Annel. vol. i, p. 332, pl. x, fig. 1. 1865.
" " EHLERS. Die Borstenwürmer, p. 360, pl. xvi, figs. 8–11. 1868.
" " BAIRD. Linn. Proc. Zoölogy, vol. x, p. 352.
" " MAR. AND BOBR. Ann. des Sci. Nat., vol. ii, p. 12. 1875.
" *Leidii* QUATR. Histoire Nat. des Annel. vol. i, p. 337. 1865.
" *Leidyi* VERRILL. Invert. An. Vin. Sound, etc., pp. 319, 593, pl. xii, fig. 64. 1874.
" *sanguinea* WEBSTER. Annel. Chæt. of the Virginian Coast, p. 236, pl. vi, figs. 76–80; pl. vii, figs. 81–83. 1879.

This species is by no means common. Some young specimens taken had one antenna, others three antennæ; eyes, four; branchiæ, from tenth segment; palpi hardly apparent.

DRILONEREIS (*Clpd.*) *Webster.*

CLAPAREDE. Annel Chet. du Golfe de Naples. Supplément, p. 25. 1870.
WEBSTER. Annel Chæt. of the Virginian Coast, p. 240. 1879.

DRILONEREIS LONGA *Webster.*

Annel. Chæt. of the Virginian Coast, p. 240, pl. vii, figs. 84–88. 1879.

Common in sand at low water.

LUMBRICONEREIS (*Blv*) *Ehlers*

EHLERS. Die Borstenwürmer, p. 377. 1868.

LUMBRICONEREIS TENUIS *Verrill.*

VERRILL. Invert. Animals of Vineyard Sound, etc., pp. 342, 594. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 241. 1879.

Not common; sand, low water.

ARABELLA (*Grube*) *Ehlers.*

GRUBE. Die Familien der Anneliden, p. 45. 1851.
EHLERS. Die Borstenwürmer, p. 398. 1868.

ARABELLA OPALINA *Verrill.*

Lumbriconereis splendida LEIDY Marine Invert. Fauna R. I. and N. J., p. 10. 1855.
" *opalina* VERRILL. Invert. Animals of Vineyard Sound, etc., pp. 342, 594, pl. xiii, figs. 69, 70. 1874.
Arabella opalina VERRILL Proc. Acad. Nat. Sci Phila. for 1878, p. 299.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 242. 1879.

Common at low water in sand and mud, and occasionally dredged, ten to fifteen feet.

STAUROCEPHALUS (*Grube*) *Ehlers.*

GRUBE. Archiv für Naturgesh., p. 97. 1855.
EHLERS. Die Borstenwürmer, p. 422. 1868.

STAUROCEPHALUS PALLIDUS *Verrill.*

VERRILL. Invert. Animals of Vineyard Sound, etc., pp. 348, 595. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 242. 1879.

Only one specimen was found — fifteen feet, sand and shells.

Fam. GLYCERIDÆ.

RHYNCHOBOLUS *Claparède.*

Annélides Chétopodes du Golfe de Naples, p. 492. 1868.

RHYNCHOBOLUS AMERICANUS *Verrill*

Glycera Americana LEIDY. Marine Invert. Fauna R. I. and N. J., p. 15, pl. xi, figs. 49, 50. 1855.
" " EHLERS. Die Borstenwürmer, p. 668, pl. xxiii, figs. 43–46. 1868.
" " GRUBE. Jahres-Bericht der Schles. Gessell. für Vaterlän. Cultur, p. 64. 1869.
Rhynchobolus Americanus VERRILL. Invert. An. Vin. Sound, etc., p. 596, pl. x, figs 45, 46. 1874.
" " " Proc. Acad. Nat. Sci Phila. for 1878, p. 300.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 245. 1879.

Common; low water to fifteen feet.

RHYNCHOBOLUS DIBRANCHIATUS *Verrill.*

Glycera dibranchiata EHLERS. Op. cit., p. 670, pl. xxiv, figs. 1, 10-28. 1868.
" " GRUBE. Op. cit., p. 64. 1869.
Rhynchobolus dibranchiatus VERRILL. Op. cit., p. 596, pl. x, figs. 43, 44. 1874.
" " WEBSTER. Op. cit., p. 245. 1879.

Common; low water to fifteen feet.

GONIADA *Aud and M. Edw.*

Annales des Sciences Naturelles, vol. xxix, p. 266. 1833.

GONIADA SOLITARIA *n. sp.*

PLATE (IV) VII, FIGS. 41, 42. PLATE (V) VIII, FIGS. 43, 44.

Head as long as the first seven segments taken together, acutely conical, with minute antennæ.

Eyes small, black, circular, lateral, posterior.

Proboscis not seen in complete extension, covered with numerous longitudinal series of stout hooks; on the dorsal surface three rows of hooks on either side of a naked median space; on the ventral surface four rows, two on either side of the median line; one lateral series; ventral and lateral hooks smaller than the dorsal; at the base, on the ventral surface, numerous, quite small hooks scattered about irregularly.

The first twenty-five segments are uniramous; the ramus has two lips (fig. 41), anterior long and narrow; posterior short and broad; dorsal and ventral cirri widely divergent, bluntly conical, dorsal a little shorter than ventral. After the twenty-fifth foot a dorsal ramus appears (fig. 42), composed at first of a broad, thick, squarish plate, with a slight emargination near its upper margin, indicating its future division into lips; it contains from three to six straight aciculæ or setæ, usually concealed, sometimes projecting slightly; the dorsal cirrus becomes smaller; the other parts of the foot do not change much; further back the dorsal ramus is divided into two bluntly rounded lobes (fig. 43).

Anal cirri long, filiform.

Setæ of one kind only; in two bundles, upper and lower; upper most numerous; very long and slender; the appendix nearly as long as the stem (fig. 44).

Body slightly convex above, flat below, anterior two-thirds of uniform width, tapering a little along the posterior third.

Color gray, slightly tinged with green.

Length, 25^{mm}; width, 1.3^{mm}.

The only specimen taken was a female filled with eggs; low water, mud.

Fam. THELETHUSIDÆ.

ARENICOLA *Lamarck.*

ARENICOLA ? CRISTATA *Stimpson.*

STIMPSON. Proc. Boston Soc. Nat. Hist., vol. v, p. 114.
QUATREFAGES. Histoire Naturelle des Annelés, vol. iii, p. 673. 1865.

Only the anterior part of a single specimen was found. Probably belongs to Stimpson's species.

Fam. CHLORÆMIDÆ.

TROPHONIA (*Aud. and M. Edw.*) *Claparède.*

CLAPAREDE. Annél. Chét. du Golfe de Naples, p. 105. 1868.

TROPHONIA AFFINIS *Verrill.*

Siphonostomum affine LEIDY. Marine Invert. Fauna R. I. and N. J., p. 16. 1855.
Trophoni affinia VERRILL. Invert. An. Vin. Sound, etc., p. 605, pl. xiv, fig. 75. 1874.

This species is reported from Great Egg Harbor by Leidy, from Block Island and Buzzard's Bay by Verrill. We failed to find it.

Fam. CHÆTOPTERIDÆ.

SPIOCHÆTOPTERUS (*Sars*) *Webster.*

SARS. Fauna Littoralis Norvegiæ. Seconde Livraison, p. 7. 1856.
WEBSTER. Annel Chæt. of the Virginian Coast, p. 246. 1879.

SPIOCHÆTOPTERUS OCULATUS *Webster.*

Annel. Chæt. of the Virginian Coast, p. 247, pl. viii, figs. 98–102. 1879.

Low water, sand; only a few specimens were taken.

Fam. SPIONIDÆ.

NERINE (*Johnston*) *Sars.*

NERINE AGILIS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 600. 1874.

Prof. Verrill reports this species from the outer beach, burrowing in sand at low-water mark. We failed to find it.

SCOLECOLEPIS *Blv.* 1828 (*teste Malmgrem*)

SCOLECOLEPIS VIRIDIS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 600. 1874.

Our specimens do not agree in all respects with Verrill's description, and at first it seemed necessary to refer them to a new species; comparison with specimens received from him has established their identity. Verrill ascribes four eyes to *S. viridis*; our specimens have no eyes, as they were examined in this respect in the fresh state; the alcoholic specimens received from Prof. Verrill have no trace of eyes remaining, whatever their condition may have been while living. We found but one green specimen; the others were dark brown, or dark brown with a reddish or greenish tinge. There are from eight to ten anal papillæ (cirri), subulate, three to four times as long as the anal segment.

On one specimen the head and a few of the anterior segments had been lost and renewed, but the branchiæ were still wanting.

Common in sand at low water.

SCOLECOLEPIS TENUIS *Verrill.*

Invert. Animals of Vineyard Sound, etc., p. 601. 1874.

Reported by Verrill from Great Egg Harbor, in sand at low water. We failed to find it.

SPIO (*O. Fabr.*) *Œrsted.*

ŒRSTED. Annulatorum Danicorum Conspectus, p. 39. 1843.

SPIO SETOSA *Verrill.*

Nerine coniocephala? A. AGASSIZ. Annals Lyceum Nat. Hist. of N. Y., vol. viii, p. 333, pl. x, figs. 39–45. 1866. (See Verrill, op. cit.)

Spio setosa VERRILL. Invert. Animals of Vineyard Sound, etc., p. 602, pl. xiv, fig. 77 (copied from Agassiz).

Verrill says of this species that the lateral lobes of the head are shorter than the median; this is true in alcoholic specimens; the reverse is the case in living forms. Common in sand at low water.

POLYDORA *Bosc.*

Histoire Naturelle des Vers, vol. i. 1802.

POLYDORA HAMATA *Webster.*

Annel. Chæt. of the Virginian Coast, p. 251, pl. viii, figs. 111–116, pl. ix, figs. 117, 118. 1879.

Common, living in galleries in shells. From low water to fifteen feet.

POLYDORA LIGNI *n. sp.*

PLATE (v?), VIII, FIGS. 45–47.

Head deeply emarginate in front, lateral lobes bluntly rounded (fig. 45), pointing forward and outward; lateral margins, in front and back of the eyes, concave; opposite the eyes (middle third) convex; a rounded carina runs back to the middle of the fourth segment; at the front margin of the third segment this carina bears a small conical papilla, always distinct, even on the smallest specimens.

Eyes four, black, circular, placed at the angles of a trapezoid; anterior pair larger than posterior.

Tentacles short, with the usual structure, colorless, without markings.

Dorsal cirri, long and stout on the anterior segments, smaller on those having branchiæ.

Branchiæ begin on seventh segment, long, finger-shaped, colorless, with red center; they are found on all segments after the sixth, except a small but variable number of posterior segments.

Setæ of the fifth segment (fig. 46) eight to twelve in number, stout, apex bluntly rounded and slightly curved; a little below the apex is a small tooth on the side of the seta, forming a very small angle with the seta; dorsal setæ long, capillary, longer behind than in front; ventral setæ (fig. 47) short, bidentate; inner tooth very long, sharp, given off at right angles to the body of the seta; outer half covered by a membrane.

Terminal sucker broad, shallow, white; anal opening surrounded by low papillæ.

Body colorless, except as colored red or brownish-red by the blood and contents of the intestine; on either side of the carina a brown line, diverging in front, and passing to the outer base of the tentacles.

Length, $1-4^{mm}$; segments numerous.

Found on water-soaked wood, living in crevices, etc.

Tubes made of dirt, fragile, constructed with great rapidity.

STREBLOSPIO *n. gen.*

Head conical; proboscis incomplete above, divided below into two lobes along its anterior part. First segment prolonged laterally and below nearly to the front of the head; above carrying one pair of tentacles and one pair of branchiæ. Second segment with raised dorsal membrane, forming a pouch. Dorsal setæ capillary. Ventral setæ of first six segments like the dorsal, afterward both uncinate and capillary. Anal segment simple, without appendages.

STREBLOSPIO BENEDICTI *n. sp.*

PLATE (V), VIII, FIGS. 48–50.

Head, in extension, pointed, conical; posterior half somewhat compressed, sharply convex; anterior half slightly depressed.

Proboscis deficient above, below divided into two lobes for about one-half its length; these lobes are triangular at base, but (in extension) terminate, each in a short, finger-shaped process, covered with numerous long cilia. The first segment is about the length of the following segments, dorsally; at the sides and below it is prolonged, forming a kind of hood for the head. This hood or sheath originates as a thin, almost membraneous elevation of the sides of the segment, just within the dorsal setæ, passes forward external to the bases of the tentacular cirri and branchiæ, is prolonged to near the apex of the head, then curves suddenly downward, presenting a thin, free, anterior margin; laterally it is closely applied to the head, but rises above it, presenting a free, upper margin on each side; the head projects but very little beyond its hood. Dorsally the anterior margin of the first segment is concave, and carries a minute, conical, median papilla or cirrus.

Tentacular cirri (tentacles) have the same structure as in POLYDORA; turned backward they reach to the eighth or ninth segment.

Branchiæ behind and a little within the tentacles; reach back to the seventh or eight segment; widest in the middle, tapering uniformly in both directions, except that near the top they are suddenly constricted, ending in a short cylindrical process; they are flattened below, carinate above, giving a triangular cross section for most of their length; edges thin, and thrown into deep, rounded folds or scollops. Both tentacles and branchiæ are densely covered with long cilia; turned forward they completely cover the head; the setæ of the first segment, both dorsal and ventral, are similar to those of the next five, but are a little shorter.

Second segment, covered dorsally by a raised membrane, forming a pouch; the free anterior margin of this pouch is deeply concave; its elevation above the dorsum equal to the thickness of the body; at the sides it passes into the dorsal cirri (lobes).

Dorsal cirri: back of each fascicle of dorsal setæ, on the first ten segments, is a broad, rounded plate or lobe; back of the tenth segment this plate gradually becomes narrower, until it is changed into a short, conical cirrus, which remains to the end.

Ventral cirri: on the first six segments behind each bunch of ventral setæ is a lobe similar to the dorsal lobe, but smaller; at the seventh segment it disappears.

Dorsal setæ, capillary; those on the anterior segments (fig. 48) wider and shorter than those further back (fig. 49); ten to fifteen in each fascicle in front, gradually decreasing in number till only four or five are found on the posterior segments; they are arranged along the lateral line of the dorsum, and point upward; the ventral setæ of the first six segments are similar to the dorsal, but less numerous, and a little shorter; back of the sixth segment the capillary setæ are nearly replaced by uncinate setæ — a few, however, remaining in the lower part of each series, even to the end; the uncini (fig. 50) are arranged in a single, transverse series, three to five in number, quite short, hardly projecting beyond the surface; they become gradually more numerous, each series having from eight to twelve on the posterior segments, at the same time growing a little longer; they have four terminal teeth, the outer one being shortest (fig. 50), and are covered by a delicate membrane.

Anal segment with slightly thickened, rounded margin; no appendages.

Body slightly convex above, flattened below.

Color: tentacles colorless; branchiæ dark green, with transverse bands of light green or yellowish-green; body colorless or light flesh-color; a few specimens with the first eight segments dark green.

Length of adult, 6^{mm}; width, 0.6^{mm}; number of segments, 70.

Found in great numbers on beds of *Mytilis edulis;* also in ditches to which the tide water had access, very near high-water mark; the only other annelid found under the same circumstances being *Nereis limbata* EHLERS; the first specimen taken was on a shell, dredged. This species lives in dirt tubes, which they leave very readily when disturbed, and move about rapidly with quick, jerking motions of the body; they soon settle to the bottom, and immediately construct a new tube of any loose dirt that may be at hand.

The first part of the generic name is intended to recall their peculiar method of locomotion. The specific name is given in recognition of Mr. James E. Benedict, a sound and enthusiastic naturalist — my associate for the past two years in zoölogical work, who not only discovered the species in New Jersey, but has since found it in South Norwalk, Conn.

Female.

On one specimen the middle third of the dorsum was covered by a very thin, transparent, raised membrane. Unfortunately no figures of the young were made, and the notes are not full. They were broadly rounded in front and behind; sides convex; two small red eyes on the anterior margin of the head; lateral depressions indicating three segments; two circles of cilia, one just back of the head, the other near the posterior end.

Fam. ARICIIDÆ.

ANTHOSTOMA *Schmarda.*

Neue Wirbellose Thiere, vol. 1, part ii, p. 61. 1861.

ANTHOSTOMA FRAGILE *Verrill.*

VERRILL. Invert. Animals of Vineyard Sound, etc., p. 598. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 258. 1879.

The branchiæ may begin on any segment from the thirteenth to the twenty-first, according to the size of the specimen.

Common in sand at low water.

Fam. CIRRATULIDÆ.

CIRRATULUS *Lamarck.*

Hist. Nat. des Animaux sans Vertebres, vol. v, p. 300. 1838.

CIRRATULUS GRANDIS *Verrill.*

VERRILL. Invert. An. Vin. Sound, etc., p. 606, pl. xv, figs. 80, 81. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 258. 1879.

Rare; only one specimen was taken.

CIRRHINEREIS *Quatrefages.*

Histoire Naturelle des Annelés, vol. i, p. 462. 165.

CIRRHINEREIS FRAGILIS *Qtrfg.*

Cirrhatulus fragilis LEIDY. Marine Invert. Fauna R. I. and N. J., p. 15, pl. xi, figs. 39–43. 1555.
Cirrhinereis fragilis QUATREFAGES. Op. cit., vol. i, p. 464. 1865.
" " VERRILL. Op. cit., p. 607. 1874.

Rare; a single injured specimen was found which probably belongs to this species.

Fam. CAPITELLIDÆ.

NOTOMASTUS *Sars.*

Reise i Lofoten og Finmarken, p. 199. 1850
Fauna Littoralis Norwegiæ, p. 12. 1856.

I have referred the following species to NOTOMASTUS *Sars*, although somewhat in doubt as to what constitutes a NOTOMASTUS. The following species of this genus and of the allied or identical genus ANCISTRIA have been reported from our coast: *Notomastus luridus* VERRILL, *Notomastus filiformis* VERRILL, *Ancistria acuta* VERRILL, *Ancistria capillaris* VERRILL and *Ancistria minima* QUATREFAGES (reported by Webster). It is quite certain that these five species belong to the same genus, but to what genus? Certainly to ANCISTRIA *Quatr.*, if it is a good genus. But Claparède says that ANCISTRIA is a synonym of CAPITELLA. But so far no one has seen the peculiar male sexual organs and setæ upon which so much stress is laid as characteristic of CAPITELLA. Prof. Verrill writes that he has never found them; I have never let a specimen pass without looking for these organs, but to no purpose. Accordingly, while our specimens belong to ANCISTRIA, they do not belong to CAPITELLA. It will be noticed that two of our species have been referred to NOTOMASTUS; and in fact they cannot be said to differ from NOTOMASTUS except in the length, and number of setæ, of the ventral rami. But Claparède speaking of the "tores hamifères ventraux," says (Glanures, p. 58): "Le développement extraordinaire des tores ventraux du côté dorsal est même le caractère essentiel des Notomastus," according to which dictum not one of our species is a NOTOMASTUS, as they have not the elongated ventral rami and numerous setæ of the type species, *Notomastus latericeus* SARS. In regard to ARENIA *Quatr.*, Claparède (Annel. Chét. du Golfe de N., p. 18) claims that is a NOTOMASTUS, and that the type species, *A. cruenta* QUATR., is *Capitella* (*Notomastus*) *rubicunda* KEFERSTEIN. In this case one must believe that Quatrefages entirely mistook the character of the posterior dorsal setæ, since he describes and figures them as capillary.

NOTOMASTUS FILIFORMIS *Verrill.**

PLATE (V), VIII, FIGS. 51–54.

Invert. An. Vin. Sound, etc., p. 611. 1874.

Head very small, pointed, conical.

Proboscis apparently smooth; when magnified seen to be covered with minute papillæ.

First five setigerous segments with capillary setæ in both rami, not differing from each other, arranged in each ramus in a single transverse series, containing from eight to twelve setæ. After the fifth segment uncini only are found. At first the uncini are quite

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* I regarded this as a new species, and gave it the specific name of *lævis;* but on submitting specimens of the same form, taken at Provincetown, Mass., to Prof. Verrill, he referred them to his *N. filiformis.*

long (fig. 51), but few in the dorsal rami, from eight to twelve in the ventral; they grow progressively shorter backward (figs. 52, 53), and along the posterior third their number is much reduced, there being one to three in the dorsal rami, three to five in the ventral; a few of the posterior segments may be without setæ. The form of the uncini changes, as shown in the figures.

The anterior segments are biannulate, afterward crossed by from three to five deeply impressed lines.

The anal segment is obliquely truncated; margin thickened and rounded (fig. 54); from its lower border projects a finger-shaped cirrus, which is distinctly annulated. (A similar cirrus exists on *N. luridus* Verr., *Ancistria minima* Quatr., and on several as yet unpublished species from Beaufort, N. C. I do not know that this cirrus has been previously described as belonging to this genus, or to any in the family.)

Color: red to purplish-red in front; flesh-color to bright red behind.

Length very variable; greatest diameter of largest specimen 1.2^{mm}.

Common; low water to fifteen feet.

Notomastus luridus *Verrill.*

Invert. An. of. Vin. Sound, etc., p. 610. 1874.

Rare; only one specimen was taken.

Young forms of Notomastus?

(a). One specimen, evidently immature, had capillary setæ only on the first four segments, then uncini only; but about the middle of the body the dorsal uncini were replaced by capillary setæ. Posterior segments lost.

(b). Another form, of which several specimens were found, had capillary setæ in all the dorsal rami, uncini in all the ventral. Length of (a) and (b) 10–20^{mm}.

Found in shells bored by sponge; low water to fifteen feet.

Fam. MALDANIDÆ.

CLYMENELLA *Verrill.*

Invert. Animals of Vineyard Sound, p. 607. 1874.

Clymenella torquata *Verrill.*

Clymene torquata Leidy. Marine Invert. Fauna R. I. and N. J., p. 14. 1855.
Clymenella torquata Verrill. Op. Cit., p. 608, pl. xiv, figs. 71–73. 1874.
" " Webster. Annel. Chæt. of the Vir. Coast, p. 258. 1879.

Very common in sand at low water.

MALDANE (*Grube*) *Malmgren.*

Grube. Archiv für Naturgeschichte. 1860.
Malmgren. Nordiska Hafs-Annulater, p. 186. 1865.

MALDANE ELONGATA *Verrill.*

VERRILL. Invert. Animals of Vineyard Sound, etc., p. 609. 1874.
WEBSTER. Annel. Chæt. of the Virginian Coast, p. 259. 1879.

Rare; only one specimen was taken.

PRAXILLA *Malmgren.*

Nordiska Hafs-Annulater, p. 191. 1865.

In characterizing the genus PRAXILLA Malmgren assigns to it twenty-six segments, of which nineteen are setigerous, and five ante-anal without setæ. The following species belongs to Praxilla in all other respects, but has more than twenty-six segments, and less than five nude ante-anal segments.

PRAXILLA ELONGATA *n. sp.*

PLATE (VI), IX, FIGS. 55–59.

Buccal segment (fig. 55) with a projecting margin, slightly emarginate in the middle line above, and with a very narrow, hardly perceptible incision on each side, a little back of the middle. The cephalic plate has a well-defined, median carina, widest in front, and with a battened, slightly projecting portion, broadly rounded at the apex.

After the fifth segment the diameter increases gradually to the tenth; remains unchanged to the thirteenth; decreases gradually to the sixteenth; then falls off suddenly to about one-half the previous diameter, after which it remains unchanged.

Segments one, two, four, five and six have about the same length; three, seven, eight and nine are a little longer than the preceding; ten to fifteen about double the ninth; sixteen to thirty-six a little shorter than the fifteenth; last three equal to each other—together equal to the thirty-sixth (fig. 56).

The anterior margin of the fifth segment is raised and rounded, embracing the posterior end of the fourth. The first fifteen segments are nearly cylindrical, segmentation distinct, and crossed by numerous impressed lines; after the fifteenth the form suddenly changes, the anterior end being narrow, diameter increasing regularly to near the posterior end, then somewhat suddenly decreasing; the posterior margin of the ante-anal segment is raised, rounded, forming a sheath for the anterior end of the anal segment.

The anal segment is funnel-shaped; margin surrounded by a circle of conical or finger-shaped papillæ; very similar to the anal segment of *Clymenella torquata* VERRILL.

Setæ; dorsal (capillary) numerous, long, delicate, bilimbate (fig. 57); after the fifth segment there is a distinct, rounded papilla, or dorsal ramus, from which the setæ arise; ventral (uncini), on the first three setigerous segments only one, or occasionally two, to each ramus; these end in three sharp teeth (fig. 58), of which two are very small; along the inner two-thirds are numerous longitudinal striæ, interrupted by transverse striæ, unequally distant from each other; at the fourth setigerous segment the number of uncini increases suddenly to ten or fifteen in each series, and the form also changes (fig. 59); they have now five terminal teeth, a short, external part is quite narrow, and divided from the stouter, internal part by a deep constriction, simulating a compound seta; the thirty-seventh segment has only the dorsal setæ; to the tenth segment the setæ are found in the middle of each segment; after the tenth they suddenly recede to near the posterior end.

Three specimens were collected — one perfect, the others with anterior part only; and of these only one, having the ten anterior segments, was observed while living; its general color was yellowish-white, with narrow, red bands on the posterior part of each segment after the fourth, increasing gradually in width so as to occupy one-half the length of the tenth segment; indications of similar bands can be traced on the entire specimen, in alcohol, but not after the tenth segment.

Length of entire specimen, 95^{mm}; greatest diameter, 3^{mm}; diameter of buccal segment, 2^{mm}.

Number of segments, 39; buccal (coalesced with the cephalic), 1; setigerous, 36; ante-anal, nude, 1; anal, 1.

Rare; found in sand at low water, associated with *Clymenella torquata* Verrill.

Praxilla elongata *var.* Benedicti *Webs.*

plate (vi), ix, figs. 60, 61.

Mr. J. E. Benedict found at South Norwalk, Conn., a variety of this species, differing from the form just described in the following particulars:

First two segments short (fig. 60), together about equal to the third; after the fifteenth segment the diameter suddenly becomes less, segments short, and, except the last four, equal. (Compare the first segment of fig. 61 with the first of fig. 56.) The ante-anal segments (fig 61), quite short, together equal to the anal; anal cirri longer than in the New Jersey form.

Length of an entire specimen, 20^{mm}; number of segments, 37.

A young specimen had twenty-six segments, with a length of 3^{mm}.

PARAXIOTHEA *n. gen.*

No cephalic plate.

Anterior margin of first segment prolonged as a thin membrane, emarginate above, and with a slightly projecting conical process in the middle line below.

Mouth situated on the lower surface of a conical process, arising from the bottom of the cylindrical cavity inclosed by the frontal membrane, not reaching to the front margin of the membrane. First segment with capillary and uncinate setæ, similar to those on the remaining segments.

Anal segment funnel-shaped; margin digitate.

PARAXIOTHEA LATENS *n. sp.*

LATE (VI), X, FIGS. 62–66.

Frontal membrane (figs. 62, 63) forming one-half the length of the first segment; anterior margin slightly reflexed, lobed or scolloped by shallow incisions, which are continued as impressed lines for some distance, on both the outer and inner surface of the membrane; superior emargination broad but shallow.

First segment a little longer than the second, about equal to the sixth; second, third and fourth equal; fifth a little shorter; segments six to ten grow progressively longer, but so gradually that the change is hardly perceptible; eleven to thirteen also gain in length progressively, but rapidly, the thirteenth having double the length of the tenth; fourteenth, fifteenth and sixteenth about equal to the tenth; seventeenth and eighteenth short, equal, together about equal to the sixteenth, a trifle longer than the anal.

Diameter of first segment a little less than that of the second; uniform from second to tenth inclusive; falling off about one-third at the eleventh, after which the decrease is very slight.

One ante-anal nude segment (fig. 64) with thickened, rounded, posterior margin, forming a collar around the front end of the anal segment.

Anal segment with numerous, short, unequal cirri or digitations, quite similar to *Clymenella torquata* VERRILL, or *Praxilla elongata* WEBSTER.

The dorsal (capillary) setæ (fig. 65) are long, delicate, numerous, with a single thin margin. The uncini have the same form on all the segments (fig. 66); they have five sharp terminal teeth, of which three are small and equal; the fourth longer and larger than the third; the fifth double the size of the fourth. On the first three segments there are from fifteen to twenty uncini in each series; after the third, from twenty to twenty-five, except on a few of the posterior segments, where there is a smaller number. The first five segments have the setæ on the middle line, and a deeply impressed ventral line connects the series of uncini on each segment. After the fifth segment the setæ are near the posterior end, and after the tenth the dorsal rami (*tori uncinigeri*) are quite large, making the segments somewhat club-shaped.

Number of segments, 19; of these 17 are setigerous; one ante-anal, nude; one anal.

Color (in alcohol) yellowish-white; on one specimen broad bands of umber-brown cross the ventral surface, dividing at the uncini, giving a narrow band on each side of each series of uncini after the fifth.

At Great Egg Harbor we obtained two specimens, both of which had lost their posterior segments. The longest has fifteen segments, with a length of 65^{mm}; greatest diameter, 3^{mm}. The description was completed from a single perfect specimen, collected by Mr. James E. Benedict of South Norwalk, Conn., during the same summer.

Length of entire specimen, 46^{mm}; greatest diameter, 3^{mm}.

Found at low water, in sand, associated with *Clymenella torquata* VERRILL.

Fam. HERMELLIDÆ.

SABELLARIA *Lamarck.*

SABELLARIA VARIANS *Webster.*

Annel. Chæt. of the Virginian Coast, p. 259, pl. ix, figs. 133–136; pl. x, figs. 137–139. 1879.

Prof. Verrill has described a species of SABELLARIA (*S. vulgaris*) from Great Egg Harbor, and in the proceedings of the Academy Natural Sciences of Phila., for 1878, p. 300, mentions that he has also received the same form from Beaufort, N. C. After careful comparison of numerous specimens from New Jersey, Virginia, and North Carolina, I have found it impossible to refer any of them to his species. It will be necessary to compare type specimens of the two forms.

Fam. AMPHICTENIDÆ.

CISTENIDES *Malmgren.*

Nordiska Hafs-Annulater, p. 358. 1865.

CISTENIDES GOULDII *Verrill.*

Pectinaria Belgica GOULD. Invertebrata of Mass., 1st ed., p. 7, pl. i, fig. 1. 1841.
Pectinaria ouricoma LEIDY. Marine Invert. Fauna R. I. and N. J., p. 14. 1855.
Cistenides Gouldii VERRILL. Invert. An. of Vineyard Sound, etc., p. 612, pl. xvii, figs. 87, 87a. 1874.

Common at low water. One very large specimen was taken; length, 50^{mm}; diameter, 9^{mm}; length of tube, 80^{mm}. The color of all our specimens was yellowish-white, save as colored red by the blood showing through.

Fam. AMPHARETIDÆ.

SABELLIDES (*M. Edw.*) *Malmgren.*

The following species agree with SABELLIDES *Mgrn.*, except that the uncini begin on the third setigerous segment instead of the fourth, and that the first ramus, though smaller than the second, is not very small.

SABELLIDES OCULATA *n. sp.*

PLATE (VII), X, FIGS. 67–69.

On the middle line of the head two minute eye specks, black, lateral.

Cirri numerous, light flesh-color.

Anal cirri short, obtuse.

Branchiæ delicate, reaching back to the ninth or tenth segment.

Capillary setæ, some (fig. 67), with a single, narrow margin; others (fig. 68) bilimbate. Uncini begin on the third setigerous segment; fourteen posterior segments with uncini only; they have five sharp teeth (fig. 69).

Branchiæ green with dark green center; head white; body flesh-color.

Length, 18–20^{mm}.

Dredged, fifteen feet, shelly bottom.

Fam. TEREBELLIDÆ.

AMPHITRITE (*Müller*) *Malmgren.*

MALMGREN. Nordiska Hafs-Annulater, p. 364. 1865.

AMPHITRITE ORNATA *Verrill.*

Terebella ornata LEIDY. Marine Invert. Fauna, R. I. and N. J., p. 14, pl. xi, figs. 44, 45. 1855.
Amphitrite ornata VERRILL. Invert. An. Vin. Sound, p. 613, pl. xvi, fig. 82. 1874.
" " WEBSTER. Annel. Chæt. of the Virginian Coast, p. 262. 1879.

Very abundant at low water; sand and mud.

SCIONOPSIS *Verrill.*

Invert. Animals of Vineyard Sound, p. 614. 1874.

SCIONOPSIS PALMATA *Verrill.*

VERRILL. Op. cit., p. 614. 1874.
WEBSTER. Op. cit., p. 262. 1879.

Common; dredged ten to fifteen feet.

POLYCIRRUS (*Grube*) *Malmgren.*

MALMGREN. Nordiska Hafs-Annulater, p. 393. 1865.

POLYCIRRUS EXIMIUS *Verrill.*

Torquea eximea LEIDY. Marine Invert. Fauna of R. I. and N. J., p. 14, pl. xi, figs. 51, 52. 1855.
Polycirrus eximius VERRILL. Invert. An. Vin. Sound, p. 616, pl. xvi, fig. 85. 1874.
" " WEBSTER. Annel. Chæt. of the Vir. Coast, p. 263. 1879.

Common on shells, etc.; dredged.

Fam. SABELLIDÆ.

SABELLA (*L.*) *Malmgren.*

MALMGREN. Nordiska Hafs-Annulater, p. 398. 1865.

SABELLA MICROPHTHALMA *Verrill.*

VERRILL. Op. cit., p. 618. 1874.
WEBSTER. Op. cit., p. 265. 1879.

Quite common.

Fam. SERPULIDÆ.

HYDROIDES *Gunnerus.* (1768.)

Hydroides dianthus *Verrill.*

Serpula dianthus Verrill. Op. cit., p. 620. 1874.
Hydroides dianthus Verrill. Proc. Acad. Nat. Sci., Phila. for 1878, p. 300.
" " Webster. Annel. Chæt. of the Vir. Coast, p. 266. 1879.

Common on rocks and shells, from low water to fifteen feet.

Union College, Schenectady, N. Y.,
December, 1878.

NOTE ON SOME OBSCURE ORGANISMS IN THE ROOFING SLATES OF WASHINGTON COUNTY, NEW YORK.

By James Hall.

For some years there has been in the State Museum several specimens of roofing slate from Middle Granville, Washington county, N. Y., showing what have been considered as obscure plant or graptolitic markings. They were presented by Rev. J. E. Baker, of Rochester, and were placed upon exhibition among the fossils of the Quebec group. Two of the specimens are of such remarkable form, and since organic remains are so unusual in the slates of this locality, it seems desirable to make some published record of them.

The smallest specimen measures 70^{mm} across, and shows six ovate peripheral expansions, with short stalks, radiating from a small central disc. The larger specimen has a diameter of nearly 130^{mm} and differs from the preceding not only in size, but in the length of the foot stalks of the leaf-like expansions, which are from 10 to 20^{mm} long.

The peripheral expansions or bodies, preserve more carbonaceous matter than the stalks or the central disc, and would appear to indicate that they were of firmer (possibly chitinous) texture and contained more organic matter.

The distal ends of the expansions show a dark spot surrounded by light and dark concentric bands, such as would be preserved if the body had been a bulb open at the end, or contained a large vesicle.

It is difficult to determine the true biological position of these obscure specimens. They differ in their mode of growth from the compound fronds of graptolites, such as Graptolithus, Retiograptus, Loganograptus or Phyllograptus, in having six rays to the frond, while in those genera the multiplication of the branches is by regular dichotomy or is four rayed as in Phyllograptus.

Associated with these organisms are fragments of other organisms which have all the appearance of undoubted plant remains (described as *Facoides flexuosa*, by Emmons) and from the absence of characteristic graptolites in the shales, it would seem to warrant the conclusion that these radiate specimens are not of graptolitic origin, but are referable to the sponges or possibly the marine algae.

The name *Dactyloidites bulbosus* is proposed for these fossils. See plate 11, figs. 1, 2.

A SPIRAL BIVALVE SHELL FROM THE WAVERLY GROUP OF PENNSYLVANIA.

By Charles E. Beecher.

The eastern development of the Waverly group, has not been as extensively examined by palæontologists, as its importance would seem to warrant, from its being the lowest member of the Carboniferous series. This has arisen principally from the fact, that the rocks of the group become much attenuated east of the State of Ohio, and are also covered and obscured by the mass of overlying strata of the lower coal measures. Their close lithological resemblance to the underlying and greatly developed Chemung series, has, in addition, rendered the group comparatively inconspicuous.

The fauna of this attenuated Waverly series in north-western Pennsylvania is, however, not commensurable with the thickness of the strata. In the section of the rocks at Warren, and the list of Waverly fossils at that locality, published in Proc. Am. Ass. Ad. Sci., vol. 33, pp. 2-4, this disparagement is very evident. And it will be noticed that the number of species is as large as from any locality where the Waverly group forms a conspicuous physical feature of the country.

The Waverly deposits in Warren county, Pennsylvania, show many evidences of having been formed not far from the shore-line. This condition is indicated by the numerous mud furrows, land plants and the drifted and worn shells. The interpolation of an extensive bed of conglomerate, further shows that the sea-bottom was not in a condition of repose. After the deposition of the conglomerate and the return of the previous physical conditions, nearly the same fauna returned and persisted to the base of the great Carboniferous conglomerate. A region subject to these profound changes in the nature of the sediments, and to various oscillations of the sea-bottom, would be expected to furnish many interesting faunal forms. The same varying conditions are also present in the Chemung group of this region; and these two series of strata, the Chemung and Waverly groups, present the palæontologist with many species not yet observed elsewhere, and also with several truly remarkable forms of life, among which may be mentioned the *Spiraxis Randalli* of Newberry. But few of these have as yet received descriptive and illustrative notice, and others remain as yet undescribed.

The subject of the present paper may well be included in the list of mirable forms from this region. Failing to find any publication of allied species in the literature on the lamellibranchiata, I am induced to present the only species known to me, and to refer it to a new genus.

SPIRODOMUS, N. G.

[σπεῖρα, *spira*; δέμω, *domus*.]

SPIRODOMUS INSIGNIS, *n. sp.*

Plate 12, figs. 1–5.

Description.— Shell cylindrical, longitudinally spiral or twisted, the margins making nearly a complete volution; length nearly three times the breadth. Ventral margin entire, curved. Dorsal margin of the same curvature as the ventral border. Hinge-line extremely short or obsolete.

Valves compressed posteriorly, gibbous along the middle and anterior portions. The transverse section of the two valves in position, in the middle of their length, is broadly elliptical. The greatest depth of both valves is in the anterior third.

Beaks terminal, small and appressed, situated in the middle of the anterior end. Umbo not prominent.

Test thin. Surface marked by very fine striæ of growth. Ventral and dorsal margins strongly crenulate, produced into a thin reflexed expansion. Posterior margin simple, slightly bent.

The cast of the interior is marked by a small, distinct pit or depression at the anterior extremity, and just below is, apparently, a small muscular scar (*vide* fig. 4). At this point the pallial line originates and extends parallel to the ventral margin, to the lower third of the posterior extremity, terminating in a small muscular scar. The upper part of the posterior muscular impression, in the cast, is marked by two or three nodes, from which a low rounded ridge extends anteriorly about one-third the length of the shell and then becomes merged into the general convexity of the valve. This ridge was probably produced in the recession of the muscular scar consequent on the growth of the shell.

A specimen of medium size has a length of about 82^{mm}; greatest breadth of the cast 30^{mm}; breadth of posterior end 21^{mm}; greatest depth of both valves as conjoined 19^{mm}; and the width at this point is 24^{mm}.

Having but a single species at this time, the generic characters are necessarily included in the specific description. The features of the most general importance are: The equivalve, elongate spiral form; the terminal beaks; the absence of a proper hinge-line, and the muscular impressions situated at the two extremities of the valves.

I know of no recent or fossil genus with which this shell may be satisfactorily compared. A somewhat similar form could be produced, in imagination, by twisting a solen, so that the ventral and dorsal margins formed a complete turn of a spiral; but the beaks are in the middle of the anterior extremity, and other characters are incompatible with a solenoid shell. Its form suggests Parallelopipedum, but it is evidently not an Arca. In its reflexed and minutely plicate margins and absence of proper hinge, it resembles some forms of Pholas, and, in addition, its spiral form is strongly indicative of a burrowing habit. Further, the small mass of rock containing the specimens of *S. insignis*, preserves the remains of several individuals, showing that they were gregarious after the manner of other burrowing shells.

The twisted form of the shell and the position of the muscular scars precluded any considerable opening of the valves by the animal; and the shape of the anterior end shows that there could have been no well-developed foot for locomotion. Taking all these features into consideration, it seems evident that in this genus, we have a farther addition to the interesting group of boring mollusca.

EXPLANATION OF PLATE 12.

Spirodomus insignis, Beecher.

Page 162.

Fig. 1. A transverse section, taken from about 45mm from the anterior end of a specimen.

Fig. 2. A transverse section, posterior to the middle of the specimen fig. 4.

Fig. 3. *Id.* Section of the conjoined valves, at about the posterior quarter of their length.

Fig. 4. *Id.* Ventral aspect of a specimen, which is a partial cast of the interior, showing the form of the shell, the muscular scars, pallial line and crenulated margins.

Fig. 5. *Id.* The left side of the embedded specimen in the rock, showing the expanded crenulate margins of the valves and the pallial line. Waverly group. *Warren, Pennsylvania.*

REPORT ON GEOLOGY.

Prof. JAMES HALL, *Director of the State Museum of Natural History and State Geologist of New York:*

SIR — In conformity with your letter of instructions to me, of date August 4, 1885, respecting the field work of the year, I began work in Dutchess county August 19th. It was continued with some interruptions (amounting in the aggregate to one month) to December 5, 1885.

The first part of my survey was a hurried reconnaissance across Westchester and in the eastern part of Dutchess county; and a section across the Mount Washington range, Massachusetts and eastward into northern Connecticut as far as Norfolk in that State.

The work of tracing the outlines of what were recognized as Archæan rocks was then taken up and the geological boundaries of the Stissing mountain range; of the East or Dover mountain range; and then, of the Highlands east of the Hudson were followed and located.

The relations of the bordering or over-lapping formations of Potsdam sandstone, of blue, magnesian limestone, of Hudson river slate, and of the mica schists and quartzytes on the east and south-east of the Highlands were ascertained, as far as could be done from their respective outcrops.

A few sections across the Archæan outcrop were traversed and the position of the strata noted.

Collections of the crystalline rocks and from the newer adjacent, sedimentary strata were made incidentally while at work on the geological map. About 500 specimens (many very small, however, and not cabinet specimens) were collected from 380 localities.

The general results of this reconnaissance are presented in the following report.

JOHN C. SMOCK.

NEW YORK STATE MUSEUM, ALBANY, N. Y., *Jan.* 13, 1886.

REPORT.

A GEOLOGICAL RECONNAISSANCE IN THE CRYSTALLINE ROCK REGION, DUTCHESS, PUTNAM AND WESTCHESTER COUNTIES, NEW YORK.

The country covered by the reconnaissance described in this report occupies the eastern and south-eastern portions of Dutchess county, the whole of Putnam county and the northern and middle parts of Westchester county. The territory is very naturally divided into the following four parts or belts:

1. Stissing Mountain.
2. East or Dover Mountain.
3. Highlands east of the Hudson River.
4. Westchester County.

The report consists of general and detailed descriptions of the limits of the Archæan rocks in the first, second and third of these divisions; secondly, of notes on the geological structure, so far as the data collected lead us to infer it; and, thirdly, descriptions of the characteristic rocks of the several belts. Following these descriptions are references to published articles on the geology of each belt; and, lastly, a brief statement about the geological age of these crystalline rocks.

The *analysis* shows:

I. Stissing mountain.
   1. Geographical location and height.
   2. Geological boundaries.
   3. Structure.
   4. Descriptions of rocks.

II. East or Dover mountain.
   1. Geographical situation and height.
   2. Outlines of gneissic rocks.
   3. Structure.
   4. Rocks.

III. Highlands of the Hudson.
   1. Geography and topography [notes].
   2. Limits of the Archæan rocks.
   3. Notes on geological structure.
   4. Structure.
   5. Notes on typical rocks.
   6. References to literature on Highlands.
   7. Geological horizon — Archæan.

IV. Westchester county.

I. STISSING MOUNTAIN.

The isolated and prominent ridge, known as Stissing mountain, is in the towns of Pine Plains and Stanford, Dutchess county. A depression near the north end separates it into what are termed locally as "Big Stissing" and "Little Stissing." The whole length is four and a half miles, and the trend of the ridge is north 20° east. The northern point of the ridge is near the Pine Plains and Mount Ross road; the southern end is about a half a mile north-east of old Attlebury, and not quite one mile west-north-west of Stissing Junction. The eastern side is steep, with vertical cliffs in places; the western slope is more gentle and having a more nearly uniform angle of descent. On the east the mountain is bordered by the Pine Plains; on the west and north is the gently-rolling slate and blue limestone country, but largely drift-covered. The average breadth of the mountain varies between one-half and three-quarters of a mile, that is from the border of the plains to the newer rocks at the west foot.

According to repeated observations with an aneroid barometer the highest point of the range, near the depression and west of Stissing lake or Thompson's pond, is 900 feet above the general level of Pine Plains and 1,400 feet above tide. Little Stissing rises to a height of 550 feet above the plains. To the south-south-west the ridge lowers gradually and east of Miller pond it is only 950 feet high. The most southern outcrops of the gneissic rock are not more than 100 feet above the plains' level, equivalent to a descent of 800 feet in three miles.

The surface of this mountain range is so rocky that its cultivation in farms has scarcely been attempted, excepting a very limited area on the western slope, in the gap between Big Stissing and Little Stissing. And the limits of the cleared farm lands follow very closely the foot of the mountain and the geological boundaries.

The extent of the gneissic or crystalline rock outcrops, which make up this mountain mass, outlined above in general, may be described in detail, as follows: Beginning on the north about a half a mile south of Keller's Corner, on the Pine plains and Mount Ross road, the eastern boundary line runs a south-south-west course, to the west of Mud pond, separating the gneiss from the argillyte, nearly to the depression or gap. Thence on the same general course it runs at the foot of the mountain and at the border of the Plains, from an eighth to a quarter of a mile west of the lakes. Here the drift formation of the plains lies upon the foot of the mountain. South of the lakes a greyish white quartzite makes its appearance and borders the gneiss in low lying ledges nearly the whole distance to the south-west end of the Stissing mountain belt or range of crystalline rocks. These outcrops of quartzite were seen in close proximity to gneisses at several points along this south-eastern part of the range. Their diverse dips indicate unconformability.* From the southern point of the gneissic

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* Mather refers to the quartzite at the south-west side of Mount Stissing in his chapter on "Taconic System" and calls it a "granular quartz" and Potsdam sandstone. *Natural History of New York, Geology of First District*, pp. 418, 423, 436–437.

This quartzite has been examined by Prof. Wm. B. Dwight of Poughkeepsie, who says (in a letter recently received), that he has failed to discover any organisms in it.

Lithologically it resembles the Fishkill and Poughquag quartzites, which have been called Potsdam.

rocks the bounding line between them and the quartzite beds on the south-west and west follows a quite marked hollow in the surface first in a north-west and then in a more northerly direction to Miller pond. This depression is, in places, a few rods only in width, bordered on the one side by the gneiss, and on the other by the quartzite. Miller pond occupies the depression between the mountain and the blue limestone and slate hills. North of it the quartzite was not observed, the adjacent formation being blue limestone near the pond and slate to the north. The outcrops of the limestone are comparatively small; the slate forms a bold and rocky ridge on the west and north-west of the Little Stissing part of the range. From Miller pond to the north end of the mountain the limit of the gneissic outcrop may be said to be about three-quarters of a mile east of the main road from Old Attlebury to Mount Ross. At the north there is a rather deep depression between the two formations and it is traceable around to the north-east end of the gneiss. A wood road follows it for some distance north from the gap, east of the Simmons farm-house. Excepting near Miller pond the newer formations of slate and limestone are not seen on this western side of the mountain close enough to the gneisses to enable us to make out their relative position. South of the Simmons place and north of Miller pond there is a narrow outcrop of the blue limestone whose beds dip steeply to the north-west and within sixty feet of gneissic strata, having a steep dip also, but more to the west-north-west. Nearer the pond and to the south of this locality the blue limestone forms low ridges at the foot of the mountain and all the strata stand nearly on edge, dipping in a general north-west direction. A more interesting locality, and where there is an approximation to contact phenomena, is a half a mile south of Miller pond. At this place the gneiss (a feldspathic variety) crops out within ten feet of the grey quartzite and conglomerate. The dip of the former is 80° north 80° west (mag.) and that of the latter is the same, showing conformability. But one mile to the south and near the south end of the mountain the quartzitic rocks and the siliceous conglomerate crop out near the gneiss and their beds dip only about 10° westerly, whereas the gneiss stands vertically and with a nearly due north strike. The quartzite outcrop on the south-east and toward Stissing Junction is marked by a more nearly horizontal position of its beds. The quartzite outcrops on the east, near J. A. Thompson's place, have a gentle west-north-west dip, the strata passing under a blue limestone and a red shaly rock lying between them and the gneiss of the mountain slope. The observed phenomena of the closer outcrops of gneiss and these limestones and quartzites appear to prove a want of conformability between them.

From the observations made of dips near the foot of the mountain and on three cross-section lines, the inference is drawn that there are close folds whose axes have a general north-east and south-west direction, and are oblique to the trend of the mountain. The northern point of one of these anticlinal folds was seen one-quarter of a mile south-south-west of J. A. Thompson's residence, and at the eastern base of the mountain. The pitch or angle of inclination was 40° to the north-east, or a little north of north-east. The observed dips ranged from 50° to the east-south-east to 80° north 80° west. In Little Stissing the structure, as indicated by the dips observed, is anticlinal, the strata on the north-west slope and on the crest dipping steeply to the north-west; on the south, to the east-south-east. On the section over Big Stissing the dips are to the north-west from the crest down the western slope, and to the east-south-east on the east and steeper slope. The same change in the direction is to be seen crossing the mountain on a west-south-west course from J. A. Thompson's place, one mile south of Stissing lake. The predominant strike is to the north-north-east and the average inclination is 70° to 75° — ranging, in the observed cases, from 60° to vertical. But a much more detailed survey of the surface is needed to ascertain the position of the outcropping strata and to bring out the lines of folding and faulting and the general structure of this isolated range of crystalline rocks.

The prevailing types of crystalline rocks in Stissing mountain are gneisses, granites, granulyte and syenite. The most common variety of gneiss is a moderately fine crystalline aggregate of orthoclase, translucent quartz and muscovite. The feldspar is white to flesh-colored, and with facets up to $\frac{1}{32}$ inch; the quartz is glassy to milk-white and apparently filling in the spaces between the feldspar; the mica is in fine white to brown scales, which are disposed generally in lines or thin laminæ through the rock mass. A black mica (biotite?) is found accompanying the muscovite in nearly all of the gneisses. And it might be termed a biotite-muscovite gneiss. The varying proportions of these constituents make up an almost endless gradation — from feldspathic to quartzose and micaceous gneisses. So far as macroscopic observations go there appears to be a predominance of monoclinic feldspars, although the triclinic were detected in some of the specimens studied.

Granulyte and pegmatyte occur, but are much less common than the gneisses. The former has generally a very slight percentage of mica in it. Granite and syenite also are to be seen, but confined to small outcrops, some of which are, probably, intrusive, cutting across the bedded gneisses.

In places the presence of a large percentage of mica gives the rock a schistose appearance. And these micaceous gneisses alternate irregularly, and are interbedded with the more feldspathic and granulyte strata; or, they are confined to narrow belts or bands in the more common gneiss. They are thinner bedded also, and the stratification is more distinctly marked in them by both the arrangement of their constituent minerals and the planes of bedding. The grey, feldspathic gneiss occurs usually in thick beds, and often the stratification is recognized by the lines of minerals only. But there are comparatively limited areas of the unstratified or massive rocks, or those in which the bedding cannot be seen. No attempt was made in this survey of the range to define the limits of these areas of indistinctly-bedded and massive rocks.

The Stissing mountain gneisses and associated crystalline rocks resemble closely those of the Highlands of the Hudson. Although identification of age based upon lithological resemblances is not as satisfactory evidence as that from palæontological characters, still the relation to the overlying quartzite, the similar structure and the general *facies* of the whole appear to justify us in assigning them to the same geological age. Stissing mountain may, therefore, be considered as the most northern outcrop of Archæan rocks in the south-eastern part of the State and as an island in the newer and Palæozoic rock formations.*

II. East or [Dover] Mountain.

The mountain bordering the valley of Amenia and Dover Plains, in Dutchess county on the east, is generally known as the East mountain. East and south-east of South Amenia the more prominent peaks are known as "Peaked hill," and the "Cobble," the latter of which is just over the line in Connecticut. The designation of *Dover mountain* would appear to be more appropriate and definite, as this range is the highest and most characteristic of the ridges in the town of Dover. The north-eastern part is in Amenia, and it is a continuation of the Sharon-Cornwall range.† The south-western end is marked by the valley of the Webotuck. The part of the range embraced within the State is only about nine miles long, from the Connecticut line, east-north-east of South Amenia to the Webotuck, east of South Dover. In the town of Dover the top is moderately rolling and the whole mountain is a small table-land rather than a single ridge or mountain range.

The highest point of this mountain is near the Connecticut line about a half a mile east of the Patchin neighborhood, and its altitude above the level of tide water is reported to be 1,500 feet. The barometric observations on section lines which were followed during the survey last autumn show the highest point observed to be near the school-house in the "mountain district," and its height as 1,350 feet. The "Cobble," which is a prominent peak in the landscape from the Sharon and Amenia valley, was found to be about 1,400 feet high. There are no deep gaps in the range and the surface inequalities are, on the average, only about 200 feet, that is, from the ridges to bottoms of the adjacent valleys. But looking off into the Dover Plains on the west, and Kent Plains on the east, the boldness of the mountain and the depth of these bounding valleys are at once conspicuous features of the surface configuration. These valleys have an average height of 400 feet above tide, or are from 600 to 900 feet deep, as compared with the mountain. The outer slopes, descending to these valleys, are very steep in places, precipitous, and hence they are in forest. On the top of the mountain the less rocky and level or gently-rolling portions near the road which cross the mountain from Dover Plains and South Amenia to Kent Plains, Connecticut, have been cleared and inclosed in farms. But this deforested area is comparatively a very small fraction of the whole, and the mountain may be described as still wooded.

The boundaries of the gneissic strata of this mountain range are traced without difficulty, excepting near South Amenia, where the border of the gneiss appears under the drift of the valleys. Begin-

* Mather in his *Geology of the First District Natural History of New York*, 1842, pp. 548, 612, has a brief notice of the Stissing mountain rocks, in which he calls them Primary. See, also, pp. 436, 437 of same report.

† Dr. Percival in his "Report on the Geology of the State of Connecticut," 1842, calls this Dover-Kent-Sharon range of crystalline rocks or "granitic formation," and he represents it on his map by the designation of K., pp. 115–119.

ning at the Connecticut line east-north-east of Amenia, the western boundary line crosses the Kent Plains and Amenia road one and a half miles east of South Amenia. Thence it runs in a south-south-west course along the base of the Peaked Hill ridge ; intersecting the road to Macedonia, three-fourths of a mile south of South Amenia ; then striking the East mountain it follows the course of the mountain, first in a south-south-west, then in a south course, and lastly in a south-easterly direction, to the southern termination of the range, near Webotuck. East of Dover Plains it has an average elevation of 550 feet above the plains level. On Peaked hill and on Dover mountain quartzite borders the gneissic outcrop. See *Mather's Geology of the First District Natural History of New York*, pp. 444 and 446. Also *Percival's Geology of Connecticut*, pp. 118, 119; *Prof. J. D. Dana's* "*Taconic Rocks and Stratigraphy*," Am. Jour. Science (3), XXIX, p. 209. And these two formations were observed in close proximity to one another at several points on this side of the mountain. Contact phenomena were noted at a place near the road leading from the mountain district school-house to Dover Plains. The gneissic strata were found in all but one locality, dipping to the east-south-east and at angles varying from 60° to vertical. One locality showed a dip of 80° westerly. On Peaked hill the quartzite beds dip to the east-south-east at an angle of 40° ; the gneiss east of the quartzite has the same direction in dip, but the amount is 50°. Along the west side of the East mountain the dip of the quartzite strata is 50° to 70° and toward the north-west. Around the southern end, near Ellis lake and near the State line, north of Mitchell's Mills, the quartzite beds have an east-south-east dip and the angle is from 40° to 60°. The same direction and like angles were observed on the eastern side of the mountain, and at the west border of Kent Plains, in Connecticut. The boundary between the gneisses and the quartzite at the south is near Ellis lake, to the north-east of it — crossing the road, which runs north to the Patchin-Kennedy neighborhood, one-eighth of a mile north of the Dixon-Haviland corner and intersecting the State line about one mile north of Mitchell's Mills. The eastern boundary follows the border of the Kent Plains.

There is a want of conformability between the quartzite and gneiss when they are seen close to one another. And the prevailing dips of the quartzite are away from the mountain — an anticlinal uplift due to the elevation and folding of the gneiss. The position of the strata of gneissic rocks in the East or Dover mountain, as shown by the dips observed along the borders and on two cross sections, indicates the possible existence of a closely folded anticlinal on the western part of the range, combined, probably, with synclinals to the east of it. The strata on the west slope have in general a steep dip to the east-south-east, with a few westerly dips ; whereas on the western part of the top the angles of dip are from 45° to 80° and to the south-east. The absence of observed dips on the east slope leave much doubt as to the probable structure of this mountain range.

The rocks composing the strata of the East (or Dover) mountain range are gneiss, granite, granulyte, quartz-syenite, syenite-gneiss and mica-schist chiefly ; and other crystalline rock varieties of much less common occurrence and of very limited outcrop. The variation, due to different proportions in which the constituent minerals enter into these more common kinds of rocks, is wide and there is an almost imperceptible degree of gradation from one to another. In the range east of South Amenia there is a predominance of a fine, crystalline, banded gneiss, which is in places highly micaceous, associated with a grey granitoid gneiss. A very good section was examined between Macedonia, Conn., and Dover Plains, crossing the East mountain. On the eastern slope many ledges of dark-colored, muscovite-biotite gneiss with syenite-gneiss were seen, traversed by dikes of coarse-crystalline, grey-reddish granite. The latter rock has in places a gneissoid aspect and doubtless there are on this slope some areas of unstratified granitoid gneiss. Near the top of the mountain there is more of this grey, feldspathic, massive gneiss and granulyte, less of the micaceous, hornblendic varieties. The latter are much contorted in strike and apparently much disturbed. Small masses of these varieties were observed imbedded in the grey rock, indicating either very abrupt changes in the conditions at time of formation, or, possibly, a breaking up of an older series by the intrusion of eruptive masses. On the southern end of this mountain there is a broad area, occupying nearly the whole crest, of a peculiar-looking gneiss, consisting of flesh-colored orthoclase, white quartz and biotite. The feldspar and mica are arranged in rudely parallel, thin layers, and the quartz is quite subordinate in quantity. The feldspathic portions swell out into small lenticular masses from one-half to an inch in diameter. They give the mass a rough conglomerate, or rather a pseudo-porphyritic aspect, suggestive of the "augen gneiss" of German lithologists. There are no signs of bedding in this rock of massive outcropping ledges, unless this mineral parallelism be taken as indicative of a stratification. And in the mountain mass it may be considered as an unstratified rock; in hand specimens it has the appearance of gneiss. The same rock was observed on the top of the range to the north and also on the "Cobble" over the State line, in Connecticut. The outcrops of the western slope show as prevailing types, a dark-colored, fine crystalline, syenite-gneiss, a muscovite-biotite gneiss and a grey, granitoid gneiss. The variation in the strike of the strata of more schistose gneisses on the west side also is remarkable, amounting to 30° within a few yards, in places. Viewed as a whole the central part of the range may be said to be mainly made up of grey, massive, unstratified granitoid gneiss and granulyte, flanked on each side by the more schistose and thin-bedded gneisses and mica schist, and the latter, in turn, by the newer and unconformable quartzytic and quartz schists. As compared with the rocks of Stissing mountain and the Highlands of the Hudson, the rocks of this range have a more banded or striped appearance; they contain rather more black mica (biotite), more flesh-colored feldspar, and in their strike there is more variation, or more contorted. But these lithological distinctions are comparatively slight and apparently not sufficient to justify a division based upon them alone. Hence the range is here placed as belonging in the Archæan series and to the Highland belt.*

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* Prof. James D. Dana, in his papers on the Taconic rocks, published in the *American Journal of Science*, has referred to the Dover-Kent-Cornwall range of gneiss and called it Archæan.—*American Journal of Science* (3), vol. XVII, pp. 387-388; and vol. XXIX, pp. 214, 221.

III.

Highlands of the Hudson.

The above designation, or as it is sometimes used, the *Highlands*, is given to the mountain chain, which extends from New Jersey, through Orange and Rockland counties and, on the east of the Hudson river, through Putnam and Dutchess counties, nearly to Connecticut. The Hudson river crosses it between Peekskill and Cornwall. Its average elevation above the ocean is about 1,000 feet, and it is so much more elevated than the valleys on the north and south that it is sometimes designated as a table land. There are, however, some rather deep valleys traversing it on nearly due north and south lines, and many lesser depressions whose general course is from north-east to south-west approximately, and which alternate with rocky ridges, having the same trend. The height of these several ridges is remarkably uniform, pointing to an original plane or nearly level surface, which, through the denudation of the softer and more exposed strata, has resulted in the corrugated features now observed. The general level of these crests is at once apparent on climbing to them. The valleys are not alike uniform in depth, as for example that of the Hudson river crosses it below tidal level, whereas the Ramapo valley is several hundred feet higher, and that of Peekskill Hollow still higher.

The Highlands east of the Hudson may be said to extend north-east from the Hudson river, from Peekskill Hollow and Cornwall to Gardiner's Hollow, near Poughquag, and to Whaley pond, west of Pawling, in Dutchess county, and to the Pawling-Patterson valley, in Putnam county. The southern limit is Peekskill Hollow to Oregon ; then an irregular and not well-defined line near Shrub Oak, Jefferson Valley, Somers Hollow, and Croton falls to Brewsters. These lines do not include all of the ridges on the north and east, since the Fishkill mountain range continues north through Dover, Amenia and north-east to its termination near Copake in Columbia county. Eastward the ridges follow one another without any well-marked line of division through the towns of Southeast and Patterson, in Putnam county, into Fairfield, Connecticut. On the south-east the hilly country of the northern part of Westchester county border the Highlands.

The extreme north-east limit, geologically considered, of the Highlands belt is in the town of Beekman and at Gardiner's Hollow.* The gneissic rocks at this place are found lying unconformably against the micaceous and quartzose schists of the Dover and West Pawling range. This most interesting locality is less than a quarter of a mile north of what is locally known as the "Dug road." The full description of the north-west boundary of the Highlands Archæan rocks may be given as follows: Beginning at the north-easternmost point, the

* The probable termination of the Highlands belt of Archæan rocks, near this locality, was first suggested to the author of this paper, by a trip through this part of the State in 1880, while visiting the iron mines for the U. S. Census Office. At the close of the season the work of Dr. Percival was examined, and his description of the locality was at once verified. *See Percival's Geology of Connecticut*, p. 123.

Prof. James D. Dana has represented the Archæan Highlands, as terminating near Poughquag, on a map which accompanies an article on the "Geological relations of the Limestone Belts of Westchester county, New York." *Am. Jour. of Science* (3), XX; facing p. 452.

line of division between the gneiss and quartzite has a south-west direction, along on the lower slope of the mountain, east of Gardiner Hollow brook an average distance of a quarter of a mile, across the Beekman and Pawling turnpike and the N. Y. and N. E. R. R. line, one mile south-east of the village of Poughquag. Thence south-west the boundary is in a hollow, between the two rock formations, as far as the Poughquag station and road south over the mountain ; descending and on the same general course, it comes to the valley about half a mile east of Green Haven railroad station, and crosses into East Fishkill township near the Baptist church corner. Across East Fishkill it is located readily by the topographical features. It is near the Hopkins place, one mile south-south-east of Stormville ; near the residence of D. W. Tompkins and A. Wiltsie, a mile south-south-east of Cortlandtville ; then, in a more southerly course, it runs near the Shenandoah limonite ore-bed and Fowler's kaolin mine to within a mile of Hortontown, where it sweeps around to the north and then curves about the north-eastern point of the Shenandoah Corners gneiss ridge, resuming at the village of the same name its general south-west course.

From Shenandoah Corners the boundary of the gneissic rocks outcrop, overlaid by the patches of quartzite, is easily traced in a south-west course for a mile and a half, or to the Wickapee creek hollow, near the road crossing that stream. Again bending northward it runs for three-fourths of a mile to the northern end of a northward projecting tongue of crystalline rocks, then turning westward and south-west for a short distance, it again sweeps around a short and narrow outcrop of gneiss, the quartzite dipping at various angles away from this underlying anticlinal line. Beyond to the west there is another rather sharp curve in the line to the south, around a bold and narrow ledge of the quartzite. Crossing the township line about one mile north of the county line the course is for a little way westward, then it turns to the north and here the quartzite and siliceous conglomerate are seen unconformably resting upon the gneiss. The latter rock has its strata standing almost on edge, with an easterly dip, the conglomerate beds dip at an angle of 20° northward. The boundary has a general north-north-east course, at the eastern foot of Mt. Honness, and quite near to Johnsville, to the Fishkill creek less than a quarter of a mile north of the Johnsville M. E. church. At this point the northernmost end of the Mt. Honness range is attained and the geological line again has a west and then a south-west bearing up the Clove valley a distance of two or three miles. The drift conceals the strata and the southward limit of the newer blue limestone is known only by openings for ore in the valley. Its limit is apparently about two miles in a straight line, south of Fishkill village. Passing about the southern limit of the limestone the boundary is then traceable along the west of the Clove creek and to the north-east end of the Fishkill mountain range, proper, which is near the creek, and Fishkill village. Thence south-west for two miles, the foot of the mountain is recognized as the limit of the gneisses also. South of Glenham the line of outcrop is traced in a west-south-west course and three-quarters of a mile south of the creek. Through Matteawan it is located near the public school and a little south of the P. E. church. From Matteawan to the Hudson river the course of this line is south-west, and south of the creek and nearly parallel to it.

As thus described in detail, the line represents the boundary of gneisses and quartzitic rocks across Beekman township; in East Fishkill there are separate outcrops of the latter at the border of the gneisses, near the Baptist church; south of Stormville and near the Hopkins place; near the Shenandoah iron mine; at Shenandoah Corners; in the Wickapee hollow; in Fishkill Hook south of Johnsville, and near the town line south-south-west of the same village. In Fishkill township the border is drift and alluvial beds (in part), excepting the limestone in the Clove valley and the limestone, quartzite and slaty rocks in Matteawan, but the latter are isolated outcrops and separated from gneiss of Fishkill mountain on the south by much drift. Hence, the relative position of these sedimentary strata is not determined by any contacts or any closely out-cropping beds in this town.

The relation of the Poughquag-Fishkill quartzite to the underlying crystalline rocks of the Highlands is shown by several good sections, one of which has been referred to on page 173. Another and more interesting locality is in the town of East Fishkill, nearly two miles south-south-west of Johnsville, or three miles south of Brinckerhoff station. The mountain road leading southerly and passing West Hook district school and the Adams place, ascends, first, over the quartzite and then up the projecting tongue of gneiss. On the east and west side of this gneiss the grey-white quartzite strata crop out, dipping on the west side 35° to the west-north-west and rising up in a nearly vertical cliff 100 feet high above the gneissic base or substratum. The dip of the same rock, as seen on the east and north-east of the gneiss, is 20° north and 35° east. And the rock is in some beds a fine shaly sandstone. Overlying the latter, near the foot of the hill, a blue, magnesian limestone appears, having the same dip to north-west. Another interesting locality where the quartzite is in close proximity to the underlying granitic rock is on the McCarthy place, one and a half miles south of Johnsville. At this locality the rock is marked by the presence of a scolithus, which suggests the horizon of Potsdam sandstone. The beds dip north 55° east, 40°; and are within 200 feet to south of a granitic ledge.

Perhaps the best section showing the quartzite reposing unconformably upon the gneisses of the Highlands is south-east of the deep Poughquag cut of the N. Y. & N. E. R. R., and one mile north-west of the West Pawling R. R. station. In the deep cut the quartzite beds dip easterly at angles from 15° to 20°. To the south-east in the next (low) cut, the same rock has its strata dipping to the north-west at an angle of 20°, and the gneiss within 300 feet of the former, but lower on the slope dips at an almost vertical angle to the south-east. The same rock forms the base of this Poughquag spur on the north.*

A narrow and isolated outcrop of granitic rock north of the Fishkill creek may be described in this place, since it belongs apparently to the Highlands belt of crystalline rocks. It is traceable from the large carpet mill and the creek at Groveville through Glenham, north of Fishkill village to Vly mountain where it disappears under

* On the Poughquag-Fishkill quartzite, and its relations to the Archæan rocks, and the overlying limestones, see articles by Prof. J. D. Dana in *Am. Jour. of Science* (3), III, pp. 250-256; (3) XVII, pp. 385, 386, and (3) XXIX, pp. 209, 221.

the slates and drift. It is five miles in length; its breadth nowhere exceeds one-third of a mile, being greatest in the village of Glenham, where the Reformed church stands on the north margin and the Public or Union School-building is near the south side of the outcrop. At the north-east end, Vly mountain represents its breadth. Throughout its surface is rocky, but it is not very prominent above the adjacent formations of slate and limestone, excepting in Vly mountain where it attains an elevation of 250 to 300 feet above the Fishkill plain. The formation on the north-west is a bluish-black slaty rock, but it was not found cropping out near enough to this crystalline rock to indicate its true relation to the latter. The blue limestone bounds it on the south-east. And the beds of this rock dip south-east or from the granitoid rock, but the concealed distances between their outcrop (nowhere less than 100 feet) are too great to permit any conclusions as to their exact position in reference to one another. There is doubt about the crystalline rock being stratified. The only locality where it appears to have bedding is near Glenham, and the dip is there nearly vertical north 10°–15° east. But the parallelism in the minerals is all that is evidence of stratification.

There are two principal varieties of rock in this short and narrow outcrop. One is a pinkish-colored granite, consisting almost wholly of orthoclose and a milk-white quartz. It has a little brown mica in small, scattered scales through its mass. The other variety is a greenish-grey rock made up of a triclinic feldspar, orthoclose, white, opaque quartz and a very little black mica and hornblende. Inasmuch as the prevailing types of rock are unlike the characteristic varieties of crystalline rock in the Fishkill mountain so near on the south there is doubt about classifying this little belt with the Highlands. And it is placed here provisionally until the district can be more thoroughly studied and the rocks be examined microscopically.*

The south-eastern boundary of the Highlands Archæan rock may be described as having a general southerly course from Gardiner's Hollow near Poughquag in Dutchess county, to Towner's Station in Putnam county, and a south-west course from the Connecticut line, east of Brewsters, by Croton falls, Jefferson valley, Shrub Oak and Oregon to Peekskill Bay at Annsville. The rock of the adjacent formation throughout much of this distance is mica schist. Near Oregon, there is a very fine-grained, black, hydro-mica schist and the same rock continues bordering the gneissic outcrop thence more or less all the way to the Peekskill cove. On the Hudson river, the nearest ledges to the gneiss, which crops out on the north of the cove, are south-east dipping strata of greyish quartzite and a feldspathic quartzite in the bluff between the cove and Peekskill.

Beginning at the north-east, in Gardiner's Hollow, north-east of Poughquag, the eastern limit of the Archæan gneisses coincides with a slight surface depression whose general course is south 20° west (magnetic) from the so-called "Dug road" to the Beekman and Paw-

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*This rock was called an "altered sandstone" by Prof. James Hall and Sir William Logan, in a paper read before the Natural History Society of Montreal, Oct. 24, 1864, by T. Sterry Hunt. See *Am. Jour. of Science* (2), vol. XXXIV, p. 96.

Prof. Dana calls it a "granite-like stratum" and a stratified formation, in his description of the Taconic schists and associated limestones in that part of Dutchess county. *Am. Jour. of Science* (3), XVII, p. 386.

ling turnpike. The gneiss is conformable in strike and dip with the micaceous schists of the mountain on the east; and in some of the outcrops these widely-marked and typical rocks are within thirty feet of one another. The schist makes up the crest of the mountain; the gneiss forms a western and lower ridge of the same general range. And it is first south of Poughquag that the gneisses rise to a height equal to that of the schist ridges.

South of the Beekman and Pawling road this geological boundary has a south-west course to Whaley pond, which lies in a depression, marking the limits of two diverse rock systems or terrains. From the south-east side of the pond and where the railroad comes to the water's edge, the line of division goes, first, easterly for a short distance, then on a south-east course, east of the Whaley pond and Reynoldsville road, to the Putnam county line. The mica schist, more or less garnetiferous, makes up the most of the ridge west of the Pawling-Patterson valley and approaches close to the outcrops of the gray, fine-crystalline biotite gneiss near the bottom of the hill and near the N. Y. & N. E. R. R. line. They are so close in places as to exhibit the structural relations with certainty. Crossing into Putnam county the course of the boundary is south for two miles, being one mile east of Ludingtonville and following the lower part of the western slope of the Iron hill range and near the middle branch of the Croton river. From this valley it bends south-east around the southern end of Iron hill; and then has a north-east course nearly to the village of Four Corners, where it again takes a turn to the east and east-south-east and is also the south limit of the Patterson limestone valley thence to Towner's station on the Harlem railroad. The exact location of the line across the narrow valley, followed by the Harlem railroad, is difficult, on account of the drift and more recent formations which cover the rocks. It is possible that the limestone of the Patterson valley stretches south as far as the Croton lakes, but beyond that the gneissic rock outcrops extend quite across the valley. The boundary may run southward, following the contour of a limestone tongue as far as this lake, or one and a half miles south of Towner's station. Or it may run in a direct easterly course across by this station. East of the last-mentioned place the line has a more tortuous course, going first north-east, then north for a half a mile, around a rocky hill, west of Couch's Corner; thence east and east-south-east, at the northern base of the rocky ridges which rise up at the southern border of the great swamp. Haines' Corner is near the limit northward of the gneisses. East of Haines' Corner the alluvial deposits of the Croton river valley conceal all the older strata and make the location doubtful. Passing over this strip of alluvial and drift deposits the eastward extension of our line is put in the Quaker brook hollow, which is a deeply wooded valley, having the high schistose-rock hills of north-east Patterson on the north and the harder-grey gneisses on the south.

This valley appears to have been worn down in the softer schists at their junction with the gneiss. It is a topographical as well as a geological feature. The boundary line, as thus traced, crosses into Connecticut near the head of this Quaker brook hollow. Between Towner's station on the north and Brewsters at the south, the eastward extension of the Highlands Archæan has a breadth of six miles, and it is traced into New Fairfield and Danbury, Connecticut. Dr. Percival did not recognize in it the same general characters as in his "*Granitic Formations*," but put it under the head of "*Calciferous Micaceous Formation* (gneiss)" and represented it by H. 2. B. on his geological map. He calls it a table-land bounded north and south as indicated above. In his description of the rocks of this division or formation a *granitic gneiss* is mentioned as predominating with beds of dark *hornblendic* and *sub-hornblendic rocks* and *dark micaceous rocks*. And he adds that a range of the latter is traceable west beyond the Croton, between Carmel and Somers.* An examination of the outcrops on two sections across this division of Dr. Percival, one from Brewster's, north-east to Valleyville and Quaker brook hollow, and the other from Brewsters through Southeast Centre and Milltown and across Joe's hill, failed to show sufficiently marked and distinctive rock characters to separate it from the gneisses, granulytes, syenite-gneisses and micaceous schists common to the Highlands to the west.

The southern limits of the Archæan rocks of the Highlands from the State line east of Brewsters to the Hudson river may be described as follows: Beginning near Mill Plain, Conn., and at the southern foot of the Joe's hill ridge, the line follows the east and west valley to near Southeast Centre and then the Croton river, passing south-east and south of Brewsters. This valley has in it a white limestone and a micaceous quartzite, as also mica schist, and these sedimentary rocks have a general east and west strike and a northward dip. Joe's hill is the southernmost ridge of gneiss of the belt, whose boundaries are here given, and the limestone and schistose rocks are the adjacent bounding formations. South-west of Brewsters the tracing of the geological line is rendered difficult by the absence of distinguishing characteristics in the rocks which occur in the undoubted Archæan belt north-west of the Croton river, and some of the outcrops of gneiss which are traceable in a narrow belt eastward from north of Croton falls to Peach lake and into Ridgefield and Danbury in Connecticut. The schists in the southern part of the town of Southeast and north of Peach lake border this belt of gneiss on the north and the Salem limestone is contiguous on the south. The prevailing north-east dip makes an angle with the mean direction of that of the beds in the outcrops of the Theall mine and along the Croton valley, but no contact phenomena or localities of unconformable strata were observed. So far as rock composition is concerned there is more mica and a more schistose structure in the rocks of this Croton falls and Peach lake gneissic tongue, if it be viewed as an extension eastward of the Archæan. Garnet also is common in these rocks; and they have a striped or banded appearance. But there is the absence of well-marked distinctions which are at once recognized in the outcrops on the two sides of the boundary line as traced across Putnam and in Dutchess counties.

From the Croton river west the general course of the southern line of the Highlands belt is westerly, but it is marked by several loops, which stretch southward around the Archæan projecting ridges, as it

* *Percival's Report on the Geology of Connecticut*, 1842, pp. 83 and 92, 93.

were peninsulas or promontories of older gneisses in the later schists and associated crystalline rocks. The line may be described as located south-west of Croton falls; near Somers village at the southern end of the Round hill range; then, bending to the north-west and near the so-called "Lovell street," it strikes the Putnam county line near the Plum brook depression and the Mahopac Branch railway; then bending southward and on a west-south-west course it re-enters Westchester county at Jefferson valley; thence it is traced westward to Shrub Oak along the southern foot of a high and rocky ridge of thick-bedded, grey gneiss, which runs northward along on the south-east of the Peekskill hollow. It should be stated here that there are outcrops of true gneiss in the high ground south of Shrub Oak and Jefferson valley, and as far south as Yorktown, which may belong to the Highlands formation, and if so included, the location of this line must be somewhere near the west branch of the Muscoot river and south of Yorktown village. As no connection could be traced between these more southern outcrops and the main body of Archæan to the north, it is believed that they are parts of an isolated area in this (Yorktown) township. The thin-bedded, mica schists which have a prevailing east and west strike, and which make the more gently rolling country in the central part of Somers and Yorktown townships, are here considered as a distinct formation on the south of the Archæan gneisses of the rocky and mountainous Highlands. From Shrub Oak the direction of this boundary is west a short distance; thence north-west, again into Putnam county, nearly to Adams' Corner; thence south-west, down the valley of the Peekskill Hollow creek, north of Oregon, near which place it returns into Westchester county. From Oregon the line is traced north of Gallows hill to Sprout brook and thence to Annsville, and the Peekskill Cove to the Hudson river. North of Oregon the rock outcrops on the south-east, adjacent to the gneisses is a black crenulitic slaty rock which resembles closely the rock near Annsville, and that in the West Shore railroad cuts north o Tomkins Cove station. At the latter place the rock is graphitic and a hydro-mica schist rather than a true argyllyte.

The limestone belt in the Sprout Brook or Canopus Hollow is not here defined in its location, inasmuch as it is placed with the gneisses, as an Archæan rock; its semi-crystalline character and its foreign minerals, and its want of resemblance to the Peekskill Hollow limestone appear to indicate its close relation to the gneissic rocks adjacent to it. The general direction of strike and dip in these slaty outcrops, bordering the Highlands from Peekskill cove to Oregon, is like that of the Archæan gneisses, the prevailing dip being at a steep angle toward the south-east. The absence of any localities where contacts are to be seen makes the relative position uncertain. The observations of this reconnaissance do not prove unconformability. A more thorough survey of all the outcrops is needed to discover the true relations so far as structure is concerned.

On the eastern side of the Highlands the Archæan border has the micaceous, schistose rocks and the quartzites resting upon it; and two localities near Towner's station in the town of Patterson, Putnam county, may be here noted, on account of their closely contiguous outcrops of the bottom, granitoid gneisses and the upper schists and quartzose rocks. The first one to be mentioned is at the south end of the Iron Hill range of schist, about two miles west of Towner's. Here the garnetiferous, micaceous and quartzose schist crops out within 90 feet, horizontally of the light grey, fine crystalline gneiss, approaching a granulyte in composition and massive structure. The former dips 60°–65° north, 5° west (magnetic), and the latter shows a conformable bedding so far as any stratification is recognized in the mineral arrangement of its mass. Going a short distance south-east the strike changes to north-east and the dip is steep to south-east. Passing around the head of the little valley and to the east side of the same the grey gneiss forms the ridge on the east and at the foot and close to the meadow, the schistose outcrop appears, with west-north-west dipping strata, and passing, apparently, under the little limestone tongue in the bottom of the valley.

From the synclinal fold to be seen in the limestone outcrop at its south-west end and the opposite dips in the schists on each side it is evident that there is here a great synclinal, which includes the schist as well as the overlying limestone ; and the base is the unconformable grey, *granulytic* gneiss. About a half a mile north-east of Towner's the gneiss forms the base of an almost vertical wall of rock, whose upper portion is a drab-colored, fine-granular sandstone. The dip of the gneiss is 70° easterly; that of the sandstone is at an average angle of 30° only, also eastward. Within one-quarter of a mile to east there is a succession of gneiss, syenite-gneiss, micaceous gneiss and a micaceous quartzite, each forming distinct ledges, or low ridges on a section line which runs north 35° east (magnetic), and having about the same angle of dip — 40° nearly. Unless overturned, which condition seems impossible, the order of succession at this place gives a key to the structure of the region; and it is in harmony with the order observed at many other localities in the Archæan rocks border.

The discussion of the structure of the Archæan rocks of the Highlands belt is deferred to a final report after a careful survey of the whole terrain shall have been made. Many observations have been made on the strike and dip of the strata along the Hudson river from Peekskill to Fishkill, and from Poughquag in Dutchess county to Brewsters in Putnam county and thence south-west to the Hudson. Shorter sections also have been followed and the phenomena of outcrops noted. The surface configuration and barometric measurements of heights have received some attention. So far as the observations go, they show a prevailing steep east-south-east dip, and a north-north-east strike, that is oblique to the trend of the belt, which is east-north-east. The existence of an anticlinal fold of some magnitude is indicated in the Fishkill range. As it involves an enormous thickness to consider the formation as a single monoclinal series of strata, the probable existence of close folds, with their axial planes dipping very steeply to the east-south-east, is inferred. And this hypothesis, taken with a series of faulting planes running, in general, north-east and north-west courses, will explain most of the phenomena of structure which have been noted.

The occurrence of unstratified outcrops of granitic and syenitic rocks has been looked for, and two comparatively broad ranges have been found ; one in the Fishkill monuntain range, and the other east of Oregon, in Putnam county. Areas of granitoid gneisses, or granulyte-like gneisses, have been observed. The time of field-work was altogether too short to trace out the contours of these characteristic outcrops and map the surface according to the several prevailing rock types. Another season it is proposed to traverse the belt on numerous section lines and then follow the boundaries of these unstratified areas and determine their relations to the surrounding rocks. Their existence in the Highlands east of the Hudson is analogous to the results of the surveys and studies made in the south-western continuation of the same belt in New Jersey.* The fact of detached or isolated areas of rocks, marked by certain lithological characters in the broad region of crystalline rocks of western Connecticut and south-eastern New York was announced in 1842 by Dr. Percival in his *Geology of Connecticut.*† It has been suggested as true of the crystalline rock of New Hampshire; also, where there are 22 of these ovoidalare as of Laurentian rocks.‡

In describing the outlines of the Highlands Archæan rocks, references to their general characters have been incidentally made. The kinds of rock most common are gneiss, syenite gneiss, granite, quartz-syenite, granulyte and hornblende schist. The varieties under these heads are very numerous, since the constituent minerals are present in so varying proportions. Orthoclase and quartz prevail, but mica (usually biotite) is rarely altogether wanting. Hornblende, also, is common. Triclinic feldspars, muscovite and augite occur frequently, and of rarer occurrence and as accessory constituents in the prevailing rock types are epidote, graphite, magnetite, apatite, ilmenite and pyrite. These latter minerals in places make up so much of the mass as to give names to the rock; and there are magnetic iron ore, titaniferous ores, beds of pyritiferous rocks, of graphitic gneiss and of epidotic gneiss.

The more common rocks are rather coarse crystalline and the constituent minerals are readily identified by the aid of a good lens. The fine crystalline to amorphous varieties occur within very limited outcrops usually, and are quite subordinate in importance. The feldspars are generally prominent in the crystalline mass of the rock, often giving it a porphyritic aspect. And in the coarser crystalline varieties orthoclase clearage surfaces are in some cases an inch in diameter. A common phase of the prevailing gneiss is a rude parallelism in the mineral arrangement of the rock mass. This aspect may be due to simple alternations of thin layers of the feldspars and the quartz, but it is more generally observed in the case of the micaceous and micaceo-hornblendic varieties, where the dark lines of the biotite and hornblende are in contrast with the white to flesh-colored feldspathic portions. Where the mica is abundant, the rock assumes a schistose structure.

Viewed as to chemical composition the feldspathic, or granulyte-like rocks are more siliceous and contain more potash and soda; the hornblendic and biotite gneisses are characterized by less silica and less of the alkalies, but more iron.§ And the latter occur usually near the beds of iron ore or are associated with them. Some authors have considered the former as an acidic or highly silicated class and the latter as basic or poorly silicated. The query is here propounded that, perhaps, in these marked differences in composition there may be a

* *Ann. Reps. of State Geologist of New Jersey* for 1884, pp. 65-67; and for 1885, pp.

† *Report on the Geology of Connecticut, by J. G. Percival*, 1842, pp. 143-144.

‡ *Descriptions of Geological Sections across New Hampshire and Vermont, by Prof. Chas. H. Hitchcock, State Geologist of New Hampshire*, 1884, pp. 29-30.

§ M. de Lapparent in his *Traité de Geologie*, 1885, refers to the division of the Archæan system into a lower series (étage) marked by the presence of silica and alkalies, and by greater uniformity of chemical composition and an upper series whose rocks are more diverse in composition and contain more iron, lime and magnesia.

clue to the conditions prevailing at the time of deposition, and to their probable origin. The importance of studying these crystalline rocks from the chemical standpoint rather than from that of mineralogical composition is worthy of note, since the first points back to the original sediment; the latter is the result of subsequent conditions prevailing during the time of alteration or metamorphism. The presence of minerals having definite composition leads to the very common supposition that crystalline rocks are definite compounds also, and in this respect differ from the fragmental rocks. This distinction does not exist, and the former grade into one another by imperceptible differences; and they are no more definite in chemical composition than the latter class. They are the results from the cooling of liquid masses in the earth crust; or they are the altered products, through the agencies of heat and pressure, of original sediments deposited, as gravel, sand, mud, or as fine precipitates through chemical action.*

The collections of typical rocks from the Highlands, made in the course of this reconnaissance, are not large enough and do not represent all its out-crops sufficiently to afford the proper material for a careful microscopic examination. Another season of field-work is necessary in order to get this material.

The first geological representation of the Highlands region was made by William Maclure in his geological map of the United States, published in 1817, whereon the rocks of the district were classed as belonging to the *Primitive Formation.*

In 1819, S. Akerly described the Highlands as made up of gneiss, granite and micaceous schists and belonging to the *Primitive Class.*†

Prof. Amos Eaton, in his "Index to the Geology of the Northern States," published in 1820, refers to the granite in the higher mountains of the Highlands flanked by gneisses (pp. 107 and 131–2); and in his "Geological Nomenclature for North America," 1828, he notes the granite at West Point, mica slate at Fort Montgomery, and hornblende rock in Butter Hill as *Primitive Rocks.*

Prof. William W. Mather, in his Report on the Geology of the First District, described the rocks of the Highlands and called them *Primary.* His report contains a great mass of notes on occurrences and phenomena of out-crops in the district, but without much order or any apparent, broad generalizations.‡

The work of Dr. Percival, State Geologist of Connecticut, lapped over into Westchester, Putnam and Dutchess counties, and he placed the rocks on the border in his *Western Primary System.*§

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* It is interesting here to refer to a very suggestive and pertinent note by Prof. James Hall in his introduction to Vol. III, Part I of the *Palæontology of New York:* "The student from the unaltered rocks has been accustomed to see all the sedimentary strata, presenting the aspect of fine shale or slate, or of sandstone and of strata showing infinite gradations between the slate and sandstone; intermixtures and interlaminations of the one and the other, and all possible modifications of these two simple materials in the sedimentary deposits; the admixture of calcareous matter producing calcareous shale and calcareous sandstone, and giving a less or more calcareous character to all the intermediate varieties of these rocks and finally the development of limestone. All these are familiar to him; and as he approaches the changed forms of these rocks, and sees the beginnings of metamorphism, and the gradual development of the segregated and crystallized minerals, he still looks upon these rocks in the mass, as strata of shale, sandstone, and the intermediate varieties of rocks made by the mingling of these and the accession of calcareous matter."

† *On the Geology of the Hudson River, S. A. Kerly, New York,* 1820.

‡ *Geology of the First District Nat. Hist. of New York, Wm. W. Mather,* 1842, pp. 516, 549.

§ *Report on the Geology of Connecticut, by J. G. Percival,* 1842. (See *loc. cit.*)

In 1864, Prof. James Hall and Sir William Logan visited the district and announced, as a result of their examinations, the existence of *Laurentian* rocks in the Highlands.*

In the same year Prof. George H. Cook, State Geologist of New Jersey, mapped the Highlands (west of the Hudson and the New Jersey range) as *Azoic.*†

The same district was represented, with much detail of geological boundaries, on the map of northern New Jersey, which accompanied the "Geology of New Jersey," published in 1868. The term *Azoic* was retained.‡

Reference has already been made to several articles by Prof. Jas. D. Dana on the geological structure of the south-eastern part of the State.§ The term *Archæan* was proposed by him in 1872 for the gneisses of the Highlands, in an article in the *American Journal of Science,* on the "Poughquag Quartzite."‖ In 1879, and in the same journal he gave the boundaries, in part, of the Highlands Archæan on a small (page) geological map of that part of the State.¶ In subsequent articles on the "Geological relations of the Limestone Belts of Westchester county," Prof. Dana assigns the crystalline rocks of the Highlands to the Archæan; and in one of them he gives a map showing these belts with the Archæan of Putnam county.** References to the rocks of Dover or East mountain, which have been described in the preceding pages of Archæan and an outlier of the Highlands, are made by the same author in a paper entitled "on Taconic Rocks and Stratigraphy," published in March, 1885.††

The crystalline rocks of the Highlands of New York have been described in this report as belonging to the *Archæan Era.* This term has been accepted in preference to the older designation, *Azoic,* because it is not open to the objections which are forcibly opposed to the use of the latter, when applied to these rocks. We cannot draw the line where life began on the globe, but from the standpoint of a gradual development from lower to higher organisms it is reasonable to assume that the earliest life consisted of infusorial protophytes, which lived in conditions such as prevailed during the deposition of the first sediments. And they may have given rise to much of the carbonaceous and siliceous deposits so common in these crystalline gneisses, limestones and associated strata. *A priori* we should not look for the preservation of the earliest microscopic forms in beds which have been so metamorphosed as the older crystalline rocks. The presence of limestone, graphite and apatite with beds of iron ore prove as much for the existence of life as the reverse. Again the term *Azoic* is expressive of a negative condition and not in harmony with the other terms of the geological scale. It is not as consistent with *Palæozoic, Mesozoic* and *Cenozoic* as *Archæan,* which refers to a period of geologi-

* *Am. Jour. of Science* (2), XXXIX, pp. 96–97. (Notice of a paper read before the Nat. Hist. Soc. of Montreal.)

† *Am. Report of the State Geologist, for* 1864, map facing page 23.

‡ *Geology of New Jersey,* 1868, *Portfolio of maps; Map of Northern New Jersey.*

§ See pages of this report.

‖ *Am. Jour. of Science* (3), III, pp. 253–254.

¶ *Am. Jour. of Science* (3), XVII, p. 379

** *Am. Jour. of Science* (3), XIX, p. 191; XX, pp. 21–22; and 368–375; XXII, pp. 105–108, 11

†† *Am. Jour. of Science* (3), XXIX, pp. 209, 221.

cal history, and the term *Azoic* is as applicable to large areas of undoubted newer formations as to the Highlands rocks, if the absence of life remains be the basis of our nomenclature. Lastly the possibility of future discoveries of the slightest traces of even th lowliest forms of life renders the continuance of *Azoic* doubtful. *Archæan* is not open to these objections, including, as it does, the earliest rocks, or original crust of the earth and the first sediments deposited in that "era in which appeared the earliest and simplest forms of animals." * Adopting the term *Archæan,* the possibility of a subdivision upon lithological grounds has been pointed out in the statement upon structure.† The more massive and unstratified out-crops, or granitoid gneissic areas constitute the older central masses about which the more distinctly bedded and schistose rocks have been deposited. And they belong to two well-defined horizons or periods of Archæan time. At present there is no evidence from any remains of life to separate the one from the other. They are distinguished by their diverse lithological characters and geographical position. It may be said here that the rocks of the New York Highlands resemble closely the typical gneisses and other crystalline rocks of the Laurentian of Canada, but this resemblance, of itself, appears insufficient to decide the fact of exact equivalency of horizon in the case of so widely-separated formations.

The identification of a Huronian group by means of rock characters has not been made out, nor do there appear to be, so far as the present reconnaissance goes, any out-crops which can be thus recognized as corresponding to the typical Huronian rocks. Provisionally, the formation in the Highlands, as outlined in the preceding sections, is designated as *Archæan*. It may be Laurentian also.§

The reconnaissance in the country south of the Highlands and in Westchester county shows the existence of a great variety of crystalline rocks. Aside from the out-crop of the Cortland series of Prof. Dana, and the limestones there appear to be two great classes of out-crops, as in the Highlands, but not counterparts of one another in all respects. The Highlands type of a grey, massive, granitoid gneiss approaching a granulyte, is recognized but not developed over so wide belts, apparently, as to the north, in the Archæan district.‖ Far more common is the other class, in which are here included the micaceous gneisses and mica schist marked by the presence of biotite and less frequently by garnets, and the hornblende schists which contain biotite also. These micaceous and hornblendic rocks are dark-colored, and are schistose in structure. In stratification the bedding of the latter is thin and more contorted in strike. To the ordinary observer they look possibly more like the common fragmental rocks than do the more massive grey, granitoid gneisses. They seem to

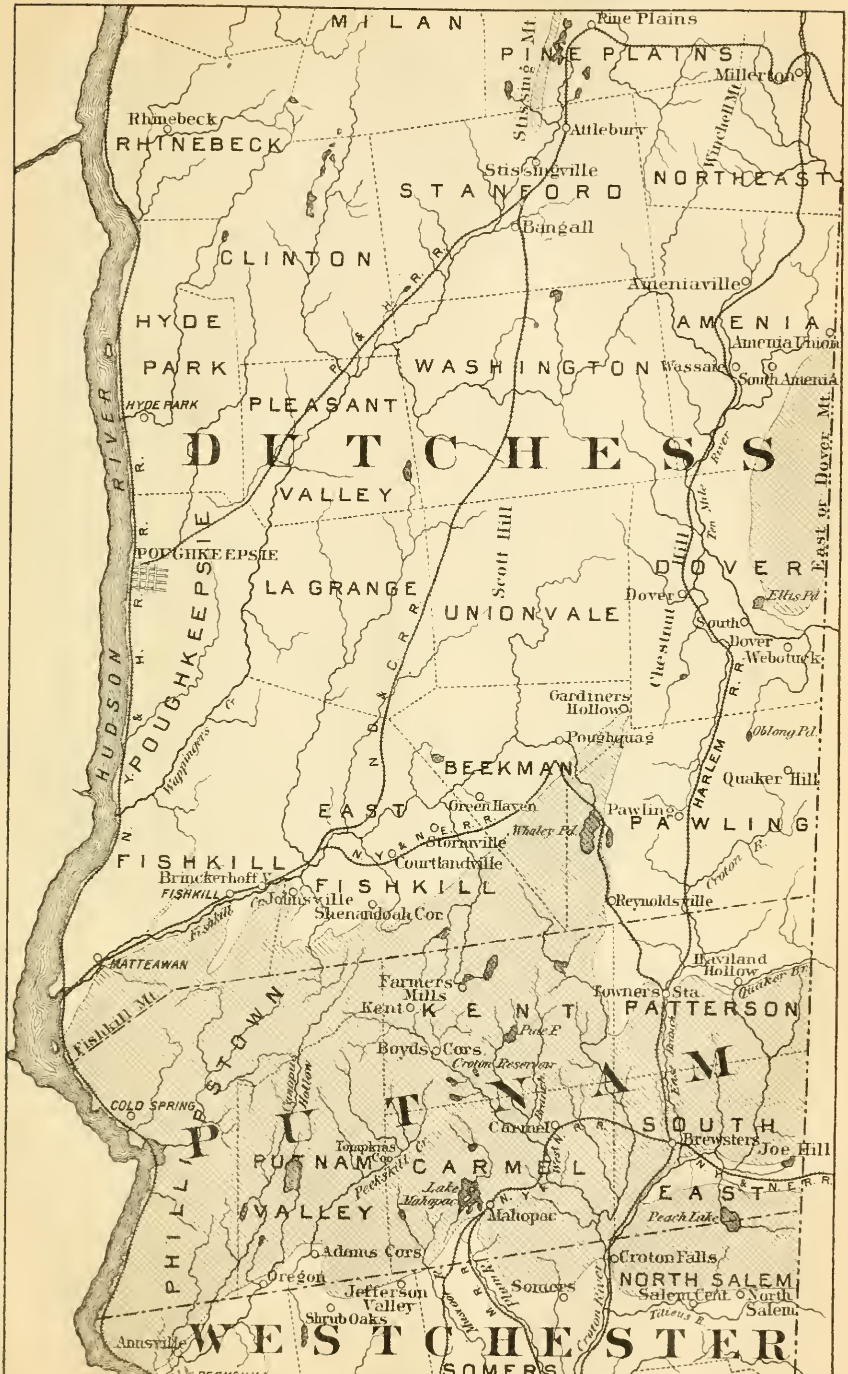
* *Manual of Geology, by Jas. D. Dana,* 1874, p. . See, also, *Am. Jour. of Science* (3), XXVIII, pp. 313-314.

† Pages *of this report.*

§ It is proper to state in this connection, that in the absence of all palæontological evidences of age, this recourse to the nature of the rocks is not considered as altogether and absolutely scientific, since lithological resemblances cannot be regarded as conclusive proofs of geological age. They indicate like conditions, and these conditions when found prevailing over wide areas of out-crops, which are overlain by rocks of known horizons, may be suggestive of equivalency of age when taken in connection with the relation to adjacent fossiliferous formations.

‖ See page of this report.

MAP OF THE ARCHÆAN AREAS OF THE HIGHLANDS, EAST OF THE HUDSON RIVER IN NEW YORK.



Scale 6 3/10 Miles to one Inch.

Weed Parsons & Co. Albany N.Y.

differ from the schists east and north-east of the Highlands, in having less quartz and more biotite and hornblende, and in being not so generally laminated in structure. From the mineral aggregation it is evident that they contain more iron than the former and much less silica in form of quartz. These differences, it should be here said, are not apparent always in hand specimens. They come out when the district is viewed more or less as a whole and by the field geologist who has had some experience in the crystalline rocks to the north, in the Highlands and in the country to the north-east of the Highlands. On account of want of time it was not possible to trace out the outcrops, marked by these diverse characters, or to determine how their outcrops are related.

From the occurrence of areas of grey, granitoid gneisses in the Highlands on the north, it is reasonable to assume that like belts or isolated areas will be discovered in the Westchester county region also—the southward continuation of the Highlands Archæan formation. The existence of a main belt or range with its outliers on both the north and the south, in Archæan time, is quite as probable as that of like separate outcrops in the formations of subsequent eras. And it appears to be so highly probable an hypothesis that it is presented in this report as the one 'est suited to meet the facts and to explain the structure of a part of Westchester county. What designation shall be given to these typical schist formations is not so important. The term *Manhattan gneiss* or *series*, proposed by Professor Hall in , commends itself, coming from the typical localities on New York Island and the adjacent parts of Westchester county.

Note.—Reference should be made here to the work which has been done by Prof. Dana on the geological structure of Westchester county and New York Island, particularly in mapping the limestone belts; in showing the position of the strata in these belts and that of the adjacent schists and gneisses; and in the study and description of the rocks composing them. What Prof. Dana has done in the limestone out-crops adds very largely to our knowledge of the district and is of great value in the study of the gneisses and associated crystalline rock of the adjacent territory. A like carefully-executed survey of the gneisses and schistose rocks will, it is believed, demonstrate that hypothesis which is set forth as our working basis.

REPORT ON BUILDING STONES.

By Prof. JAMES HALL

The following report on building stones was communicated to the Commissioners of the New Capitol in 1868. The report was called for before it could be properly completed, and much material intended for incorporation, was never finally prepared for publication. At that time the author was promised further facilities for continuing and completing the work, but these were never granted, and the report, in its very incomplete and unsatisfactory condition, has remained as originally published. The small number of copies at that time issued was quite insufficient to supply the demand; and the author has been frequently solicited to republish the report. This has been postponed from time to time, in the hope of being able to add matter of interest, and especially some tables of the comparative strength and resistance to crushing force. But these data still remain as they were recorded in 1868; and there is no prospect of being able to resume a work which, if properly carried out, would be of important economic value.

The report is herewith communicated as originally presented. It forms a part of the work accomplished by the author since assuming the charge of the State Museum of Natural History in 1866. It may very properly be regarded as the result of museum work. It is illustrated by the museum collections of marbles, building stones, etc., chiefly in the material occupying the shelves along the sides of the entrance-hall of the State Museum on State street.

January, 1886.

PRELIMINARY REPORT.

[Communicated to the Commissioners of the New Capitol in 1868.]

Hon. HAMILTON HARRIS,

Chairman of New Capitol Commissioners:

DEAR SIR — According to instructions received from yourself and Hon. J. V. L. Pruyn in June, 1867, I proceeded to examine the quarries of building stone within the limits of the State of New York, and also those in adjacent States from which materials had been, or were proposed to be offered for the building of the New Capitol.

To this object I devoted the greater part of my time during the remainder of the season, returning from my last journey on the 4th of December; leaving the investigation, however, very far from being completed. During this time I visited many of the quarries within the State of New York and others in the State of Massachusetts, and some in Connecticut, Vermont, New Hampshire, Maine, and Ohio.

In order to have before you the tangible results of this investigation, I have brought to Albany, and deposited in the Geological Rooms, specimens from the greater part of the quarries examined. In nearly all cases the specimens were freely contributed by the proprietors of the quarries, and some of them in the most liberal and handsome manner, as I shall have occasion to mention in the course of my report. Other specimens have likewise been promised for the collection, from quarries examined, and from others not visited. The materials now arranged in the Hall of the Geological Rooms, though far from complete, constitute a valuable and instructive series of building stones; from among which, I believe, satisfactory selections may be made, not only for the construction of the New Capitol, in its foundations and superstructure, but they will serve as a guide for architects and others in the selection of materials for other purposes.

I had hoped to be able to finish my observations upon the quarries, and the general distribution of building material, during the present season; but other duties have prevented this, and I would respectfully suggest that some further examination, particularly in some parts of New York, be authorized by the Commissioners before the Report shall be considered complete. I venture to suggest this, believing that a more acceptable service could not be rendered to the building and economic interests of the State; and the New Capitol Commissioners have an opportunity of rendering this service to the general welfare of the community, while fortifying themselves with all available information to govern their own action in the selection of materials, not only for the exterior walls, but for interior use and decoration.

For the latter object, I would very earnestly recommend that specimens from all formations yielding marble, or of limestone bearing a good polish, be used in some part of the New Capitol work. With this object in view, I have already procured specimens of some of these stones, but the collection in this department is scarcely begun.

I have already recommended to you certain localities from which foundation stones may be obtained. In this statement, I think I omitted, or did not definitely specify, the locality of gneiss or granite in the Highlands on the Hudson river, of which the quarries at Breakneck and Butter hill offer good examples.

As a preliminary to our inquiries after *proper building stone*, we may first consider what are the materials with which we have to deal. The rocks or varieties of rocks offered in nature, and from which we are compelled to make our selections, may be named under the following heads:

1. GRANITES, including SIENITE, GNEISS, etc.
2. MARBLES, *or* METAMORPHIC CRYSTALLINE LIMESTONES.
3. LIMESTONES, *not metamorphic, compact or subcrystalline.*
4. SANDSTONES *or* FREESTONES, *and* their varieties resulting from admixture of clay or carbonate of lime, etc.

In the first place, it should be understood that under each of these heads there is an almost infinite variety in *texture*, *color*, *power* of *resistance* to *pressure*, *durability*, etc.; that the substances named are very widely distributed, and that they vary in different and distant localities; that a *sandstone* is rarely a purely siliceous rock, or a *limestone* a purely calcareous or calcareo-magnesian rock; other materials foreign to their strict constitution, according to the usual designation, enter into their composition, and, for the most part, to the injury of the mass. In the purely sedimentary rocks, which have undergone no subsequent change, the sandstones are more or less permeated by argillaceous matter or clay, which constituted a part of the original sediment, and which may be uniformly mingled throughout the entire mass, or may form thin layers or seams separating the harder layers. In either case it is a dangerous ingredient; for no rock with clay seams can long be exposed to the weather, without a greater or less degree of separation or disintegration; and when any considerable amount of the same material is distributed through the mass, its ready absorption of water renders it equally dangerous to the stability and integrity of the whole. Placed beneath the surface, and beyond the reach of frosts, the conditions are different, and such rocks last for an indefinite period of time.

The same remarks hold true with regard to limestones; and there are few limestones that are not marked by partings of shale or clay, which, in the course of time, weather into open seams, causing those unsightly appearances so common in structures of this kind.

In the granite and crystalline limestones, other causes, as the want of cohesion among the particles, presence of destructive agents or liability to chemical changes, and seams or patches of foreign matter, are symptoms to be guarded against. It is not because a rock offered as a building stone is a *granite*, a *marble*, a *limestone*, or a *sandstone*, that it is good or bad; but this characteristic is to be sought in other conditions, and the objectionable feature may be accidental or adventitious.

One other condition should be remembered. These materials used for building are not promiscuously distributed over the country, but are restricted to certain geological formations, and can only be found within certain limits. Although we find granite, gneiss, and various sienites, with crystalline limestone, in the mountainous regions of Northern New York, it would be quite absurd to look for rocks of this kind in the Catskill mountains. We find white and variegated marbles in the region skirting the Highlands on the east, and extending through Western Connecticut, Massachusetts and Vermont; but no well informed person expects this material in the Helderberg mountains, or in the hills of the southern counties of New York. Investigation has shown that certain kinds of rock, or rocks of similar but very distinct characteristics, are confined to certain geological formations, and do not occur out of these; and again, that these formations have certain limits which are already defined and well understood. Geology has so well defined these matters, and the association of certain rocks and minerals, that when told that a known geological formation covers a portion of country, we know what kind and character of rocks and other mineral products to expect.

In a State where the geological structure is so well known as that of New York, I think I may be allowed to speak of the various building materials under the heads of the several geological formations to which they belong, or in which they occur; thus conveying general information, while treating of the *special subject*.

All the GRANITES, *granitic*, *sienitic*, or *gneissoid* rocks of the State are confined either to the northern portion, known as the Adirondack region, from the name of the high mountain range in its central part; or to the Highland region along the Hudson river, which is of the same geological age as the northern portion, and all belonging to the Laurentian System.

In the northern part of the State, CRYSTALLINE LIMESTONE, of various colors, is associated with granitic or gneissoid rocks; the same is true, in a less degree, of the granitic region of the Highlands.

The WHITE and VARIEGATED MARBLES, so much in general use, belong to a different geological age and constitute a distinct belt of formation, running to the eastward of the Highlands generally, and occupying portions of Westchester and Dutchess counties in New York, and thence extending into Connecticut and Massachusetts. The ordinary gray or dark-colored bluish limestones and the various colored sandstones have a much wider distribution, but are still limited to certain belts of country.

Treating these in their order, we may arrange and discuss them as follows:

I.

GRANITES, INCLUDING SIENITES, GNEISS, OR GNEISSOID AND SIENITIC ROCKS; THEIR GEOLOGICAL POSITION AND GEOGRAPHICAL DISTRIBUTION.

The term granite, in its strict signification, means a crystalline rock composed of quartz, felspar and mica in intimate mixture, the separate minerals being composed of crystalline grains. It is a very common condition of the granitic rocks, that the mica may be absent, and in its stead we have hornblende, and in this form the rock is termed a sienite.* On the other hand, the presence of mica in thin scales, forming lamination, or rendering the lines of bedding visible by coloration or otherwise, produces what we term *gneiss;* though some geologists would apply the term *gneiss* to all stratified granitic rocks.

The proportion of mica in gneiss is not necessarily larger than in some of the granites; but the faces of the thin laminæ being arranged parallel to the lines of bedding and the freest line of cleavage, causes it often to appear in larger proportion.†

Quartz, felspar and hornblende without mica or with a very small proportion of this mineral, constitute some of the best granites; while in the lighter gray or whitish gray granites, the quartz, or quartz and felspar, are the chief component parts, and there is little either of hornblende or mica. The grains or aggregations of these minerals may sometimes be so large that each one presents its distinctive mineralogical or individual character, becoming so coarsely crystalline as to be unfit for building purposes.

GRANITES OF NEW YORK.

In the lower portion of the Adirondack region, or the Laurentian System bordering Lake Champlain and extending from Saratoga to Clinton county, the rocks consist mainly of a gray gneissoid granite, which is sometimes traversed by coarser crystalline veins, and sometimes nearly or entirely losing its gneissoid character from the small proportion of mica, but always regularly stratified. The latter character is presented in the exposures at Little Falls and other places;

* The Egyptian sienite or syenite, according to DELESSE, contains mica.

† A distinction has sometimes been made between gneiss and granite, that the one is stratified and the other not. This does not hold true; for nearly all, if not all, the granites that are extensively quarried are stratified, and I believe all of them cleave in one direction more freely than in another, while the other free line of cleavage or breaking is rectangular to the first.

while the true compact gneiss is seen at the quarries in Saratoga county, and the partial or entire absence of the mica characterizes the rock at many localities farther to the north. This gray gneissoid rock graduates downward, through alternating beds of variable character, into a hornblende rock, and becomes a compact dark-colored sienite extremely hard and tough in its character.

The same general features prevail in the granite rocks in the Highlands as exposed along the Hudson river, the strata being tilted at a high angle. In many places, however, the lines of bedding become obscure, the mica is to a great degree absent, and the rock assumes the character of a true granite. The principal points of exposure, where the gneiss or granite of the Highlands has been quarried, are at Butter hill, on the west side of the river, and at Breakneck on the east side. In some portions of the mass, at both of these localities, the rock loses in a measure its gneissoid character, and presents a comparatively even admixture of the component parts. At both localities the rock is penetrated by trap dykes, which have affected the beds adjacent to them; and these, together with other causes, have produced a more than ordinarily fractured or jointed condition of the rock.

In the higher part of the Laurentian series, and in localities more inaccessible to means of transportation, we have the highly felspathic granites of the central portion of the Adirondack region. These are usually coarsely crystalline and of a dark color, but weathering to a lighter hue. They have nowhere been brought into use for building purposes; and not being within the limits of reasonable cost of transportation, it is scarcely worth while to indicate their localities more particularly.

Granites of New England.

The granites examined beyond the limits of the State belong to an entirely different geological age from those of New York, and present a different aspect in the aggregation of their component parts. They moreover differ among themselves, in a very extreme degree, both in color and texture; varying from the dark-colored compact sienite of Quincy and the neighborhood, through the lighter-colored varieties of the same locality and that of Chelmsford and other places, to the greyish-white varieties like that of Rockport on Cape Ann. All the quarries that I have examined along the coast are free from mica; and when hornblende is not present, we have the quartz and felspar only. The dark colors are usually due to the presence of hornblende; the reddish or brownish colors, to the colored felspar; and some of the quarries offer a granite of quartz, brownish felspar and dark hornblende, giving thus within these ranges a considerable variety of color, due either to the original color of the substances, or to the proportions in which they are mingled in the mass.

The principal quarries that came under my observation were those of Quincy and Weymouth, Rockport on Cape Ann and Dix island in Maine, with others of less importance. The collection embraces specimens from each of these places. All of the granites (sienites) quarried along the coast are durable stones; a character determined as well from their abundant use in building, as also from their exposed surfaces in nature, which have withstood the action of weathering for centuries without perceptible disintegration.

The granites of the interior of New England, as of Concord and Fitzwilliam in New Hampshire, Hallowell in Maine, Medfield in Massachusetts, Westerly in Rhode Island, and of Barre, Berlin and other places in Vermont, are compounds of quartz, felspar and mica. They are, for the most part, light-colored and fine grained. The felspar predominates, and they are easily wrought and bear fine working.

The Concord granite, which is now so largely in use, occupies a long hill near the town of Concord in New Hampshire, which has a direction or range from north-east to south-west. It is quarried at several places on this hill, within a moderate distance from the town and railroad. The rock presents distinct lines of bedding with an apparent dip to the north-west, as indicated by seams or laminæ of different color, and also by the splitting of the rock both in the line or *rift* (so termed by the workmen), and in the direction perpendicular or vertical to the lines of bedding.*

The beds of this granite are unequal in thickness, varying from one to three or four, or even five or six feet, which can be split in any desired lengths. The texture is pretty even, with some coarser beds, with occasionally some blotches of coarser or finer, or lighter or darker material.

The granite of Fitzwilliam, a locality some forty miles west of Concord, occupies a hill having a direction from north-east to south-west, with the dip apparently to the north-east. In texture and quality it is very similar to that of Concord, the prevailing beds perhaps a little thinner, the thickest being four feet. The rock is easily worked, and can be dressed with great facility.†

A mile northward of the principal quarries the rock is somewhat coarser in texture, but of similar light gray color, readily worked, and making a handsome building stone. The granite of Hallowell in Maine is similar in texture to that of Concord and Fitzwilliam.

There is also a light-colored granite in the town of Medfield in Massachusetts, from which the Court-house in Dedham has been built. In color and texture, this granite differs but little from the Concord granite, being perhaps a little coarser. The Court-house was erected more than forty years ago; and considering the time and the less perfect dressing of the stone as compared with work of the present day, the building still presents a very fine appearance.

The granites of Barre, Berlin and other places in Vermont, are of

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* In splitting the blocks vertically to the bedding, I am informed by the foreman of the quarry, Mr. ROE, that they open much more readily in lines east and west and north and south, than in any direction oblique to these.

† I am informed that the statues on the Horticultural Hall in Tremont street, Boston, are from the Fitzwilliam granite, the structure itself being of Concord granite.

a whitish-gray color, with the component parts very distinctly granular and evenly mixed throughout, containing less mica than the Concord and Fitzwilliam granites, and producing one of the finest building materials in the country, possessing a fine color, strength and durability.

II.

Marbles, or Metamorphic Crystalline Limestones; their Geological Position and Geographical Distribution.

Crystalline limestones are everywhere interstratified with the gneiss rocks of the Laurentian System, but usually forming a very small proportion of the entire mass. These limestones frequently contain a large proportion of other minerals, as serpentine, augite, etc.; often producing a marble of variegated character which is quite ornamental. When free from these materials, it is often grayish or bluish-gray, and generally coarsely crystalline.

Limestones of this age follow the line of outcrop of the gneiss of the same system, appearing to the northward in Saratoga county, and extending thence with more or less continuity through Warren, Essex and Clinton counties. In St. Lawrence and Jefferson counties, the crystalline limestones of the same age are more extensively developed, and have there been known and used for a long time. The same limestones likewise occur in Lewis county. In some localities these limestones are cut and wrought as a marble; but generally they have only a local use, though some of them with the serpentine admixture may yet prove of general commercial value.

The white and variegated marbles of commerce are mainly confined to the geological formation known as the Quebec group, which underlies a belt of country extending from Canada through Vermont, the western part of Massachusetts and Connecticut; thence into the eastern part of New York, through New Jersey, Pennsylvania, Maryland, etc.

The marbles of this group are largely quarried in Westchester county; and the quarries of Tuckahoe and Scarsdale, and other points, furnish large quantities of the material for buildings in New York city and elsewhere. The rock is rather coarsely crystalline, but compact and durable. The same marble, on the west side of the synclinal axis, is quarried at Hastings and at Sing Sing, and also at several places in Dutchess county.

The formation is abundantly developed in Litchfield county, in Connecticut, and at Stockbridge, Sheffield, Egremount, Barrington, Alford and other places in Massachusetts.

In its northern extension, the same formation furnishes the marbles of Vermont, at Rutland, Southerland Falls, Brandon and other places.

Neither to the eastward nor to the westward of this formation are there any extensive beds of white or variegated marble, and the great sources of this material for building and ornamental purposes is to be songht in this range of rocks.

III.

Limestones not Metamorphic, Compact or Subcrystalline; their Geological and Geographical Distribution.

The limestones used in building, or for foundations, canal locks, bridge abutments and other solid masonry, are very widely distributed, and in great variety within the State of New York.

In their geological order, we have the *Chazy limestone*, the *Trenton limestone group* (embracing the *Birdseye*, *Black river* and *Trenton limestone* proper), the *Niagara limestone*, the *Lower* and *Upper Helderberg limestone groups*, and the *Tully limestone.*

These limestones vary from a dark bluish-black or black color to bluish-gray, gray, or sometimes reddish or brownish-gray.

1. The oldest of these, the Chazy limestone, as its name indicates, occurs at Chazy in New York. It forms the island known as Isle la Motte, and other islands in Lake Champlain, and extends likewise into Vermont and Canada. It exists in heavy beds, and is largely quarried for different purposes, as will be mentioned hereafter.

2. The Trenton limestone group, in one or more of its members, occurs both on the east and west shores of Lake Champlain, and is extensively quarried at Willsborough and other places. The same rock occurs at Glens Falls and in the neighborhood of Saratoga Springs. It likewise extends along the Mohawk valley from the neighborhood of Hoffman's Ferry to Little Falls, and is quarried at Amsterdam, Tribes Hill, and other places. At Little Falls the continuity of the limestone formation is interrupted by the southern extension of the Gneiss formation, but it comes in again to the south and west beyond this, and is extensively quarried at Jacksonburgh on the south side of the Mohawk river. The same formation extends, by the way of Trenton Falls, through Lewis and Jefferson counties, everywhere offering quarries for building-stone and for lime.

3. The Niagara limestone, though extending further to the eastward, acquires little force or thickness till we reach Monroe county, where it has a considerable thickness on the Genesee river, and some of the beds of the formation are valuable as quarry-stones. It is only in the neighborhood of Lockport, however, that the lower beds of this formation become important as a building stone. The principal working beds are a light gray stone, varying in some instances to a brownish color from the admixture of organic remains. The same limestone occurs at Niagara Falls and vicinity, extending thence through Canada West to Lake Huron. The upper parts of the formation are of a brownish, or often of an ashen gray color, with irregular bedding and of unequal texture, as well as marked by cavities and crystalline masses of calc-spar, selenite or compact gypsum, celestine, etc. The stone of this part of the formation is adapted only to the heavier and coarser masonry, and care is required in its selection to secure a strong and durable stone.

4. The Lower Helderberg limestone formation, in its most easterly extension within New York, appears in the Helderberg mountains and extends west as far as Herkimer county. The lower beds of the formation afford a very excellent building stone of a dark-bluish color, which, when polished, is nearly black. It is principally quarried at Schoharie and Cobleskill; it is likewise worked at Carlisle and Cherry Valley, and to a small extent at points west of the latter place. The middle portion of the group consists of a gray or bluish-gray subcrystalline limestone, but affords no beds of great value for building material. The upper member of this formation is a gray subcrystalline limestone, sometimes variegated with brownish spots from organic remains. It is quarried both for a building stone for rough masonry, and likewise for a marble, bearing a pretty good polish, and the variety of color from the fossils gives it a handsome appearance.

5. The Upper Helderberg limestone formation consists principally of two members, the Onondaga and Seneca limestones. The former was so named from its having been extensively quarried in Onondaga county; and the latter, from its greater development in Seneca county.

This formation, or group, extends through the State of New York from the Hudson river westward to Black Rock on the Niagara. Constituting the higher limestone of the Helderberg mountains, it approaches the river, and continues in its outcrop along the river counties as far as Kingston in Ulster, where one of its members is largely quarried for various building purposes. The Onondaga limestone is worked at various points along its outcrop; but the principal quarries are in the county of Onondaga, to the southward of Syracuse. From this neighborhood, the stone was used for building some of the locks on the Erie canal in its original construction, and has been extensively used in the enlarged canal, as well as in the buildings of Syracuse. The upper member of the formation is quarried at Springport in Cayuga county, and largely in the neighborhood of Seneca Falls. From this point through the western counties one or both the members of this group are more or less extensively quarried, and used in building, or for door and window caps and sills, foundations, and other masonry.

6. The Tully limestone constitutes a belt of formation of from one to twenty-five feet in thickness, lying above the shales of the Hamilton group and below the Genesee slate. The geographical extent of this formation is very limited, having no great thickness or importance to the east of Cayuga county, and almost entirely disappearing on the west within the limits of Ontario county. It is mentioned here among the sources of building material, but it is rarely in such a condition as to be reliable for this purpose.

IV.

Sandstones or Freestones, and their Varieties; their Geological Position and Geographical Distribution within the State of New York.

1. The Potsdam sandstone formation is the lowest member of the unaltered stratified rocks. The formation consists of numerous beds of varying thickness, and of a gray, white, buff or red color. The rock is naturally fine-grained and compact, and in many localities furnishes a strong durable material. The beds are usually thin, but generally sufficiently thick for the ordinary purposes of construction.

In its eastern extension, this formation occupies a considerable area in Washington county, and is especially conspicuous in the neighborhood of Whitehall. It occurs at numerous places along the west side of Lake Champlain, and is especially developed in the neighborhood of Keeseville. In some parts of Clinton county the rock is too friable for any economical use beyond furnishing sand for glass-making. In Franklin county, at Malone, the rock has been extensively quarried and used for building and flagging stones for many years past. At Potsdam, and other places in St. Lawrence county, the stone is of a reddish brown color, close-grained and compact in texture. The rock continues of similar character in Jefferson county on the north side of the Black river valley. Its commonly striped or variegated color offers an objectionable feature for general use in building.

2. Sandstones and argillaceous sandstones of the Quebec and Hudson river groups. Certain parts of both of these groups of rocks furnish building stones of greater or less value. The greater part of the stone known as *blue stone* (the Malden *blue stone* belongs to a different formation and has a different character), along the Hudson and Mohawk valleys is derived from one or other of these formations. The higher beds of the Hudson river group have also been quarried in Oneida, Oswego and Lewis counties, but they are not extensively used.

The quarries along the Mohawk river below Schenectady have furnished a large quantity of this blue stone, for foundations, water tables, and for entire buildings. Where the strata are but little disturbed and lie nearly horizontally, the beds are easily worked, and the blocks are readily dressed. The rock can be quarried in regular masses and of any required dimensions. In the valley of the Hudson, the rock is so much disturbed that the strata are broken, and do not readily afford the means of furnishing large quantities of regular formed blocks for masonry. Nevertheless they are largely used for foundation stone, and many thousands of tons are annually quarried along the river. At and below Poughkeepsie, the stone of this character, quarried along the river, is of the Quebec group. The strata all consist of an argillaceous sandstone, very compact and strong, but breaking irregularly. Those which break into large masses are very strong, and make excellent foundation stones; but I believe none of the beds are used for dressed stone.

The two formations lie side by side along the Hudson river valley, extending northward through Washington county and into Vermont and Canada.

To the westward, the Hudson river group extends along the Mohawk valley, and thence in its upper members through Lewis and Oswego counties; overbearing in its upper part some heavy-bedded gray sandstone which is available for foundations and rough masonry, but I am not aware that it has been much used in the superstructure of buildings.

3. The Medina sandstone formation, from its eastern extension in Oswego county to the Nigara river, furnishes building stone in some of its beds, which, in some localities, is good and reliable, while in other parts of the same formation it becomes rapidly disintegrated upon exposure to the atmosphere. It is quarried at Fulton and other places in Oswego county, and at a few points in Wayne county. It has been heretofore quarried on the Genesee river below Rochester; but the more reliable quarries are at Holly, Albion, Medina and Lockport; and again it crops out in the bank of the Niagara river above Lewiston, where it can be worked with facility. The formation furnishes valuable flagstones in the neighborhood of Lockport.

4. Sandstones of the Clinton group. The Clinton group is made up of a series of shales, thin beds of limestone, and impure shaly sandstone with more perfect beds of the latter. In Herkimer county, on the south side of the Mohawk river, there are some beds of brown sandstone in this group which are worthy of attention. The material is mainly siliceous and the texture good. So far as known, these beds are limited within the width of the county. In the same neighborhood, and lying above the brown beds, there is a considerable thickness of gray siliceous sandstones of the most durable character. So far as known, the rock has not been quarried to any considerable extent, and its economic value is, therefore, not fully known. In other parts of the Clinton group, there are thin flaggy beds which are used for rough building or foundation stones.

5. The Oriskany sandstone, though a good and valuable stone in some of its strata, does not occur in such thick or extensive beds as to render its use very extensive, and, except locally, it is unknown as a building stone.

6. Freestones or argillaceous sandstone and flagstone of the Portage group and upper part of the Hamilton group. In Eastern New York, the upper part of the Hamilton group and lower part of the Portage group yield an abundance of the finest flagstone yet known in any part of the country. Some of these beds become thick enough for building purposes; and the fine "*blue stone*" of the Malden quarries on the Hudson river (now much used), is from the lower part of the Portage group. In Central New York, the upper part of the Portage group yields an abundance of fine-grained argillaceous sandstone, which is not always durable. In the extreme

western counties of the State, however, some of the beds are durable, and make a valuable building stone.

The extension of the same formation into Ohio yields the famous fine-grained standstone of Berea, and the gray freestone of Amherst and vicinity ; the latter of which is now so largely used for building in New York and Philadelphia, Cleveland and Buffalo, and which enters into the construction of the Houses of Parliament at Ottawa.

This sandstone, like all others of the same class of rocks, is very variable in its character at different points along the outcrop of the formation ; owing chiefly to the greater or less proportion of argillaceous matter contained in the mass, and sometimes the almost entire absence of that material. The latter condition exists in some of the beds at Berea, but more particularly in those of Amherst and neighborhood.

7. The sandstone and argillaceous sandstone of the Chemung group are very irregularly distributed over the southern counties of the State. The beds fit for building-stone are usually intercalated between shaly beds, and sometimes continuous for many miles; while the coarser masses are not frequently lenticular in form, thinning away in every direction, or ending in thinly laminated beds which are unfit for building stone, but may be used for flagstones.

The stone varies in different localities and in different beds, from fine sandy layers of a light gray color, to more or less of an argillaceous character with a dark olive-brown color. It is not possible to trace any set of beds continuously through the country, and the rock can scarcely come into general use for building purposes. In certain localities, the arenaceous beds will prove of great value to the immediate neighborhood.

8. New red sandstone. Within the State of New York, this rock is limited to the county of Rockland; extending from Haverstraw along the river, beyond the limits of the State into New Jersey. The same sandstone has a wide area in the Connecticut river valley, and it is from this region that we chiefly know it in its uses as a building stone. Within the State, the stone has been quarried at Haverstraw, and on the river bank below; though it has not been extensively used from these localities, so far as I know. The quarries in New Jersey have been more extensively worked; and from the stone there obtained, some fine structures have been erected. The same formation extends through Maryland, where it has furnished material for the erection of the Smithsonian Institution and other buildings in Washington.

The *brown stone*, in its varieties, is well known in all the Atlantic cities, and has been more extensively used than any other in the country.

I have sketched, in a hasty manner, the general geological and geographical distribution of the principal building stones which may be brought before you for consideration. The portions of the country occupied by these have been roughly traced in different colors upon the map accompanying this report, so far as it covers the ground. I shall hope to have an opportunity of completing this work, and presenting such a map as will illustrate the important points relating to the subject of materials for construction and ornamentation.

V.

On the Selection of Building Stones, and the Causes of their Decay.

In the selection of building stones for the exterior walls of a building, *color*, *texture*, and *durability* are objects of the first importance; and all of these ought to be combined, to render the structure perfect. Too little attention has been given to the subject of building stones; while on the one hand we are largely using a brown stone, which gives a sombre, cheerless aspect to the structure, the opposite extreme has been sought in the white marble, or that which is more nearly white in color. In contrast with these we have the red glaring color of brick; and it is only partially that this offensive aspect is palliated by painting of neutral tints. In a few eastern cities and towns we find the light gray granites now used in preference to the brown freestone, the white marble, or the dark granite, which have been much in use in past years.

No one can fail to experience the sensation of relief afforded by the structures, of light-colored granites in the city of Boston, or those of the buff or dove-colored limestone in the city of Chicago, or of the light gray freestone of many buildings in Cleveland and other places and of the buff-colored brick of Milwaukee. In these cases we have not the excessive reflection of light, or the glare which comes from white buildings whether of marble or of painted brick; nor the sombre, cheerless expression of the darker stone, caused by its great absorption of light. It is only necessary to consider the effects produced by the structures of these different materials upon one's own sensation, in order to determine what are the most agreeable tints, or those which please the eye and produce a cheerful impression upon the mind.

In the majority of structures, the necessities of locality, cheapness, or other causes compel the erection of structures from materials most accessible; but these considerations are not imperative in the cases of an important public building.

In many cases where the rock is homogeneous throughout and the color uniform and satisfactory, it is only to be inquired whether the coloring material is such as will produce decay or disintegration of the particles. When the general color is produced by the aggregation of different materials of distinct coloration, the character of each one is to be considered, and its effect upon the whole; and it is important to have such material comparatively fine-grained, and the different parts as uniformly mingled together as possible. As a general rule, it is only in the darker stones that the coloring matter has any tendency to disintegrate the mass.

In the selection of building stones, the simple presentation of a sample is not enough. The rock in place should be examined in the outset; for in its natural outcrop it has been exposed to the action of the weather, in all its influences, for many thousands of years. One of the principles taught in elementary geology is that the soft and decomposing rocks appear in low rounded or flattened exposures, or entirely covered by the soil or their own debris, forming no conspicuous feature in the country; while on the contrary the harder rocks stand out in relief, producing marked and distinguishing features in the landscape. It not unfrequently happens that the geologist, having familiarized himself with the succession and character of the rocks of a particular locality or neighborhood, by seizing the features and character of the prominent beds, is able to trace them in succession along the escarpment or mountain range as far as the eye can reach, and to approach them from any distant point with assurance that he has not been deceived.

The strata which make these features in the landscape are the ever-enduring rocks, which have withstood the action of the atmosphere through a period a thousand times longer than any structure of human origin. One cannot doubt that if properly placed in any artificial structure, they would still withstand the action of the elements. These escarpments, in their natural situation, may be coarse, rough and forbidding, more or less dilapidated or unequally dilapidated from the effects of time; but as they there present themselves, we shall be able to see their future in any structure exposed to the same influences.

It is true, however, that no artificial structure or position will ever subject the stone to the same degree of weathering influence to which it is exposed in its natural position, but the same changes in degree will supervene upon any freshly exposed surfaces. In its natural position the bed has been encased in ice, washed by currents, saturated with rains and melting snows, frozen and thawed, and exposed to the extreme of summer heat without mitigation. The rock which has withstood these influences is quite equal to withstand the exposures of a few centuries in an artificial structure. Yet there are occasionally modifying influences and conditions which have sometimes subdued the permanence of a durable stone, and given preference to others less durable. It therefore becomes necessary to carefully examine all these conditions, and to determine not only from the rock in place, but also from its physical constitution, whether it will meet the requirements of the structures proposed.

It not unfrequently happens, in working a quarry, that layers are reached which have not been exposed to the weather, and it is then necessary to test the strength and power of endurance of the stone. This may be done by repeated exposure to freezing and thawing, by testing the strength or power of resistance to pressure, etc. The exposure to freezing and thawing will not only determine its power of resisting the action of the weather, but will determine also whether such foreign ingredients as iron pyrites may exist in the mass. Chemical analysis may be resorted to for the purpose of comparison with specimens of known composition and durability ; but chemical analysis alone cannot determine, without other testing experiments, the strength or power of endurance of the stone.

In some countries, and in certain localities in our country, the evidence obtained from ancient structures is available in determining the durability of the stone which has been used. Yet it would seem that this information has been of little avail in many places, where the rebuilding of edifices is repeated every century. Experience in many cases does not teach the lesson anticipated ; and when a dilapidated structure is pointed out, the argument is made that "these stones were not well selected," or they were obtained "at the first opening of the quarry, and were not as good as now furnished." And again, as already remarked, there are few cases in which parties are permitted to select the material without prejudice, the influence of interest, or the absence of important information. Examples are everywhere before us of the improper selection of materials for buildings, and these examples do not deter from their use in the erection of others. When good material is abundant and accessible, it will be used ; in other situations, comparatively few durable structures are likely to be erected.

VI.

General Composition and comparative Durability of Building Stones.

All the stones used in building, under whatever name they may be known, are composed of a few essential elementary minerals ; these are:

1. Silica or Quartz;
2. Alumina-Clay or Argillaceous Matter;
3. Carbonate of Lime;
4. Carbonate of Magnesia.

Beyond these, except in crystalline rocks, the presence of other material is almost non-essential to the composition of the stone, often accidental or adventitious, and usually injurious to the integrity of the mass. The ultimate chemical composition of a stone has little to do, as a general rule, with its character for durability ; nor will a chemical analysis determine the value of a stone for building purposes.

Physical Conditions of the Aggregates of the several named Substances.

1. The silica or quartz may occur as a mechanical aggregation of

particles of sand simply cohering among themselves, or by the intervention of some argillaceous, ferruginous, or calcareous matter acting as a cement; or lastly through a partial solution and cementation of the siliceous particles themselves. In the latter case, and where the mass is pretty purely siliceous, the process may have gone so far as to give a vitreous rock known as quartzite. In many cases, however, the siliceous or arenaceous deposits present great inequalities of texture, from the aggregation of coarse particles or small pebbles among the finer materials, always to the injury of the strength and durability of the mass. Under certain other conditions, these mixtures become crystalline rocks of various character.

2. The clay, or argillaceous matter by itself or with a small admixture of silica, and often more or less of carbonate of lime, becomes a slate or shale rock, but quite unfit for building stone; and as a general rule, any rock in which argillaceous matter predominates is unfit for a durable building stone.

3. Carbonate of lime and magnesia, or the former alone, constitutes extensive beds of solid and durable stone, but which is often deteriorated by the presence of argillaceous matter. In many limestones, the mass consists of an aggregation of fine particles which have been deposited in the form of a fine calcareous mud. Other and often very extensive beds are visibly composed of the debris of shells and other organic bodies, cemented together by the finer particles of calcareous mud, or often by the partial solution of calcareous matter. Under the influence of subsequent conditions, these simple mechanical aggregations of calcareous matter, or the calcareous magnesian deposits, become crystalline marbles of various colors.

In the purely siliceous stones, or quartzites, the mass is too hard and brittle for easy working or comely shaping of the pieces; an admixture of clay or argillaceous matter being essential to the possibility of working stone whose basis is silica. When, however, this argillaceous material becomes excessive, the stone is liable to rapid disintegration from the action of the weather. While the silica absorbs but an extremely small quantity of water, the clay will absorb largely; and this, on freezing, will destroy the stone more or less rapidly. Some of the argillaceous sandstones, on drying in a hot sun and then being suddenly wetted, will crack and crumble into pieces. The same effect is often produced by the sudden freezing of large blocks which have been freshly quarried, and which still retain their water of absorption.

When the argillaceous matter is evenly and intimately mingled with particles of silica or quartz, and not in too large proportions, the stone will last a long time, and will disintegrate but slowly; but when the argillaceous material is in *seams* or *laminæ* of deposit, it is far more injurious, and every such seam in a block of stone must sooner or later lead to its destruction. The manner of this is very simple. The clay seam absorbs water, and, holding it while freezing, the seam expands; if disintegration does not immediately follow, the seam is widened so that it admits more water on the next occasion ; and so on successively with alternate freezing and thawing until an unsightly crevice is produced, which constantly widens and encroaches more or less on the adjacent parts till the stone is destroyed.

This condition occurs in the gray or light-colored freestones, as well as in the brown ones; but in the brown freestone or sandstone, there is a further cause of destruction. The coloring matter, which is also in part the cementing matter of the grains of sand, is ferruginous, the siliceous grains are covered with peroxide of iron, and this substance is intimately combined with the argillaceous matter of the mass which cements the particles. Experience has everywhere proved that the brown sandstones or freestones are not durable stones; their destructibility is not only due to the presence of argillaceous matter, but to the oxide of iron ; for the gray or neutral-tinted stones, of the same composition otherwise, are much more durable.

As an evidence of the rapid decomposition of the red or brown sandstone when the siliceous element is deficient, we may sometimes find a large area, which, when broken up, decomposes so rapidly that it becomes in a few years an arable soil. The same is essentially true in some parts of the Medina sandstone. In order to demonstrate this fact, it is only necessary to examine any building of brown stone which has been erected for a period of twenty-five years. The State Library building is an example in point. The Capitol and the Albany Academy have been longer erected, and were originally of better material than the Library building. The basement of the old City Hall in New York is an example of the same kind, where the brown stone, from its inherent destructibility and from the presence of clay seams, presents a dilapidated appearance; and other examples might be mentioned. In Europe the same condition exists, and many old buildings of the red or brown sandstone are falling in ruins.

In the lighter-colored sandstones, we have mainly to guard against clay seams and too large a proportion of argillaceous mixture in the mass. Beyond this, the presence of iron pyrites is to be looked for. This mineral is present in so many rocks of this character, especially those with a bluish or greenish olive tint, that it is to be suspected in all such stones. It should be remarked, moreover, that iron pyrites (sulphuret of iron), when in visible grains, nodules or crystals, is not so dangerous or destructive to the rock as when disseminated in fine or imperceptible grains through the entire mass. This mineral, however, may be so disseminated and not prove entirely destructive, since in some stones it decomposes from the first exposure to the weather, staining the exterior of a rusty hue, and thus continuing to exude as an oxide of iron so long as any of it is reached by the moisture of the atmosphere; at the same time the free sulphuric acid unites with the lime or magnesia, if either be present, or to some extent with the alumina in the absence of the other substances; and this chemical change may sometimes go on for a long time, without seriously affecting the texture of the stone, producing no important result beyond the unsightly appearance. Generally, however, the decomposition of the pyrites produces the gradual destruction of the stone.

We have in the State of New York a class of argillaceous sandstones largely in use as building stones, and which are less known in any other State. They are of the character of rocks formerly known as "*Graywacke*," and the name might be usefully retained to designate the argillaceous sandstones of the Hudson river group, the Hamilton, Portage and Chemung groups. These beds of the Hudson river group are known as *blue stone*, which is a compact argillaceous sandstone consisting of variable proportions of these materials.

The name *blue stone* is equally applicable to the heavy-bedded compact arenaceous layers, and the thin-bedded slaty layers, which are largely used in the foundations of ordinary buildings. Much of the heavy-bedded slaty rock of this character, which is quarried along the Hudson river valley, belongs to the Quebec group; but I am not at this time aware of any quarries in the same formation, which furnish dressed building stone.

In the Hudson river group, this rock occurs in many localities, in very regular beds which are cut by vertical joints presenting clean, straight faces, and are thus laid in the building. The composition of these stones (that is, in the proportions of silica and alumina) often varies in the distance of a few rods; but, if well selected and laid on its natural bedding, it makes a durable building material. Much of it, however, becomes stained from the decomposition of iron pyrites, which after a length of time, either leaves the surface of a permanently rusty brown color, or the decomposition goes on till the rock crumbles or scales off in thin laminæ. Sometimes the faces of the joints are coated by thin laminæ of carbonate of lime, arising from the solution and infiltration of calcareous matter; and this forms a permanent coating, which resists all further change from atmospheric influences. It is of the greatest importance that these stones be carefully selected, or otherwise they soon become disintegrated.

The flagstones, so abundantly supplied from the upper part of the Hamilton group and lower part of the Portage group, are among the most enduring of the compounds of silica and alumina. The material is a fine-grained compact argillaceous sandstone of a blue or grayish-blue color, which, when free from seams, is scarcely influenced by the action of the weather. These beds are not only used for flagstones in most of the Atlantic cities, but in Albany, Troy, and other towns along the river and elsewhere, this stone is used for door-steps and caps, window-sills and caps, water tables, etc. The stone is very strong and durable, sometimes slightly staining from the decomposition of iron pyrites, but rarely or never undergoing disintegration from that cause.

The blue stone of Malden on the Hudson river, which has of late come into use for ashlar, door-steps and sills, pillars or pilasters, window-sills and caps, water tables, etc., is obtained from some heavier beds in the Portage group along the base of the Catskill mountains. The stone has great strength and durability, wearing very slowly when used for steps, and possessing the great merit of retaining a certain degree of roughness of surface. The dark color may be regarded as the only objectionable feature.

In the central and western part of the State, the Portage sandstones are of a lighter color, usually more friable than those of the eastern outcrops. Many of the beds are of a greenish or olive-gray color, occurring both in flaggy and heavier courses, which are easily dressed and present a very good appearance. The frequent presence of iron pyrites, causing both staining and disintegration, offers an objection to their extensive use. In the western counties, however, some of the beds are nearly gray, having lost the greenish or olive color almost entirely, and at the same time have less argillaceous matter in their composition, with scarcely a trace of iron pyrites. The stone from these beds has a very uniform gray color, a fine texture, and if quarried and dried before exposure to the frost, is a very durable stone.

In Ohio, the arenaceous beds of the Portage group furnish the friable gray sandstone from which grindstones are largely manufactured, and from which more recently large quantities of building stone have been furnished. The cohesion of the particles is slight, and the stone is very brittle on first quarrying, but becomes stronger and harder on exposure, and, if properly selected, resists the effects of the atmosphere in a remarkable degree. The strong cohesion of the particles, therefore, is not always a requirement for durability, though it is for strength, either as resisting direct pressure or the effect of tensile force.

It should not be forgotten, however, that neither all the beds of this stone, nor all parts of the same bed, are uniform in texture, composition or durability, and it will not be surprising, if in its indiscriminate use it may sometimes prove unsatisfactory as a building stone.

The argillaceous sandstones of the Chemung group are generally or comparatively free from iron pyrites, and range in color from gray to olive or dark olive-brown. When quarried and exposed to drying before freezing, they are comparatively durable stone; but they cannot be safely quarried during winter, or exposed to freezing soon after quarrying. Building stones from this group, within the State of New York, have long been used, and new quarries have been opened at many points, though the stone has usually but a local importance. The more important structures erected from this stone are the buildings of the Cornell University at Ithaca.

Manner of Laying.

Sandstones or freestones, and all the varieties of argillaceous sandstones, should be laid in the building according to the natural bedding of the rock, so that the wear of the elements may act upon the exposed edges of the laminæ. Since it is impossible to have any great thickness of stratified stone, especially sandstone, entirely uniform and homogeneous in texture, or without interlamination of shaly matter, it follows that by turning the blocks upon their edges, we shall in one case have the face of a harder or coarser layer, and in another of a softer layer of the same rock, thus exposing the wall to unequal weathering. Not unfrequently the face of the stone is the line of the soft shaly parting, and the effects of this practice may often be seen in the scaling off of an entire surface of a block of ashlar for several square feet in extent. Such examples may be seen in some of our buildings, which have been erected within the past twenty-five years. Had these blocks been laid in an opposite direction, the edges of the shaly seams only would have been exposed, and their destruction would have been comparatively slow. The sandstones separate usually with great freedom along the line of bedding, and thus offer great facilities for dressing the surface in the direction of the laminæ; and from this cause, and the desire to present as large a surface as practicable in each block, has arisen the practice of setting them upon their edges. A block of stone may, however, be split in the same direction, through one of its more sandy layers, and the objections urged may not be so palpable.

An equally reprehensible practice is the cutting of step-stones from blocks with distinct shaly partings, which produce exfoliation and consequent inequality of the surface.

MODE OF DRESSING.

In the use of argillaceous sandstones, as well as some other rocks, there are some considerations as to the mode of dressing which should not be forgotten. There are some stones which, if dressed elaborately, disintegrate rapidly upon the surface. This comes from the crushing of the material under the tool;* the natural texture and cohesion of the particles being thus broken up, it absorbs more water, and on freezing, decays rapidly and becomes unsightly. Many stones that are unfit for finely dressed work are nevertheless quite durable if rough dressed; that is, by dressing the joints close and a smooth space along the edge, while a greater part of the face is left roughly broken without tool-work of any kind. During wet weather, the moisture will collect at the numerous projecting points or edges, and much of it drops off which will be absorbed by a smooth dressed face of stone. The effect of freezing is much less destructive under such conditions. Moreover, a moderate degree of weather-wearing on such surfaces is less conspicuous than on finely dressed stone. The dressing of the stone in the University buildings at Ithaca is a good example of this kind of work.

* The term *deadening* of the surface is used by the workmen to designate this condition.

Limestones and Marbles.

In limestones and marbles, the conditions of durability and causes of destruction, as a general rule, differ little from those of sandstone. There is nevertheless one point of distinction, which may be noted in the outset. In all the marbles and older stratified limestones — that is, of the Silurian, Devonian or Carboniferous age — the want of cohesion among the particles, or a friable condition of the rock, may be regarded as fatal to its durability as a building stone; while on the other hand, as has been observed, some of the friable sandstones harden by exposure to the weather. In the calcareous deposition termed *travertin*, however, which is a deposit of modern origin, the mass, on first exposure, is soft and friable, and is frequently cut into blocks of the required shape and dimensions by the axe or saw; after being laid up in the wall it hardens and becomes quite indestructible. Some limestones are said to possess this power of hardening upon exposure.

In almost all limestones, as well those which are unaltered as those which have been metamorphosed, and are known as marbles *par excellence*, there is a considerable amount of argillaceous matter, either present in seams parallel to the lines of bedding, or disseminated through the mass. In the dark-colored uncrystalline or compact fine-grained limestones this matter is evenly distributed through the mass, and, when only in small proportion, produces no noticeable effect. Some of the varieties of this kind of limestone will stand the exposure of a century, without any essential or injurious change. The compact fine-grained blue limestones without seams are therefore among the most durable stones we have.

In the gray or bluish-gray subcrystalline limestones the argillaceous matter, instead of being distributed throughout the mass, is usually present in the form of seams which are parallel to the lines of bedding, or distributed in short interrupted laminæ. These seams, whether continuous or otherwise, are fatal to the integrity of the stone; and there is scarcely a limestone structure in the country, of twenty-five years' standing, which is not more or less dilapidated or unsightly, from the effects of absorption of water by the clay seams, and the alternate freezing and thawing. When laid in the position of the original beds, which is the usual mode, the separation by the clay seam is slower; but when used as posts or pillars, with the lines of bedding vertical, the change goes on more rapidly.

In the dressing of limestone, the tool crushes the stone to a certain depth, and leaves the surface with an interrupted layer of a lighter color, on which the cohesion of the particles has been partially or entirely destroyed; and in this condition the argillaceous seams are so covered and obscured as to be scarcely or at all visible, but the weathering of one or two years usually shows their presence.

The usual process of dressing limestone rather exaggerates the cause of dilapidation from the shaly seams in the material. The clay being softer than the adjacent stone, the blow of the hammer or other tool breaks the limestone at the margin of the seam, and drives forward into the space little wedge-shaped bits of harder stone. A careful examination of dressed surfaces will often show the limestone along the seam to be fractured, with numerous thin wedge-shaped slivers of the stone which have been broken off, and are more or less driven forward into the softer parts. In looking at similar surfaces which have been a long time exposed to the weather, it will be seen that the stone adjacent to the seam presents an interrupted fractured margin; the small fragments having dropped out in the process of weathering. Limestones of this character are much better adapted to rough dressing, when the blows are directed away from the surface instead of against it, and when the entire surface shall be left of the natural fresh fracture. By this process the clay seams have not been crushed, nor the limestone margining them broken, and the stone withstands the weather much longer than otherwise. The attempt at fine hammer-dressing is injurious to any stone; for the cohesion of the particles is necessarily destroyed, and a portion of the surface left in a condition to be much more readily acted upon by the weather.

The gray, sometimes brownish-gray, subcrystalline limestone, which is not metamorphic, is usually composed of fragments of organic remains more or less comminuted, with the interstices filled with fine particles of the same, or with an impalpable calcareous mud. In such rocks, the fragments of fossils being crystalline, withstand the weathering action, while the intermediate portions wear away, leaving a rough and sometimes unsightly surface. The disintegration from this cause is slow; and in the absence of clay seams, a structure of this kind of stone may remain a long time without material deterioration.

One of the best limestones of this character, and perhaps the best in the country in relation to freedom from clay seams, is the encrinal limestone of Lockport, which, at that point, constitutes a portion of the lower part of the Niagara limestone. The Onondaga limestone, in the quarries south of Syracuse, is one of the most useful and serviceable of these limestones, and when free from clay seams, is equal to any other limestone in color, quality and durability. In some portions of the Onondaga beds to the westward, and in some similar beds of gray limestone in the Lower Helderberg group, the mass requires firmness; and the want of compactness or close coherence among the particles allows the infiltration of water, which, charged with carbonic acid, acts still further to lessen their cohesion.

In some of the Lower Silurian limestones, the entire mass of the dark-colored beds is completely penetrated by irregular ramifications of siliceous matter, which, in their position and relations, seem as if they may have been fucoidal or spongoid bodies growing upon the bottom at the time of the deposition of the calcareous deposits. The beds of this character furnish a strong and durable material for rough masonry and foundations, and some of the beds bear dressing with satisfactory results.

In the process of metamorphism, the limestones have become more or less changed to a white, bluish or grayish-white color, or to variegated white and gray. The seams of argillaceous matter which mark the line of bedding in ordinary limestones have undergone some chemical change, and have become chloritic, talcose or micaceous, of a greenish, bluish or variegated color, but nevertheless still retaining the same relations to the calcareous part of the mass as in their normal condition. Although they are no longer a clay or shale, but have undergone some chemical change, these parts are nevertheless usually softer and weather more rapidly than the surrounding calcareous portions; or if not entirely weathering out, some parts of the lines or bands of color are more susceptible to the action of the weather, because unevenly disintegrated, and finally present an unsightly surface. Bands or stripes of color, in all the marbles, indicate a different texture and composition from the other parts of the mass, and all examples of this character will weather unequally. Such stones, therefore, should be used with great caution in all structures intended to be permanent.

In some of the marbles there are numerous spots of soft talc-like substance, which weathers more easily than the surrounding stone. These will either weather to different color, or from softening readily on exposure, give opportunity for the growth of minute lichens, thus covering the stone with dark specks or blotches. Under other circumstances these spots may be of different color, but scarcely less unsightly, and in the end working the gradual dilapidation of the stone. The white marble of Lee in Massachusetts is everywhere marked by these talcy spots, and the monuments and gravestones in the cemeteries of the neighborhood are covered with black specks and blotches.

The marbles, however crystalline they may be, are not free from the same impurities that affect the unaltered limestones ; and iron pyrites occurs in these, both as segregated veins or lines of accumulation, interrupted strings or nodules, and disseminated in minute particles throughout the mass. A good example of the latter may be seen in some marble at Sheffield in Massachusetts, where the stone contains minute particles of iron pyrites, which, becoming decomposed on exposure, gives to the entire surface a slight rusty hue. The same change supervenes in the dressed marble ; and some of the blocks in the New City Hall of New York show the rusty hue immediately after having been laid in the wall. This may be a case in which the change will cease after a time, for want of access of moisture to the interior portions, or by the filling of the pores with sulphate of lime produced by the decomposition of the pyrites, and thus protecting the deeper portions of the stone.

Besides the ordinary seams or lines of color in the direction of the bedding, many of the marbles are marked by the presence of irregular veins or lines of segregation, which are different in composition and texture from the surrounding rock, and though sometimes not very different in color, and, therefore, showing little in the outset, will nevertheless usually decompose more readily than the adjacent stone. Veins of this kind are of common occurrence in some of the marbles used for building, and may be observed in their full effect in the State Hall and City Hall of Albany. These veins usually consist of some soft talc-like mineral with magnesian limestone and iron. The pure white marble, free from seams or veins of any kind, constitutes the smallest part of any or all marble quarries. The columns in front of the "old United States Bank," in Philadelphia, offer one of the best examples of the destruction of marble from the several causes mentioned. Although erected scarcely fifty years since, the bedding seams are weathered and opened to such a degree as to present an aspect of extreme dilapidation, and less than half a century more will effect their entire destruction.

The simple presence of magnesia alone does not necessarily impair the enduring quality of a limestone. Some of the hardest and most enduring limestones we have are magnesian in character, having such proportions of lime and magnesia as constitute a dolomite. This is the character of the Niagara limestone and of some of the older limestones of the Silurian series, both in their normal and metamorphic condition. As a general rule, however, the magnesian limestones, in their normal condition, are more friable, more porous and less firm in their character than the pure carbonates of lime. The presence of iron in magnesian limestones, either as an oxide or a carbonate of iron, may often aid in hastening their decomposition. They usually weather to a brownish hue, which is sometimes yellowish or drab-colored, but more often, in the unaltered condition, to an ashen gray. The yellowish color is due to iron in some form, either as an oxide or a carbonate.

In the selection of limestones for structures of any kind above ground, care should be taken to avoid the shaly seams which are the principal cause of decay; and though the stone containing them may endure for many years, they yet present an unsightly appearance. We have, in the city of Albany, a good example of this in the walls of the Reservoir on Eagle street in Albany; and numerous other cases of similar character might be cited. In all these examples, it may be observed that the dilapidation comes from the cause specified, and no other; for in most of the structures exhibiting this defect, the tool-marks are not yet obliterated from the surface of the solid limestone.

Limestones of this character, however, are perfectly safe and fit for any foundation or other work placed beyond the reach of freezing and thawing; and they possess a strength and power of resistance to pressure, which fits them for the heaviest structures.

Although limestones, in their normal condition, as well as the marbles, are liable to decay from the action of rain-water charged with carbonic acid, yet this cause usually operates so slowly on the walls of a building that the tool-marks are rarely obliterated in a quarter of a century.* The more porous limestones, and some of the marbles which notoriously lack cohesive power, may be more affected by this action. The liability to be decomposed and disintegrated by this process is always sufficiently shown in the natural surfaces of quarries; and in some cases we find the exposed beds crumbled to a mass of sand, while the layers beneath the reach of water and frost are comparatively solid.†

GRANITE AND GRANITIC ROCKS.

In the extensive class of rocks coming under the head of GRANITES, the conditions of durability and causes of decay are somewhat modified by the chemical changes which have supervened among the original mechanical aggregations, and the crystalline character which they have assumed. In these rocks we have *quartz*, *felspar*, *mica* and

* The dark compact limestone at the base of the Lower Helderberg group, in some specimens in exposed situations, has retained the tool marks for nearly a century; and lettering cut on blocks of this stone, more than a century since, are still fresh and well defined. These examples may be seen in an old church in Schoharie, known as the Old Fort, from having been thus occupied during the revolutionary war; and in the Lutheran Church near the Court-house, where some lettered stones, from the first church erected in that town, have been laid in its foundations.

† In this process, the water dissolves a small portion of the stone as far as it reaches, and thus separates the particles still more; and the further access of water, which freezes in the stone, produces a rapid disintegration of the mass.

hornblende to deal with as simple minerals of definite constitution. The quartz or silica is in a crystalline condition. The felspar, a crystalline mineral, is composed of a large proportion of silica with alumina and a small proportion of potash, and often a small amount of soda and lime, with a trace of iron sometimes amounting to more than one per cent. The mica, also crystalline, is composed of silica with a larger proportion of alumina than in felspar, and a lesser percentage of potash or other alkali, with from three to six per cent of iron. The hornblende is likewise crystalline, and composed of a large proportion of silica with magnesia and lime and sometimes alumina, containing also a variable amount of iron, which sometimes reaches to fifteen or even twenty per cent.

We have therefore no new mineral substance introduced into the compound. The alumina, which was in mechanical mixture with the silica in the original stone, has combined chemically with a portion of that mineral, including also some potash, soda or lime, and thus produced the felspar and mica. Other portions of the silica, and sometimes of alumina, have combined with the magnesia, lime and iron, to produce hornblende. All these materials have existed in their normal condition in the mechanical or sedimentary deposits, and have taken their present form through chemical action during subsequent metamorphism. These crystalline aggregates may be coarse or fine, and the different minerals be present in very variable proportions, or even one or two of them absent from the compound. The prevailing compounds are of quartz, felspar and mica; or quartz, felspar and hornblende.

The aggregates may likewise be of very different colors, the quartz being usually translucent, the felspar varying from white to reddish brown; the hornblende, of a dark green or black color, while the mica may be of any shade from silvery white to a dark brown or black. The predominance of these, or of any one or two of them, usually gives their hue to the mass. The granites or sienites, in which hornblende predominates, are generally of a dark color; and those where quartz and felspar predominate constitute the lighter-colored granites.

As a general rule, the granites are more reliable as a durable building material than any other class of stone, and yet some varieties of them are rapidly decomposed by the action of the atmosphere. In these granites where felspar greatly predominates, or where this mineral occurs in large crystalline masses, there is danger of decomposition. The action of the weather upon the alkaline constituents of the mineral is the primary cause of the destruction; but this change goes on slowly, and, in the walls of a building, would scarcely affect the appearance of the surface in half a century. The presence of finely disseminated iron pyrites is often a cause of destruction in the gneissoid and granitic rocks.

Some of the fine-grained felspathic granites with mica are subject to a slow decomposition or disintegration of the surface, by which thin films are exfoliated. Such examples can be seen in some of the older granite buildings of the country. Fewer causes of decay are inherent in the ordinary granites than in any other stone used in our buildings; and with proper care in selection, a granite structure is comparatively indestructible from the usual action of the elements.

But it should not be forgotten that *all* the granite of a quarry may not be of the high quality desired; and in this rock, as well as in any other, though not usually to the same degree, there will be waste and refuse material. Though generally more free from iron pyrites than the other rocks, yet this mineral does occur in all the granites, and there is rarely a building erected that does not show its presence; but in all the quarries examined, from which building-material is obtained, this mineral occurs only in scattered and inconsiderable amounts.

In those granites, where the crystalline mixture consists of fine or moderately coarse grains of the different substances intimately mingled throughout the mass, we may count upon a durable building material, and one subject to a less degree of change from atmospheric agencies than any other stone in our country.

VII.

Modes of Determining the Character and Strength of Building Stones.

In the erection of all public structures, or those of any considerable magnitude, the strength and durability of the material is of the first importance, and that which should receive the most careful attention. In large and heavy structures the strength of the material is of more importance than in ordinary ones, which never approach a test of the strength or power of resistance of the material composing them. Even with all the experience we have had, and the experiments that have been made, there seems to be no settled opinion of or knowledge among engineers regarding the real strength of the various kinds of stones, either in regard to their direct resistance of pressure or their lateral strength. According to the report of Prof. Henry, the commissioners appointed to test the stone preparatory to the erection of the extension of the United States Capitol, found that the practice heretofore adopted for testing the strength or resistance to pressure was very defective, and the results unsatisfactory. If the result thus obtained be admitted, and of which there can be no doubt, the statements heretofore recorded on these points, and the tables compiled from the experiments made, are to be regarded with many grains of allowance in favor of the stone tested. While the instruments employed by Rennie and others were defective, the plan of placing the block of stone to be tested between steel plates with a sheet of lead intervening, in order to equalize the pressure from irregularity of the surface of the stone, or want of parallelism in the opposite faces, gave very imperfect results.

In experiments reported by Prof. Henry, we have the example of a cube of marble placed between steel plates, with lead intervening, giving way at a pressure of 30,000 pounds; while another block of precisely similar character placed directly in contact with the steel plates, sustained a pressure of 60,000 pounds. "This interesting fact was verified in a series of experiments embracing samples of nearly all the marbles under trial, and in no case did a single exception occur to vary the result. The explanation of this remarkable phenomenon, now that the fact is known, is not difficult. The stone tends to give way by bulging out in the center of the four perpendicular faces, and to form two pyramidal figures with their apices opposed to each other at the center of the cube, and their bases against the steel plates."

"In the case where rigid equable pressure is employed, as in that of the thick steel plate, all parts must give way together; but in that of a yielding equable pressure, as in the case of interposed lead, the stone first gives way along the outer lines, or those of least resistance, and the remaining pressure must be sustained by the central portions around the vertical axis of the cube." This fact, so clearly demonstrated, shows very conclusively that all experiments made upon blocks of stone with the intervening yielding material are fallacious, and really give us but one-half the actual power of resistance possessed by the stone tested. When we add to this fact also the practice of engineers as usually stated, that owing to imperfections of the material and other causes, it is not considered safe to load a stone with more than one-eighth of its crushing weight,* it will be seen that we are very far within the safe limits to which any stone may be loaded and retain its integrity.

By this process, Prof. Henry has shown that the marble of Lee, Massachusetts, will sustain a pressure of 23,917 pounds to the square inch. This marble was adopted for, and has been used in the capitol extension or new Capitol at Washington. In strength it is not superior to many other marbles, nor equal to some of the ordinary compact limestones, and is much inferior to the granites. In composition it consists of the carbonates of lime and magnesia, and is a true dolomite, as shown by the analysis of Dr. Genth and Dr. Torrey, containing minute proportions of iron and manganese. The experiment of using a dolomite on so large a scale will ultimately demonstrate whether a stone of this composition can be relied upon as a durable building material. As before stated, however, the simple presence of magnesia is not of itself evidence of the rapid decay of the stone; a small proportion of iron in some form, or combined with some other mineral, may effect the destruction of a magnesian limestone that otherwise appears sound and durable.

Less attention seems to have been given to the lateral strength of stone, than its importance would warrant. When we see, even in buildings of recent erection, the window sills and caps cracked through, and these parts giving way and becoming dilapidated and unsightly, it is evidently a matter of no small importance to be able to decide what amount of weight can be borne by stones of certain dimensions. This knowledge also becomes of the highest importance in view of the manner in which the foundations of heavy buildings are laid; the gradual retraction of the width above relieving the lower and outer layers of stone from the direct crushing force of the superincumbent walls, but testing its lateral strength.†

In estimating the strength of a stone to resist pressure, it is not safe to predicate an opinion upon examples of cracking or breaking in the walls of a building, whether before or after its completion; for a little inequality in the bedding may produce such a result, when, if evenly bedded, the stone would have borne many times the load it has

* According to some engineers with but one-twentieth of its crushing weight.

† The results of experiments, showing the power of resistance to pressure of several of our limestones, marbles, granites, etc., will be found in an appendix to this report.

sustained. In a large and heavy building it is all important that the foundations be firm and unyielding, for on this depends the integrity of the entire structure. Beyond this it is important that the stone be evenly cut, so that the bed of each succeeding block should rest evenly upon those below it. From an inequality in dressing two adjacent blocks of stone to the same thickness, leaving at their junction one of them projecting slightly beyond the other, I have seen the superincumbent block of granite cracked quite through. This breaking was not due to pressure alone, nor to want of strength in the material, as was evident from the perfection of the wall below, but entirely to the pressure bearing upon the center of a block resting on an uneven bed, or supported at the two ends and not in the center.

VIII.

CAUSES AFFECTING THE DURABILITY OF A BUILDING STONE, WHICH ARE INHERENT IN THE STONE ITSELF.

The causes of disintegration and destruction in the ordinary building stones have already been mentioned under each one. They may be recapitulated, however, in this place.

1. *Want of proper cohesion among the particles producing inherent weakness.* This condition may arise from the loose aggregation of the crystalline grains of carbonate of lime, or of the compound of carbonates of lime and magnesia, sand, etc., without intervening cement, or from want of the pressure necessary to consolidate the mass. We have examples of this in the friable marbles and some sandstones. In some cases this condition occurs where the rocks have been much disturbed since their deposition and partial or entire consolidation. But this condition as frequently occurs in rocks which, so far as we know, have not been subjected to change, and lie in their original horizontal position. One of the most remarkable examples occurs in the western extension of the Potsdam sandstone, much of which, in some parts of Wisconsin and Minnesota, may be easily quarried with pick and shovel, and readily crumbles into an incoherent sand. Above the Potsdam the St. Peter's sandstone has still less coherence, and is shovelled out in the same manner as the ordinary sand of the drift of the sea beach. From this incoherent condition of the mass, we have all gradations to the most strongly coherent rock. This condition of the particles, be it in greater or less degree, affects the strength and durability of the stone.

Blocks of stone, wanting proper cohesion, may crack or be partially crushed by superincumbent weight; but ordinary judgment will guard against using such improper material. The cohesion of the particles or grains composing a stone does not depend upon their hardness or density; for the grains or crystals composing a mass of marble, and having half the density of grains of sand, often produce a stronger stone than one made up of the better material.

2. *Porosity.* The porosity of a stone is, in most instances, directly dependent on the degree of cohesion among the particles. Crystalline masses are usually less porous than mechanical aggregations; and where the interstices between the crystals are filled with a finer material, it has been shown that the latter is porous and absorbent,

while the former resists the penetration of fluids. In some of the crystalline limestones, the cohesion is so slight that the water admitted, and freezing, has gradually broken up the mass, and we have a bed of calcareous sand, of several feet in thickness, lying above the rock which yet retains its ordinary consistence. Some of the fine-grained and compact mechanical aggregations of rocks resist the absorption of water in a remarkable degree.

3. *Argillaceous matter in distribution or in seams.* I have already shown that the presence of a considerable proportion of argillaceous matter distributed throughout the mass, be it calcareous or siliceous, has a tendency to weaken and destroy the stone. Its presence in seams or thin laminæ produces the same result, as we have numerous examples to show.

4. *Iron pyrites (sulphuret of iron) and other foreign substances.* Iron pyrites (sulphuret of iron), whether intimately permeating the stone or occurring in masses, layers or irregular nodules, is more or less injurious and destructive. When not immediately destructive, its decomposition renders the surfaces unsightly by staining the stone, and finally breaking or disintegrating it wherever this mineral occurs. When disseminated through the mass, as it frequently is, it produces slow but entire disintegration.

It is not an uncommon thing to find masses of rock, in their native position, completely disintegrated or softened to the depth of several feet by decomposing iron pyrites. This feature is especially observable in the gold region of Virginia, North Carolina and other Southern States. In numerous instances, and sometimes over wide areas of country, the rocks containing iron pyrites are decomposed by percolating rain water, to the general water-level of the surrounding country.

In limestones or dolomites, the presence of iron pyrites operates disastrously; for if magnesia be present, the sulphuric acid from the decomposing iron pyrites produces a soluble efflorescent salt, which exudes to the surface and forms white patches, which are alternately washed off and replaced, but leaving a whitened surface probably from the presence of sulphate of lime. If the limestone be entirely calcareous, the salt formed (a sulphate of lime), is insoluble, and therefore produces less obvious results.

In some cases, however, the lime of which the mortar or cement is made may contain magnesia, and the decomposition of the iron pyrites in the adjacent stone produces an efflorescent salt which exudes from the joints. This condition is not unfrequently observed in buildings constructed of the blue stone of the Hudson river group. As an example, we may notice the efflorescent patches proceeding from some of the joints between the stones of St. Peter's Church on State street in Albany.

The presence of iron in a low degree of oxidation tends to the destruction of the stone containing it. This is observed in the greenish shales and sandstones and in some other rocks; and this condition of iron, as well as in the form of a sulphuret, may do much injury where it exists.

5. *Size of constituent grains or particles.* This feature has already been alluded to under the head of granites, sandstones, etc. When the separate minerals of a granite are in large crystalline masses, it is an objectionable feature and a cause of decay. Coarse sandstone, or a

mixture of fine grains of sand with pebbles of various sizes, does not usually endure well. Similar sandstones or conglomerates, when partially metamorphosed, and cemented by silica, or some siliceons compound, are less affected by the weather and are more durable. In the crystalline marbles, some of the coarser varieties are weak from the want of cohesion or cementing matter between the crystals. The same is equally true occasionally of those which are more finely crystalline; and we sometimes find a coarsely crystalline marble stronger than a finer one, in similar beds but a few miles asunder, or even beds in the same quarry may differ in this respect. The coarsely crystalline marble of Tuckahoe is stronger than the finer-grained marble of Sing Sing and other places in the neighborhood. So far as the marbles are concerned, all the crystalline forms, be they coarse or fine, may be strong or weak. The fine-grained marbles, which show scarcely a crystalline structure, or such only as the calcareous muds might take on in their metamorphism, are the most durable stones of this kind.

6. *Cementing materials.* I have already alluded to this feature under the preceding head. When the cementing material is clay, or where argillaceous matter predominates, it is rapidly disintegrated by the absorption of water, and freezing and thawing while thus saturated. Where the cementing matter is calcareous, it will dissolve more slowly, and only through the agency of rain water carrying carbonic acid. Where the cement is siliceous, it is essentially indestructible from the effects of the atmosphere and water.

The cementing material of the Tertiary sandstones of which the Old Capitol, Treasury and other buildings in Washington were constructed, is clay and carbonate of lime, and its rapid disintegration from rain and frosts is always observable. As before noticed, some friable sandstones become harder on exposure, and this change has been presumed to be due to the formation of a siliceous cement on and near the surface. Sometimes probably a silicate of lime, or a small quantity of calcareous matter held in solution in the interstices of the stone, may become precipitated as solid carbonate of lime, in accordance to a well-know law, on exposure to the atmosphere.

Every geologist knows that not only sandstones, but all other rocks are more easily shaped and trimmed when freshly broken from the ledge or quarry, than after they have remained for some time exposed to the atmosphere or even carefully packed. The hardening or toughening process, however, extends but a little way beneath the surface, and the interior of a block remains essentially as when first quarried.

IX.

CAUSES AFFECTING THE DURABILITY OF A STONE, WHICH ARE ACCIDENTAL OR DUE TO ARTIFICIAL OR EXTRANEOUS CONDITIONS.

Many stones, which with proper treatment or under favorable circumstances might prove a durable building-material, are brought to a rapid decay by conditions to which they are subjected in the structure.

1. *The action of freezing and thawing.* This alternating process of freezing and thawing is the most trying to the durability of a stone, of any or all the conditions to which it is subjected. Of course this depends upon the climate or latitude in which the stone is exposed. The

Caen stone of Normandy, and some of the less coherent limestones of modern geological formations are strong enough and quite durable for buildings in Southern Europe or where the frosts are not extreme ; but in a climate like our own, they are rapidly destroyed by the alternate action of freezing and thawing.

Some of the finer sandstones, which have a considerable amount of argillaceous matter, are perfectly capable of withstanding moderate freezing ; but the extreme changes from a moist condition, or one saturated with moisture, to the extreme of freezing, are fatal to their durability.

As before repeated, any stone in which clay enters largely, or a porous stone of any kind, is liable to decay under the extremes of wet and frost. The penetration of moisture among the particles of the stone, and its expansion on freezing, destroy the cohesion of the parts, and the succeeding rains wash away the loosened particles. In this way, during a long succession of years, the surface is disintegrated and the structure gradually crumbles. Although some stones are more susceptible to these atmospheric influences than others, yet none are entirely free from its effects.

Even the changes of temperature, without frost or moisture, operate upon the masses of stone and cause a motion of the particles. The observations of Prof. Horsford upon the pendulum suspended within the Bunker-hill Monument show that this massive structure "is scarcely for a moment in a state of rest, but is constantly working and heaving under the influence of the every varying temperature of its different sides." When to this is added the extreme action of freezing and thawing, it cannot be surprising that the poorer materials will fall into dilapidation, or that the best selected building-stone will ultimately give way. This cause operating everywhere, at all times and through all seasons, is a far more active agent in the destruction of buildings than all the others operating together; and though it may sometimes require years for an appreciable change to be accomplished upon a sound material, it is nevertheless constantly going on, however slow the change may be.

2. *The improper laying of stone* by presenting the faces of laminæ to the weather, often hastens the disintegration of the mass. I have already alluded to this especially in regard to the brown freestone which is now so extensively used, and which presents such uneven weathering, from being in part laid according to the bedding, and in part with the bed facing the exterior.

3. *The vegetation of microscopic lichens* takes place upon the surface of the stone, when, from any cause, that surface becomes roughened so as to afford a lodgment for the seeds or spores of these plants. These growing, still further hasten the disintegration of the stone, and accumulating about them the fine dust floated by the atmosphere, become points for the absorption of more water, which on freezing still further roughens the surface, and the patch of lichen gradually extends. These lichens often gain attachment upon the surface of a finely dressed stone, from some little inequality of texture, or from softer material that more readily becomes decomposed, or more readily accommodates the growth of the plant. Such stones in time become partially or entirely covered by lichens, and present an unsightly aspect. The

amount and degree of this growth varies with position in reference to the sun, and with a more or less elevated situation.

It should not be forgotten, however, that any stone giving root to lichens is not one of those which most easily disintegrate; for in these the destruction goes on so rapidly, that the surface does not allow the growth of such plants. The lichen-covered rocks in nature are usually those of great strength and durability. None of the softer or rapidly decaying rocks produce this vegetation.

4. *The solvent action of water* is never so great upon artificial structures, as upon the rock in its natural position; for in the latter case, it is usually aided by a covering of soil, through which the water is filtered; and if not thus covered, the rock is exposed in broad surfaces to much greater action than in the walls of a building.

5. *The oxidizing influence of the sun's rays* is only considerable when aided by moisture, and in this condition scarcely operates except upon iron pyrites and iron in a low state of oxidation.

6. *The effect of electricity.* Prof. Henry, after citing the effects produced by water charged with carbonic acid, says: "Again, every flash of lightning not only generates nitric acid — which, in solution in the rain, acts upon the marble — but also by its inductive effects at a distance, produces chemical changes along the moist wall, which at the present time are beyond our means of estimating."

7. *Effects from sulphurous gases produced by burning coals.* In the unexpected gradual dilapidation of the New Houses of Parliament in London, the causes have been sought and apparently found in an agent heretofore little regarded as one producing serious deterioration of buildings. The stone is a magnesian limestone from Bolsover moor, and was selected as having been found to retain its integrity and to have preserved in a very perfect degree some of the carvings in Southwell church through a long period of time.

The same material, and from the same locality as stated, has been used in London with a very different result. An examination made a few years since led to the belief that this disintegration of the stone was caused by the action of sulphurous vapors arising from burning coals; which lodging with the soot against the sides of the building, and especially in sheltered positions under the projecting eaves and moulding, and thus remaining saturated with moisture under the most favorable conditions for acting upon the stone. To this cause, in London, we may attribute some portions of the effects observed in this and other examples. Now it should be recollected that in this densely populated city, with its proverbial "London fogs," and the burning of bituminous coal, the rising of the soot and its condensation on the side of buildings during the heavy damp weather and fogs, would, as a matter of course, produce some effect upon the stone.

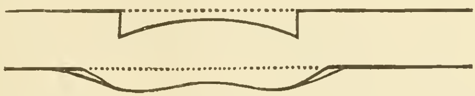
Such conditions, however, can scarcely exist in any Atlantic city (even if in any American city), with our drier atmosphere and the sulphurous gases mainly from anthracite coal, which gives no soot. In the Ohio and Mississippi valleys, where bituminous coal is burned and the soot lodges against the buildings, we might possibly look for some effect; but the comparative dryness of the atmosphere would probably counteract the otherwise evil effects from this cause. In considering this cause of deterioration, we shall find it only applicable to special localities; and even in these it may be well to inquire whether other causes have not combined with this one, to produce the results recorded.*

I have received from Prof. J. P. Lesley, of Philadelphia, the following observations regarding the influence of climate in different localities, upon stone of identical or similar character. In speaking of the durability of stone in ancient structures it becomes necessary to know the conditions of climate before a just comparison can be made.

"One of the two obelisks erected by Thothmes III, at Heliopolis fifteen or sixteen centuries before Christ, was transferred to Alexandria and is now known as Cleopatra's Needle. It is of sienite, so streaked with hornblende, obliquely, as to suggest original stratification. Along these streaks; which are of irregular width, atmospheric erosion has taken place, by the ejection of one group of crystals after another, upon the melting away of the felspathic element. The whole face of the stone has suffered from the same action, but generally to a less degree, than at these exceptional places. Especially all the sharp cut edges have been rounded off. Wherever the solar disc, for instance, occurs, there is now nothing but an unsightly hollow, where originally had been cut a sharp clear circle, with a vertical wall around a central convex tympanum.

thus:

now:



"All the hieroglyphs from pyramidion to base have suffered in this way. Some are almost indistinguishable, except in the very best slanting light of the sun. One or two of the four faces also have suffered more than the others, showing that the prevailing winds have determined the degree of erosion. The climates of Cairo and Alexandria are so different from one another, the former so constantly dry and the other so uninterruptedly wet, that we have a right to ascribe the most of this destruction to the sea air since the removal of the obelisk from its original to its present site. But all the monuments of Egypt, at least up to the first cataract, show marks of atmospheric erosion, in spite of the loose assertion often repeated by travelers, that they are as fresh and their lines as sharp as when the chisel cut them. This is not true of any monument in the open air; but is approximately true of the intaglios in the tombs. Many of the monuments of the middle and classic empires are built of such inferior kind of stone, the only wonder is that they have not tumbled into ruin themselves, through the slow wear and tear of the surface, by the atmosphere. And yet Egypt is one of the driest parts of the world. It must be remembered, however, that the stratum of air, which lies at night upon the broad bottom of the valley, is charged with the exhalations of the river, canals and irrigated fields, and in this stratum the monuments stand. When the sun rises this moist air-mass is broken up and carried over the mountain walls into the desert."

*It may perhaps be worth while to inquire whether the effects ascribed to sulphurous gases are really due to such influences alone. A writer in the "Builder," for Oct. 30, 1858, says that the river front, "to the height of the area windows, was built of the Bolsover moor stone, but that the remaining upper part, to my wonderment, was built of stone obtained from Anston, in Yorkshire, a stone not even alluded to in the report," *i. e.*, the Report of the Commissioners. If this be true, the theory adopted in explanation of the cause of decay may require some modification.

X.

Results of the Trials of the Strength of some of the Specimens submitted to the Capitol Commissioners, made at Washington in November, 1868.

Specimens of the gray gneiss of Saratoga county of one inch cubes placed between steel plates, sustained a pressure of from 16,800 to 25,600 pounds ; the lowest number doubtless from imperfection. The average of these specimens gave 22,666 pounds as the crushing weight per square inch.

Of the dark colored sienite, the range was from 18,000 to 25,700 pounds as the crushing weight; the lowest number in this case resulting from the want of entire parallelism in the two fases of the cube. The average of four specimens gives 22,575 pounds as the crushing weight per square inch.

A single cube of one and a half inches, from one of the beds of Tribes Hill limestone, sustained a pressure of 66,300 pounds, or 25,022 pounds to the square inch, before breaking. A similar specimen from another layer of the same limestone, sustained a pressure of 54,400 pounds, or 24,622 pounds to the square inch.

Three specimens of limestone from the Cobleskill quarries, in blocks of one and a half inch cubes, gave a range of from 51,000 to 72,700 pounds of pressure before breaking, being an average of 27,407 pounds to the square inch. A single cube of one and a half inches from another bed of the same limestone, gave 21,066 pounds as the crushing weight, to the square inch.

Three specimens of compact white marble from Alford, Mass., in one and a half inch cubes, sustained respectively 26,300, 26,900 and 27,000 pounds before breaking, giving very nearly 12,000 pounds as the crushing weight, per square inch.

These experiments sustain the opinion previously expressed in my report, that these compact limestones are stronger than the marbles, and equal to many of the granites.

In regard to the lateral strength of these stones, we have a right to infer from the close grain and compact texture, as well as tenacity shown in the process of crushing, that they are also superior in that character.

I may remark in this place, that the stone used in the New Capitol foundation at Washington, is gneissoid rock or mica slate, and has not the strength of the gneiss and limestones here recorded.

The remaining collection of specimens submitted for trial have been left with Prof. Joseph Henry, and the results of the experiments will be reported at a future time.

Very respectfully,
Your obedient servant,
JAMES HALL.

Note.— The remarks upon the red or brown sandstone (freestone), are mainly based upon an experience of the Connecticut river stone and in a smaller degree upon that from New Jersey. The sandstone of the same age on the Potomac river, in Maryland, known as the Seneca creek sandstone, has in many examples proved extremely durable; and I have been shown a specimen of this rock, taken from one of the old locks on the river where it has been exposed to the elements for eighty years, and the stone is still sound. This specimen, however, is very compact, highly siliceous, and with no visible seams of argillaceous matter.

The observations made upon buildings already erected of different material, have been, with few exceptions, omitted from the present report, but may be published at a future time. Probably no better service could be rendered to the future architecture of the country than an unsparing exposition of the condition of various buildings and public edifices erected of stone. When it is considered that very few of these have existed for fifty years we shall be prepared to appreciate the extreme dilapidation and ruin which must ensue within the next century.

The map presented with the report is colored to show the sources of the several kinds of building stones, as *granite, marble, sandstone, etc.*, in New York and New England, but it will not be published at the present time.*

[The author begs the indulgence of his friends and the public, in offering so incomplete a report upon a subject of so much importance as that of building stones of the State and country. The investigation requires much more time to make the result at all worthy of being presented in printed form. This time it has not been possible to give during the past year, and the publication at this moment is beyond his control. The matter has all been put in type and the first thirty-two pages printed off during the absence of the writer, in consequence of which several typographical errors have occurred. The memoranda in the margin of some of the pages were made for the writer's use in giving an abstract of the report, and were not intended for printing.]

XI.

Catalogue of the Principal Building Stones in the Collection which have been Submitted to the Commissioners for their Inspection, or which have been Collected During the Examination of Quarries.

A. *Granites and Granitic Rocks.*

1. Quincy Granite. Dressed block of one cubic foot. Old Quincy quarries, from the Quincy Railway Granite Company.
2. A smaller dressed block of the same, brought from the quarry at time of examination.
3. Quincy Granite. Light colored, a small block partially dressed, brought from the quarries of Rogers & Co.
4. Gray Granite. A rough block, brought from the quarries at Rockport, Cape Ann, Mass.
5. Porphyritic Granite. A block six by twelve inches, partially dressed, Fall River, Mass., from Geo. Wrighton, Esq., of New York.
6. Gray Granite. Dix island, Maine, from Messrs. Learned & Dickson.
7. Gray Granite. Concord, New Hampshire, a dressed block of one cubic foot, from the Quincy Railway Granite Company.

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* This map still remains as at the date of this report.

8. Gray Granite. A cubic block of six inches square from the same.
9. Gray Granite. Fitzwilliam, New Hampshire, a dressed block of one cubic foot, from Runels, Clough & Co.
10. Gray Granite. Berlin, Vermont, a dressed block of ten inches square, from M. E. Howard.
11. Gray Granite. Barre, Vermont, a dressed block of one cubic foot, from Mr. I. P. Harrington.
12. Gray Granite. Barre, Vermont, a dressed block of one cubic foot.
13. Gray Gneissoid Granite. Greenfield, N. Y., a dressed block of one cubic foot, and two dressed blocks of six-inch cubes with several larger rough blocks of the same, from John H. White, Esq., and Dr. R. L. Allen of Saratoga Springs, N. Y.
14. Dark Colored Sienite. Greenfield, N. Y., a dressed block of one cubic foot and two other blocks of six inch cubes, one of the latter polished on two sides.
15. Gray Gneissoid Granite. Luzerne, Saratoga county., N. Y., a dressed block of one foot by two feet, from Col. B. C. Butler of Luzerne.
16. Gray Gneissoid Granite. Several rough blocks from Moreau, N. Y., from Mr. W. B. Conant.
17. Gneissoid Granite. Luzerne, N. Y., a block of two feet long, twenty inches wide and one foot thick, from Dr. R. L. Allen.
18. Gneissoid Granite. Butter hill, Highlands, N. Y., a rough block, from Hon. A. M. Sherman of Newburgh, N. Y.
19. Light Gray (nearly white), Granite. Specimen of 12x8x2 inches, cut and partially polished. Said to be from St. Albans, Vt., but believed to be from Berlin, Vt. From Mr. Charles E. Young of Oswego, N. Y.
20. Sienite. Two rough specimens from Warren county, from Mr. John Higgins of Troy N. Y.

B. *Marbles of White or Variegated Colors, Metamorphic and Crystalline in Character.*

21. Variegated and Monumental Marble. Sutherland Falls, Vt.; one dressed and partly polished block of one cubic foot; three blocks of one foot face by six inches thick, polished on one face ; one block of one foot face by six inches thick, one face sand-rubbed and moulded ; one block of 12x12x10 inches, one face polished ; two blocks of six-inch cubes polished and variously dressed. These specimens were all presented by the Otter Creek Marble Co.
22. Berkshire Marble, Silver Blue Marble. Alford, Mass. ; one block of a cubic foot, variously dressed and polished on one side.
23. White, or Slightly Clouded Marble. Lakeville, Connecticut ; a block of one cubic foot, dressed with one side polished ; from H. Tudor Brownell, Esq.
24. Marble, Bluish or Dove-colored. Lakeville, Connecticut ; a cubic block of one foot, two faces polished ; from H. Tudor Brownell, Esq.
25. White Marble. Sheffield Mass.; a block of 10x10x8 inches, one side polished ; from one of Mr. Chester Goodale's quarries.
26. Clouded Marble. Sheffield Mass.; a block of one cubic foot,

one side polished; same as the marble used in the Girard College. Quarry of Mr. Chester Goodale.

27. Striped Marble. Sheffield Mass.; a block of one cubic foot, one side polished. Quarry of Mr. Chester Goodale.

28. White Statuary Marble. West Rutland, Vt.; dressed block of one cubic foot, one side polished.

29. Striped Marble. West Rutland, Vt.

30. Brocatella Marble. West Rutland, Vt.

31. Marble, Muddy Layer. West Rutland, Vt.

32. Striped Marble. West Rutland, Vt. The preceding five specimens are blocks of one cubic foot each, three of the lateral faces dressed in various modes with one face polished, the upper side showing the fracture of the stone. These blocks are from the new quarry of Sheldon & Slason, presented by the owners through W. C. Rowell, Esq., of Rutland.

33. White Crystalline Marble. Tuckahoe, N. Y.; a dressed block of one cubic foot, one face polished, the upper side showing fresh fracture; from Masterton & Hall.

34. White Crystalline Marble. Tuckahoe, N. Y., a cubic block of six inches square, one face polished; from Masterton & Hall.

35. Clouded Marble. A block of 10x7x5 inches, dressed, with one face polished.

36. Clouded Marble. A dressed block of 8x5x4 inches (blocks 54 and 36 have been received as coming from Dutchess county, particular source unknown).

37. Clouded Marble. A dressed cubic block of six inches square, one side polished; from the Berkshire Marble Company, Alford, Mass.

38. White Crystalline Marble. A dressed block of 12x8x6 inches, with one face polished; locality unknown, probably Tuckahoe or Hastings, N. Y.

39. White Marble. A dressed block of 9x9x6 inches, locality unknown.

40. Clouded Marble. A dressed block of 6x6x9 inches; locality unknown.*

41. White Crystalline Marble. A dressed block of 16x12x8 inches, with one face polished; from the State quarries at Sing Sing.

42. Gray Crystalline Marble. A dressed block of one cubic foot, one face polished; Hastings, N. Y.

43. White Marble, coarsely crystalline. A dressed block of ten inches cube, one side polished; Hastings, N. Y.

44. Gray Marble. A block of 12x12x18 inches, two sides dressed; from Stockbridge, Mass.

45. Serpentine Marble, Verd Antique. A dressed block of eleven inches cube, with one face polished; from the quarry of Mr. Walton, Port Henry, N. Y.

46. Serpentine Marble, Verd Antique. Port Henry, N. Y. A specimen dressed as a pillar with sqare base of 9x9 inches and 15 inches high, moulded above, with cylindrical shaft of two feet high; from ——— Sherman, Esq., of Port Henry, Essex county, N. Y.

47. Serpentine Marble, Verd Antique. A rough slab of 12x18x4; Port Henry, Essex county, N. Y.

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* Several specimens have been sent to the collection without the localities having been communicated to the writer.

C. *Limestones not Metamorphic.*

48. Gray Limestone. Lockport, N. Y.; finely dressed block of one cubic foot; from B. & J. Carpenter.

49. Dark Blue Limestone. A dressed block of one cubic foot, with one side polished; from James Shanahan, Tribes Hill, N. Y.

50. Dark Blue Limestone. A rough dressed block of one cubic foot; from James Shanahan, Tribes Hill, N. Y.

51. Blue and Variegated Limestone. A finely dressed block of one cubic foot; from James Shanahan, Tribes Hill, N. Y.

52. Gray Limestone. A dressed block of 14x10½x6; from J. Critzer, Jacksonburgh, N. Y.

The four preceding specimens are from the Trenton limestone group.

53. Dark Blue Limestone, Black Marble. A dressed and polished block of 12x7x6 inches, from the Howe's Cave Lime and Cement Company, Cobleskill, N. Y.

54. Gray Variegated Limestone (Coral marble). A polished slab of 8x32 inches; from the Hudson Coral Marble Company, Hudson, N. Y.

55. Gray Limestone, Gray Marble (Onondaga limestone). A dressed block of 9x9x9, with one face polished; from Mr. J. Hughes of Syracuse, N. Y.

56. White Marble. Lakeville, Connecticut. A rough block of 24x 20x12 inches; from Wm. R. Smith of Athens, N. Y.

57. Blue Micaceous Limestone. Barrington, Mass. A rough block of about two and a half feet cube; from Dr. Clarkson T. Collins.

D. *Sandstones or Freestones and Varieties of these Rocks.*

58. Brown Sandstone, Medina Sandstone. A dressed block of 12x 12x9 inches; from H. J. Sickles, Albion, N. Y.

59. Brown Sandstone. A finely dressed block of one cubic foot: from Geo. Wrightson of New York.

60. Gray Sandstone. A dressed block of one cubic foot; from B. Clough, Plato, Ohio.

61. Gray Sandstone. A dressed block of 12x17x17; from B. Clough, Plato, Ohio.

62. Gray Sandstone. A dressed block or shaft of one foot square at base, and two feet nine inches high; from B. Clough, Plato, Ohio.

63. Fine Gray Sandstone. Columbia, Ohio; a finely dressed block of one cubic foot; from B. Clough, Esq.

64. Gray Sandstone. Specimen consisting of a dressed base of 12x12 inches and six inches high, surmounted by a cylindrical shaft of fifteen inches high and terminated by a carved rosette: Amherst, Ohio; from R. P. Wilson, New York.

65. Malden Blue Stone. A finely dressed block of 12x8x5 inches; from the Bigelow Blue Stone Company, Malden, N. Y.

66. Hudson River Blue Stone. A dressed block of 20x8x7 inches; from Benedict & Gill, Schenectady, N. Y.

GENERAL ABSTRACT OF CONTENTS OF REPORT.

REPORT OF THE STATE GEOLOGIST.

To the Honorable the Board of Regents of the University of the State of New York :

In accordance with the law of 1883, I herewith submit the following report:

My duties as State Geologist are chiefly the preparation of the work on the Palæontology of the State, and it is rarely possible to find time for any field-work beyond that necessary for the collection of fossils for the volumes in hand. In regard to the progress of this work I beg leave to communicate the following statement.

The report for the State Geologist for 1884 gave a statement of the progress made during that year upon the Palæontology of the State, based upon the condition of the entire work as was fully described in the report made in 1883. It is, therefore, unnecessary to repeat these statements in detail, but confine myself to a statement of the further progress made in the volumes in immediate preparation.

Since the first of March last year, volume V, Part I, Lamellibranchiata II, has been published and distributed; the greater portion of the year having been devoted to the preparation of the manuscript and proof-reading for that volume. This work, together with the volume which preceded, Lamellibranchiata I, completed the publications of the State of New York upon this class of fossils. The volume recently issued contains 356 pages of letter-press and 50 lithographed plates with interleaved explanations of the figures. Of the mechanical execution of the volume I may speak in the highest terms of commendation.

I submit herewith a table of contents of the last published volume, and a list of the genera and number of species under each one, together with their range in the geological formations as shown in the two volumes on the fossil Lamellibranchiata. These tables will show the nature and scope of the work now presented to the public.

The work on the corals and bryozoa has been progressing in the way of making up and arranging the plates of drawings; and the preliminary descriptions of nearly all the species have been prepared. The lithographing of the plates is now in progress, and it is proposed to finish and issue this volume, if possible, during the coming year.

For the succeeding volume on the crustacea, some additional drawings have been made, and two new plates have been arranged.

In addition to the strictly Museum work within the buildings devoted to the collections, some important field-work has been undertaken by Professor Smock with a view to the determination of the limits of the older crystalline and the adjacent metamorphic rocks in the southern part of the State. Such work is very much needed in order to complete our knowledge of the limits of these formations, and has a direct bearing upon the subject of the distribution of the economic products of the State, such as the marbles, granites, iron ores, etc. The collections made in this investigation are enumerated under the head of additions to the Geological department of the Museum. The results will be communicated to the Museum report for publication and will be regarded only as preliminary to further and continued investigation.

At my request, Mr. C. E. Beecher and Mr. C. E. Hall have made some special investigations along the Mohawk valley from Little Falls to Schenectady, with a view to some determinations regarding the junction of the Upper Laurentian gneiss with the superincumbent rocks, and also to make some determinations regarding the faulting of the strata, first noticed by Mr. Vanuxem more than forty years ago. The localities of contact are very few, and the single one formerly known on the old stage road at the Noses has long since become obscured.

At Little Falls the gneiss is succeeded by massive Calciferous sandstone, but notwithstanding the excavations in quarrying, and finally for the West Shore railroad, no actual contacts of the rocks of the two systems have been exposed.

In digging a well through the lower beds of the Calciferous sandstone into the gneiss, a stratum of ferruginous sand was penetrated, lying in contact with the gneiss, below and separated from the Calciferous above. This locality was examined by myself in 1881; and it having come to our knowledge that the cutting of the West Shore railroad at the Little Nose exposed similar strata, the place was visited by Mr. McGee of the United States Geological Survey, and myself, in the autumn of 1884, and observations made upon the contacts there exposed.

An examination was also made of the Oneonta sandstone in the vicinity of Oxford, Chenango county, by Mr. C. E. Beecher, Dr. J. W. Hall and C. E. Hall. Much discussion has recently taken place in regard to the horizon and equivalency of the Oneonta sandstone. The results of the more recent investigations haye served to substantiate my previous published statements, and clearly show that the Oneonta sandstone rests upon well marked Hamilton strata, and is succeeded by strata carrying the fossils of the Chemung Group.

The draughtsmen now employed upon the palæontological work are Mr. George B. Simpson and Mr. Ebenezer Emmons. At the present time all the work is done by the figure; the price paid being at the uniform rate of $3.50 per figure.

JAMES HALL,
State Geologist.

PALÆONTOLOGY OF NEW YORK, vol. V, p. II, LAMELLIBRANCHIATA, ii

TABLE OF CONTENTS.

SUMMARY.

	No. of species.	NAME.	Schoharie grit.	Corniferous.	Marcellus.	Hamilton.	Genesee.	Portage.	Chemung.	Catskill.	Waverly.	Carboniferous.
I	34	Aviculopecten	..	5	1	12	..	..	16	..	1	...
II	13	Lyriopecten	1	1	.	4	..	..	7	..	..	..
III	22	Pterinopecten	..	5	3	8	..	..	7	..	..	...
IV	9	Crenipecten	..	..	..	..	..	..	8	.	1	...
V	12	Pterinea	..	3	.	1	..	..	10	..	..	...
VI	18	Actinopteria	1	.	2	5	..	..	10	..	..	...
VII	22	Ptychopteria	..	..	..	.	..	..	22	..	..	...
VIII	3	Glyptodesma	..	1	..	2	..	..	..	..	..	...
IX	15	Leiopteria	..	1	1	11	..	..	3	..	..	...
X	57	Leptodesma	..	.	1	1	.	..	55	..	..	...
XI	3	Pteronites	..	..	..	..	..	..	3	.	..	...
XII	2	Palæopinna	..	1	..	..	..	..	..	..	..	...
XIII	1	Ectenodesma	..	..	.	.	..	..	1	..	..	...
XIV	5	Limoptera	..	1	..	4	..	..	..	..	..	...
XV	1	Byssopteria	..	..	..	..	..	..	1	..	..	...
XVI	15	Mytilarca	2	1	..	2	..	..	8	..	2	...
XVII	2	Gosselettia	..	..	..	2	..	..	..	..	..	...
XVIII	2	Modiola	..	..	..	..	..	.	2	..	..	...
XIX	24	Modiomorpha	3	5	1	9	..	..	7	..	1	...
XX	13	Goniophora	2	..	..	7	..	.	4	..	..	...
XXI	6	Microdon	..	1	..	4	..	..	2	..	1	...
XXII	13	Nucula	..	..	..	9	..	..	5	..	1	...
XXIII	4	Nuculites	..	..	1	4	..	..	..	..	..	...
XXIV	5	Leda	..	..	.	4	..	..	..	..	1	...
XXV	20	Palæoneilo	..	1	..	10	..	1	9	..	3	...
XXVI	3	Macrodon	..	..	.	1	..	..	1	..	1	...
XXVII	3	Ptychodesma	..	..	..	1	..	..	2	..	..	...
XXVIII	4	Nyassa	..	1	..	3	.	..	..	..	..	...
XXIX	27	Grammysia	1	2	..	15		..	9	..	2	...
XXX	1	Euthydesma	..	..	..	..	..	1	..	..	..	...
XXXI	10	Edmondia	..	..	..	..	..	..	7	..	3	...
XXXII	15	Sphenotus	.	.	..	5	..	..	5	..	6	...
XXXIII	2	Spathella	..	..	..	..	..	..	1	.	1	...
XXXIV	13	Conocardium	3	3	..	4	..	.	2	..	..	...
XXXV	17	Panenka	1	2	6	6	..	1	2	..	..	...
XXXVI	1	Glyptocardia	..	..	..	1	1	1	..	..	..	...
XXXVII	1	Præcardium	..	..	..	..	..	1	.	..	..	...
XXXVIII	1	Paracardium	..	..	..	..	..	1	.	..	..	...
XXXIX	6	Pararca	..	1	..	..	..	..	3	..	2	...
XL	1	Cardiopsis	..	..	.	..	.	..	..	..	1	...
XLI	7	Lunulicardium	..	.	5	2	1	2	3	..	..	...
XLII	9	Paracyclas	..	1	..	4	..	..	5	..	..	..
XLIII	15	Schizodus	1	1	..	3	..	..	8	..	2	...
XLIV	4	Prothyris	..	..	..	2	..	..	2	.	..	...
XLV	1	Solemya	..	..	.	1	..	..	..	..	..	...
XLVI	1	Tellinopsis	..	..	..	1	..	..	..	..	..	...
XLVII	4	Cimitaria	..	..	..	3	..	..	1	..	..	...
XLVIII	3	Pholadella	..	..	..	2	..	..	1	..	1	...
XLIX	6	Phthonia	..	..	..	4	..	..	2	..	..	...
L	5	Orthonota	..	..	..	4	..	..	1	..	..	...
LI	1	Palæosolen	..	..	..	1	..	..	..	..	..	...
LII	6	Cypricardinia	1	1	..	2	..	..	1	..	2	...
LIII	4	Palæanatina	..	..	.	..	..	..	4	..	..	...
LIV	3	Prorhynchus	..	..	.	..	..	..	3	..	..	...
LV	10	Glossites	.	1	..	1	..	..	7	..	1	...
LVI	4	Elymella	..	..	.	3	..	..	..	..	1	...
LVII	2	Sanguinolites	..	..	..	..	..	..	2	.	.	...
LVIII	1	Palæomya	..	..	..	1	..	.	.	..	.	...
LIX	1	Promacrus	..	..	..	..	..	..	..	..	1	...
LX	1	Cytherodon	..	..	..	1	.	..	..	..	..	...
LXI	2	Clinopistha	..	1	..	1	..	..	..	..	..	...
LXII	1	Modiella	..	..	..	1	..	..	.	..	..	...
LXIII	1	Megambonia	..	1	..	..	..	..	..	..	..	...
LXIV	1	Amnigenia	..	..	..	1?	..	1?	..	1	..	...
LXV	1	Allocardium	..	..	..	1	..	..	..	..	..	...
65	520		16	41	21	174	2	9	252	1	35	...

EXPLANATION OF PLATE 1.

ASCOMYCES EXTENSUS *Peck.*

FIG. 1. A leaf partly killed and discolored by the fungus.
FIG. 2. An ascus containing spores x 400.
FIG. 3. Four spores x 400.

AGARICUS (NOLANEA) BABINGTONII *Blox.*

FIG. 4. One young plant and two mature plants, the two at the left having the pileus moist and striatulate.
FIG. 5. Vertical section of a pileus and the upper part of its stem.
FIG. 6. Transverse section of the stem.
FIG. 7. Three spores x 400.

PESTALOZZIA CONSOCIA *Peck.*

FIG. 8. Part of a leaf with a discolored spot dotted by the fungus.
FIG. 9. Four spores, the one at the left immature x 400.

PESTALOZZIA CAMPSOSPERMA *Peck.*

FIG. 10. A leaf bearing the fungus.
FIG. 11. Four spores x 400.

SPHÆRELLA LYCOPODII *Peck.*

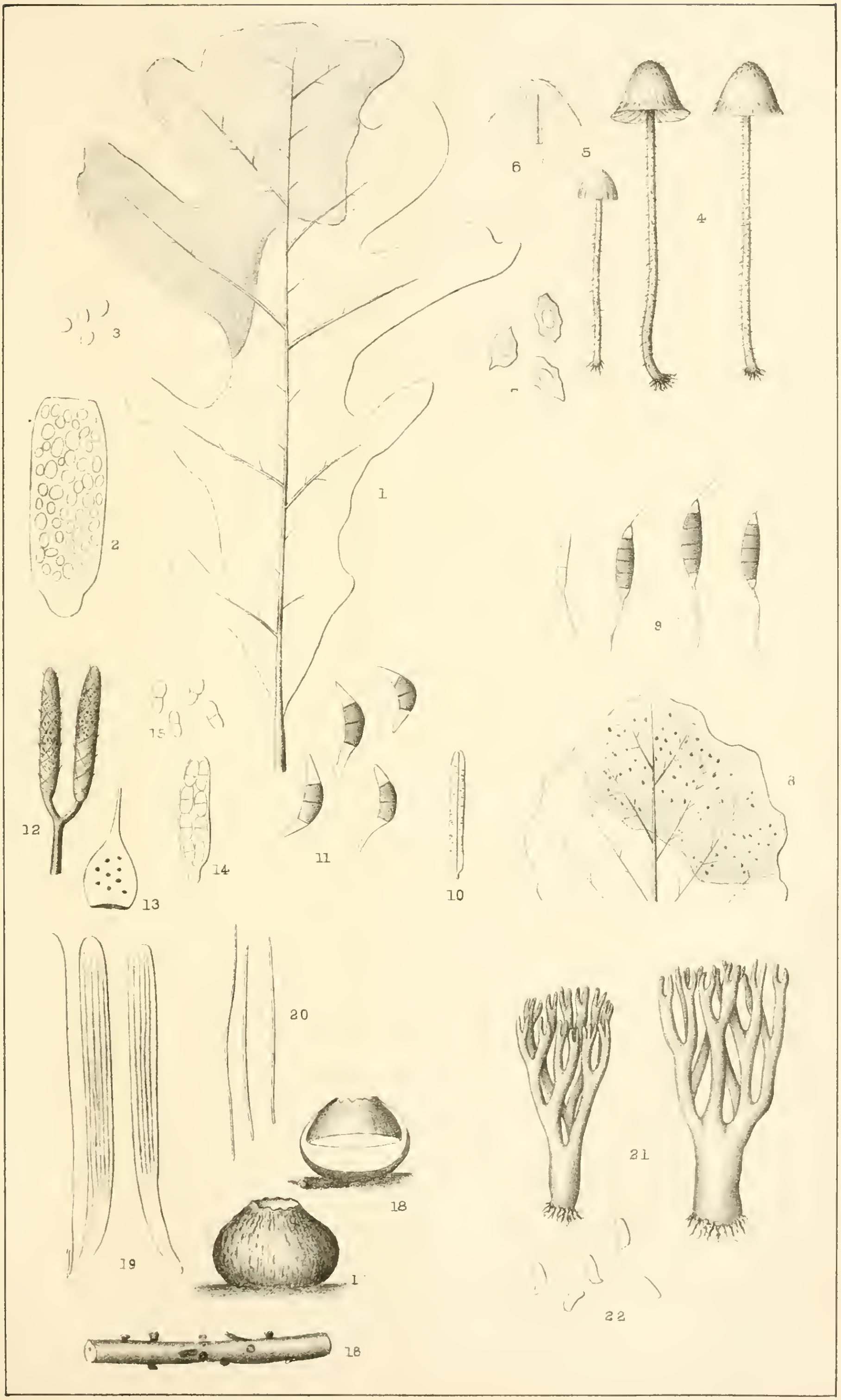
FIG. 12. Two spikes of the host plant bearing the fungus.
FIG. 13. A slightly magnified scale dotted by the fungus.
FIG. 14. An ascus containing spores x 400.
FIG. 15. Four spores x 400.

GODRONIA CASSANDRÆ *Peck.*

FIG. 16. Part of a branch bearing the fungus.
FIG. 17. A receptacle magnified.
FIG. 18. Vertical section of the same.
FIG. 19. A paraphysis and two asci containing spores x 400.
FIG. 20. Three spores x 400.

CLAVARIA CIRCINANS *Peck.*

FIG. 21. Two plants.
FIG. 22. Five spores x 400.



Weed, Parsons & Co Albany NY

EXPLANATION OF PLATE 2.

DIAPORTHE MARGINALIS *Peck.*

FIG. 1. Part of a branch bearing the fungus.
FIG. 2. A pustule magnified.
FIG. 3. Vertical section of a magnified pustule, showing three perithecia.
FIG. 4. Two asci containing spores x 400.
FIG. 5. Four spores x 400.

DIAPORTHE NEILLIÆ *Peck.*

FIG. 6. Part of a branch bearing the fungus.
FIG. 7. A perithecium magnified, its rostrum piercing the epidermis.
FIG. 8. Two asci containing spores x 400.
FIG. 9. Four spores x 400.

LEPTOSPHÆRIA KALMIÆ *Peck.*

FIG. 10. Part of a branch bearing the fungus.
FIG. 11. A piece of the bark with two perithecia magnified.
FIG. 12. A perithecium more highly magnified.
FIG. 13. A paraphysis and an ascus containing spores x 400.
FIG. 14. Four spores x 400.

LÆSTADIA ÆSCULI *Peck.*

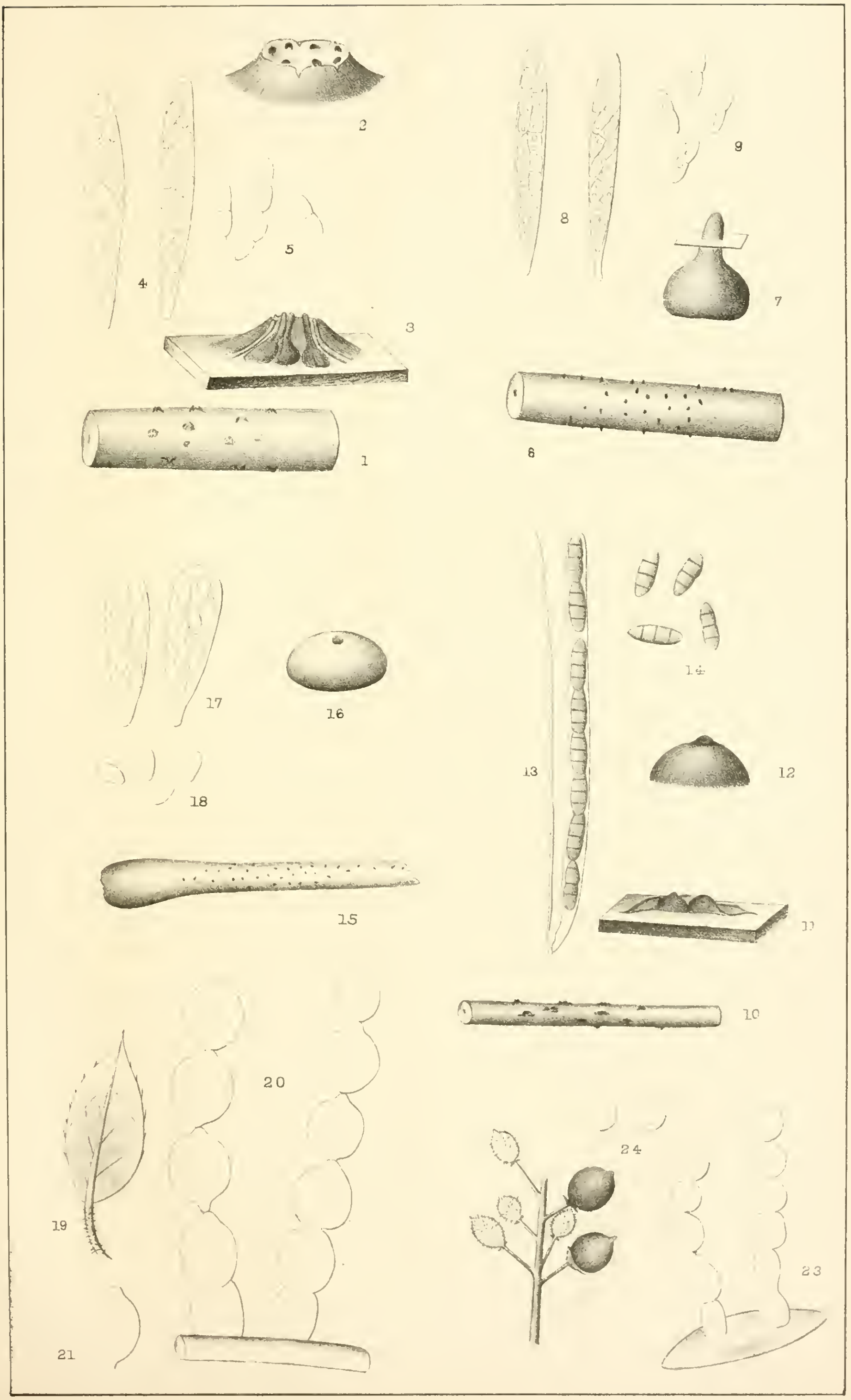
FIG. 15. Part of a petiole bearing the fungus.
FIG. 16. A perithecium magnified.
FIG. 17. Two asci containing spores x 400.
FIG. 18. Four spores x 400.

MONILIA PECKIANA *S. & V.*

FIG. 19. A leaf partly discolored and its petiole frosted by the fungus.
FIG. 20. Two chains of spores x 400.
FIG. 21. A single spore x 400.

M. PECKIANA var. ANGUSTIOR *S.*

FIG. 22. Part of a raceme with four of its young fruits frosted by the fuugus.
FIG. 23. Two chains of spores x 400.
FIG. 24. Two spores x 400.



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EXPLANATION OF PLATE 3.

Fig. 1. Veins of the pulmonary cavity.
Figs. 2, 3, 4. Showing the position of the pulmonary cavity.

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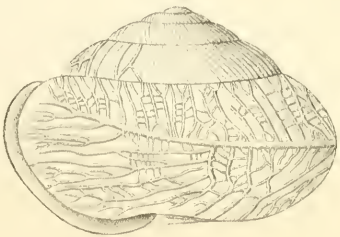

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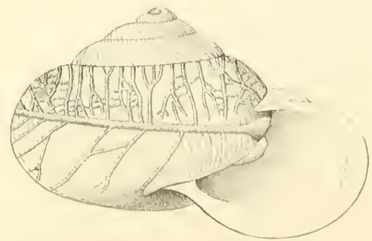

G. B. Simpson. del.

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EXPLANATION OF PLATE (I) 4.

LAGISGA IMPATIENS *n. sp.*

Page 129.

Fig. 1. Head, seen from above, X 15.
Fig. 2. Foot, seen from behind, X 20.
Fig. 3. Long ventral seta outer third, X 230.
Fig. 4. Dorsal seta, outer half, X 230.
Fig. 5. Elytron of the first pair, X 15.
Fig. 6. Elytron of the usual form, X 15.
Fig. 7. Papilla found on antennæ and cirri, X 230.

ANAÏTIS SPECIOSA *n. sp.*

Page 131.

Fig. 8. Foot, with dorsal and ventral cirri, 12th segment, X 15.
Fig. 9. Seta of medium length, outer third, X 750.


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EXPLANATION OF PLATE (II) 5.

PHYLLODOCE ARENÆ *n. sp.*

Page 133.

Fig. 10. Foot with cirri, from 24th segment, X 40.
Fig. 11. Foot with cirri, from middle of body, X 40.
Fig. 12. Seta, outer half, X 450.

ETEONE ALBA *n. sp.*

Page 134.

Fig. 13. Head and buccal segment, X 25.
Fig. 14. Foot with cirri, from 8th setigerous segment, X 40.
Fig. 15. Foot from middle of body, X 40.
Fig. 16. Seta, X 450.

PODARKE OBSCURA *Verrill.*

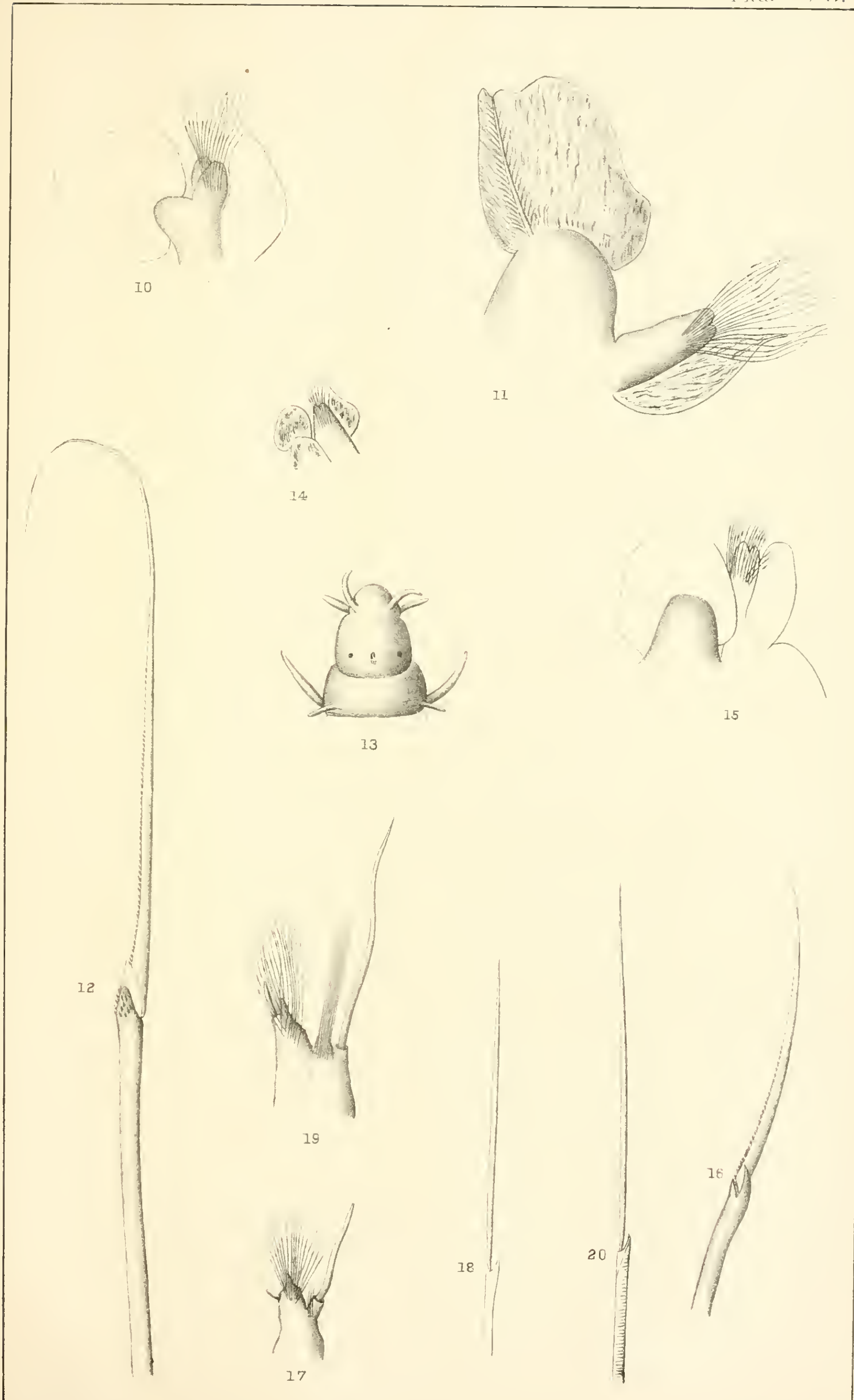
Page 135.

Fig. 17. Foot from middle of body, X 20.
Fig. 18. Seta from ventral ramus, X 230.

PODARKE LUTEOLA *n. sp.*

Page 135.

Fig. 19. Foot from middle of body, X 20.
Fig. 20. Seta from ventral ramus, X 230.



Weed, Parsons & Co Albany N.Y.

EXPLANATION OF PLATE (III) 6.

NEREIS LIMBATA *Ehlers.*

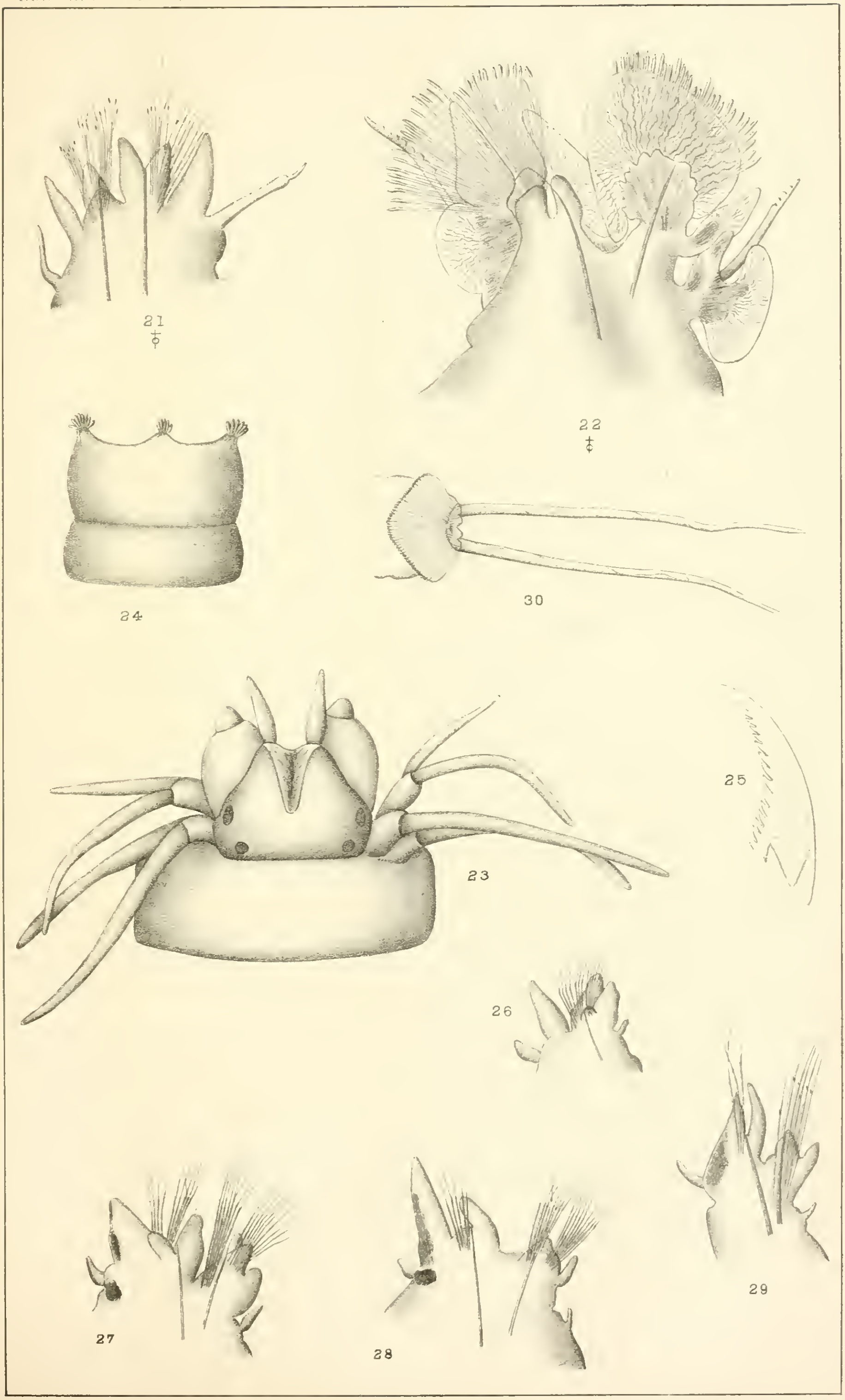
Page 139.

Fig. 21. Foot from 5th setigerous segment, ♂, X 20.
Fig. 22. Foot from middle region, ♂, X 20.

NEREIS CULVERI *n. sp.*

Page 140.

Fig. 23. Head and buccal segment, X 40.
Fig. 24. Proboscis, seen from above, magnified.
Fig. 25. Jaw piece, X 40.
Fig. 26. Foot from first setigerous segment, X 20.
Fig. 27. Foot from fifth setigerous segment, X 20.
Fig. 28. Foot from thirtieth setigerous segment, X 20.
Fig. 29. Foot from posterior segment, X 40.
Fig. 30. Anal segment and cirri, X 20.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EXPLANATION OF PLATE (IV) 7.

NEREIS CULVERI *n. sp.*

Page 140.

Fig. 31. Ordinary seta, outer part, X 450.
Fig. 32. Falcate seta, outer part, X 450.

NEREIS TRIDENTATA *n. sp.*

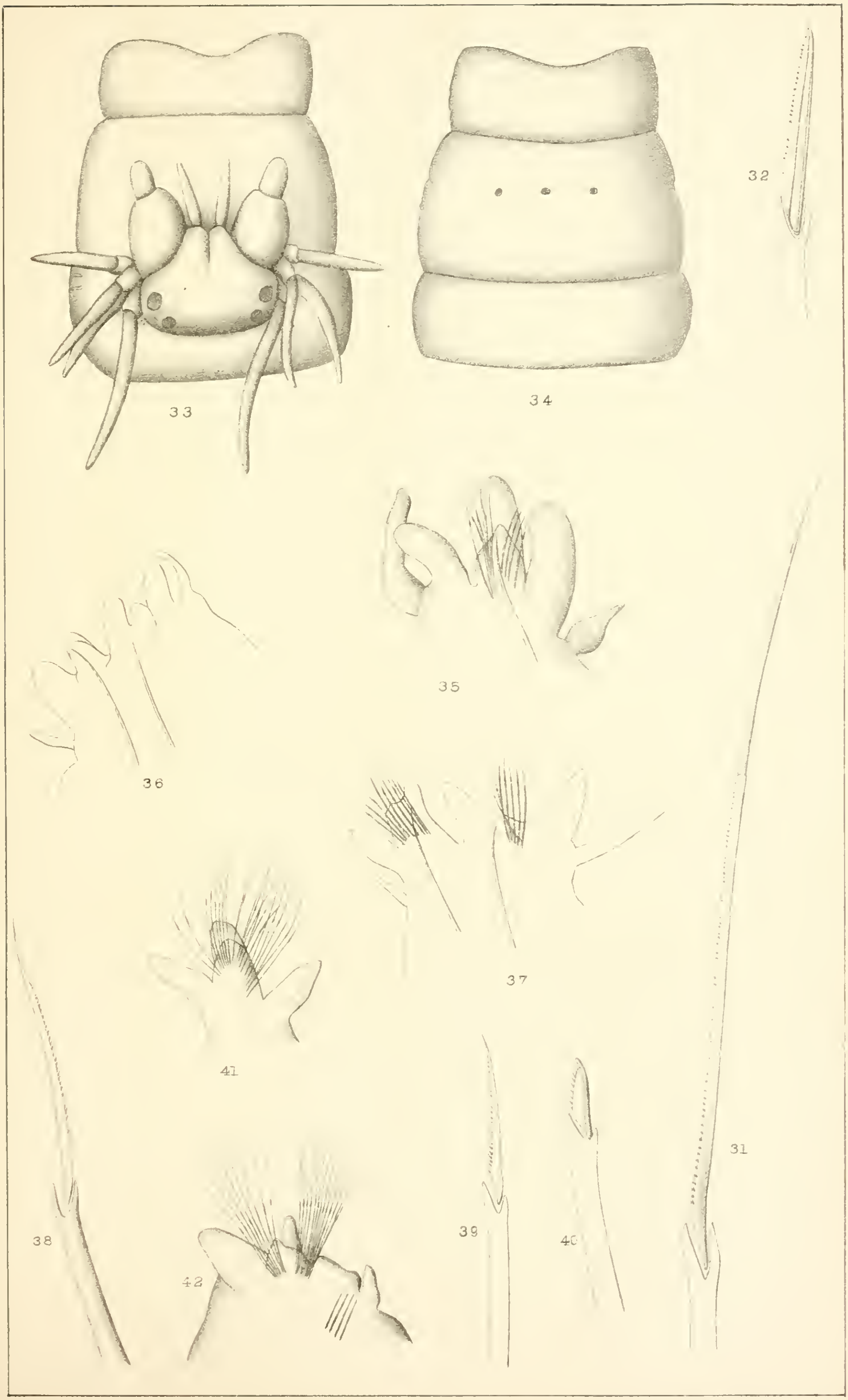
Page 142.

Fig. 33. Head, proboscis, and buccal segment, X 40.
Fig. 34. Proboscis, ventral view, X 40.
Fig. 35. Foot from first setigerous segment, X 120.
Fig. 36. Foot from anterior segment, X 60.
Fig. 37. Foot from posterior segment, X 60.
Figs. 38, 39, 40. Setæ of different form, X 450.

GONIADA SOLITARIA *n. sp.*

Page 146.

Fig. 41. Foot from tenth segment, from behind, X 60.
Fig. 42. Foot from twenty-eighth segment, from behind, X 60.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EXPLANATION OF PLATE (V) 8.

GONIADA SOLITARIA *n. sp.*

Page 146

Fig. 43. Foot from 45th segment, from behind, X 60.
Fig. 44. Seta, outer half, X 450.

POLYDORA LIGNI *n. sp.*

Page 148

Fig. 45 Head and first segments, without tentacles, X 70.
Fig. 46. Seta from fifth segment, X 450
Fig. 47 Ordinary ventral seta X 450

STREBLOSPIO BENEDICTI *n. gen. et sp.*

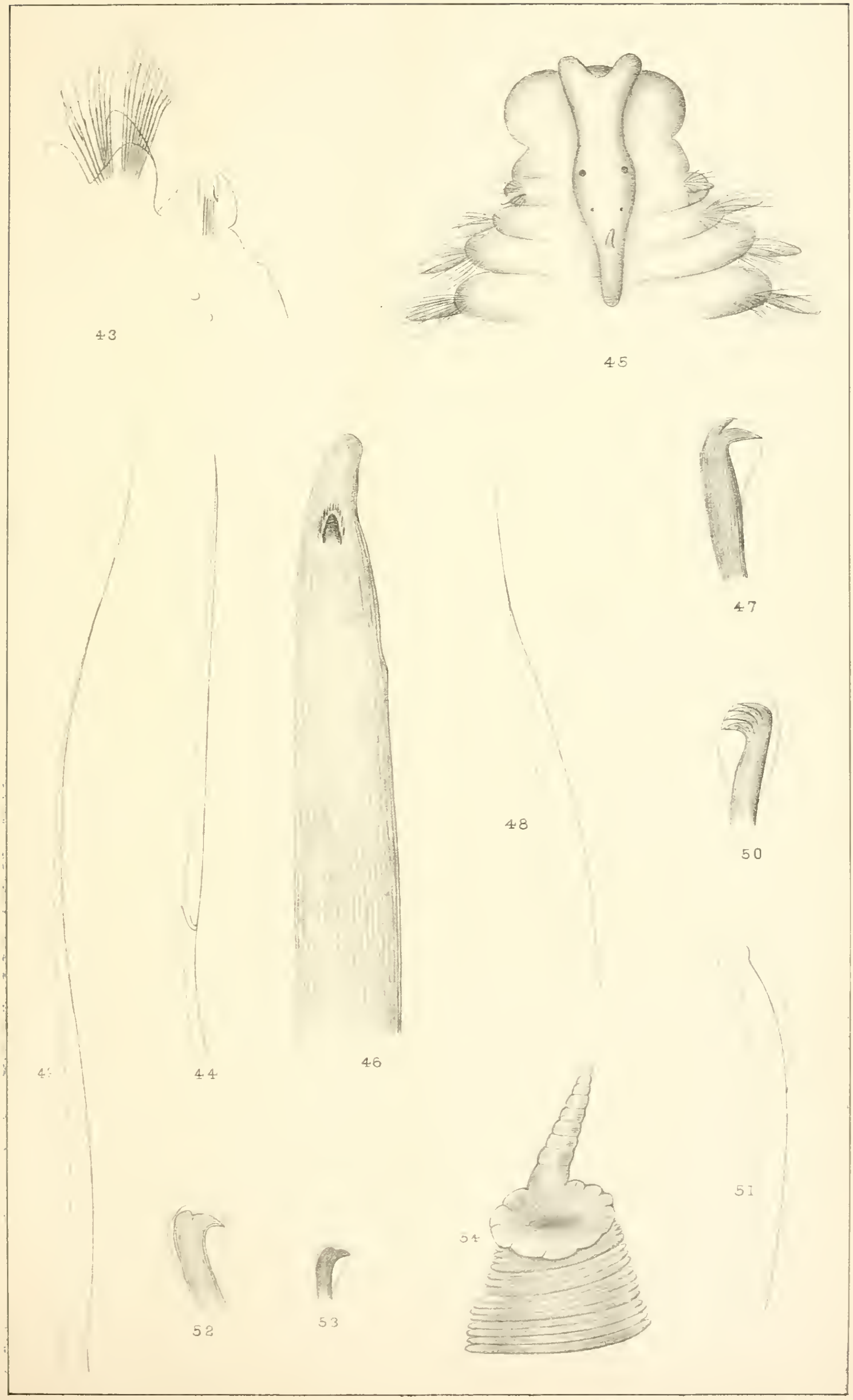
Page 149

Fig. 48. Anterior dorsal seta, X 750.
Fig 49. Posterior dorsal seta, X 750.
Fig. 50. Uncinate ventral seta, X 750.

NOTOMASTUS FILIFORMIS *Verr.*

Page 152

Fig. 51. Uncinus from anterior segment, X 750
Fig. 52. Uncinus from middle segment, X 750
Fig. 53. Uncinus from posterior segment
Fig. 54. Posterior segments with anal cirrus, X 70



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EXPLANATION OF PLATE (*VI*) 9.

PRAXILLA ELONGATA *n. sp.*

Page 154.

Fig. 55 Buccal segment, ventral view, X 15
Fig 56. Posterior segments, X 15
Fig 57. Capillary seta, X 230.
Fig 58 Uncinus, found on first three setigerous segments, X 230.
Fig 59 Uncinus, form found after the third setigerous segment, X 230.

PRAXILLA ELONGATA *var.* BENEDICTI *n. var.*

Page 155

Fig 60 Anterior segments, side view. X 15.
Fig 61. Posterior segments, X 15.

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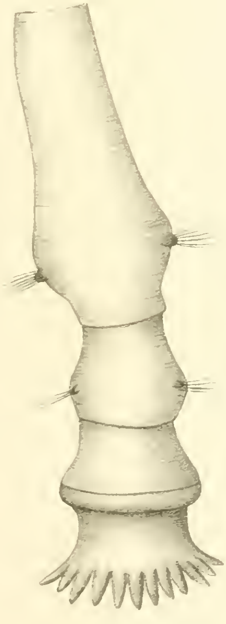

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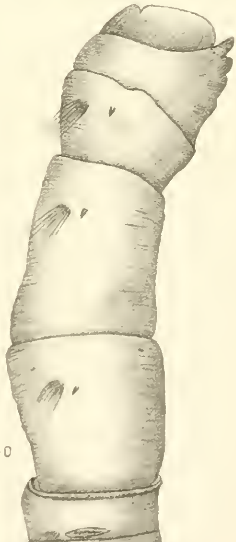

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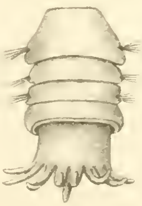

61

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EXPLANATION OF PLATE (VII) 10.

PARAXIOTHEA LATENS *n. gen. et sp.*

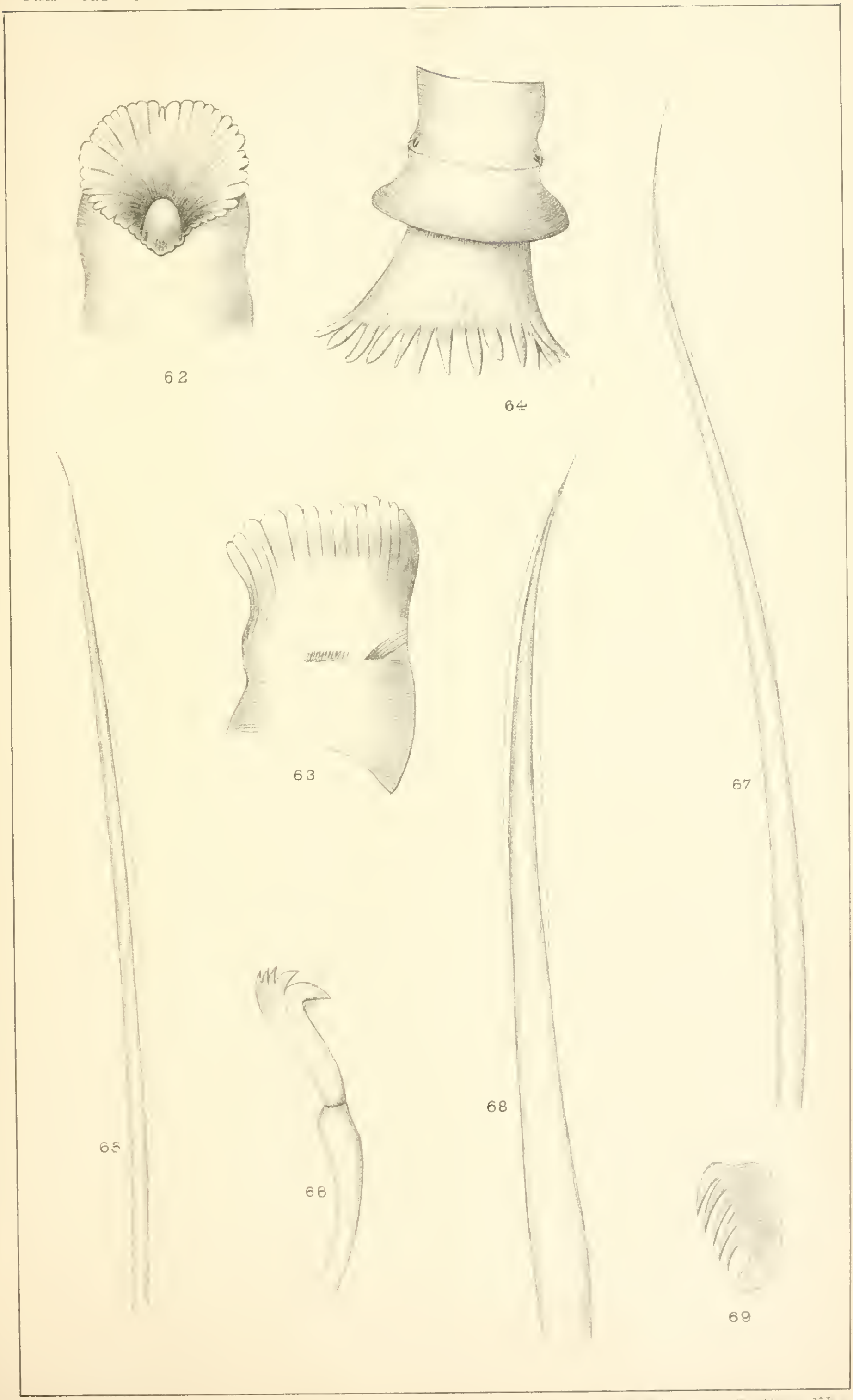
Page 156

Fig. 62. Buccal segment seen obliquely from above, X 15.
Fig. 63. Buccal segment, side view, X 15.
Fig. 64. Posterior segments, X 15.
Fig. 65. Capillary seta, X 230.
Fig. 66. Uncinus, X 230

SABELLIDES OCULATA *n. sp.*

Page 157.

Fig. 67. Capillary seta, with single margin, X 230
Fig. 68. Capillary seta, with double margin, X 230.
Fig. 69. Uncinus, X 450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EXPLANATION OF PLATE 11.

DACTYLOIDITES BULBOSUS.

Page 160.

Fig. 1. A small specimen, showing the six rays marked by concentric lines at their distul extremities.

Fig. 2. A larger specimen in which the bulbous expansious are distinctly stalked. Roofing slate, *Middle Granville, N. Y.*

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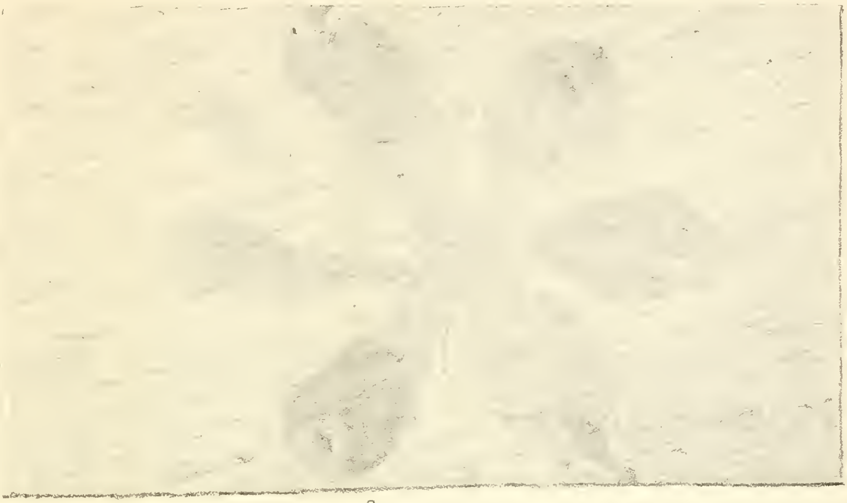

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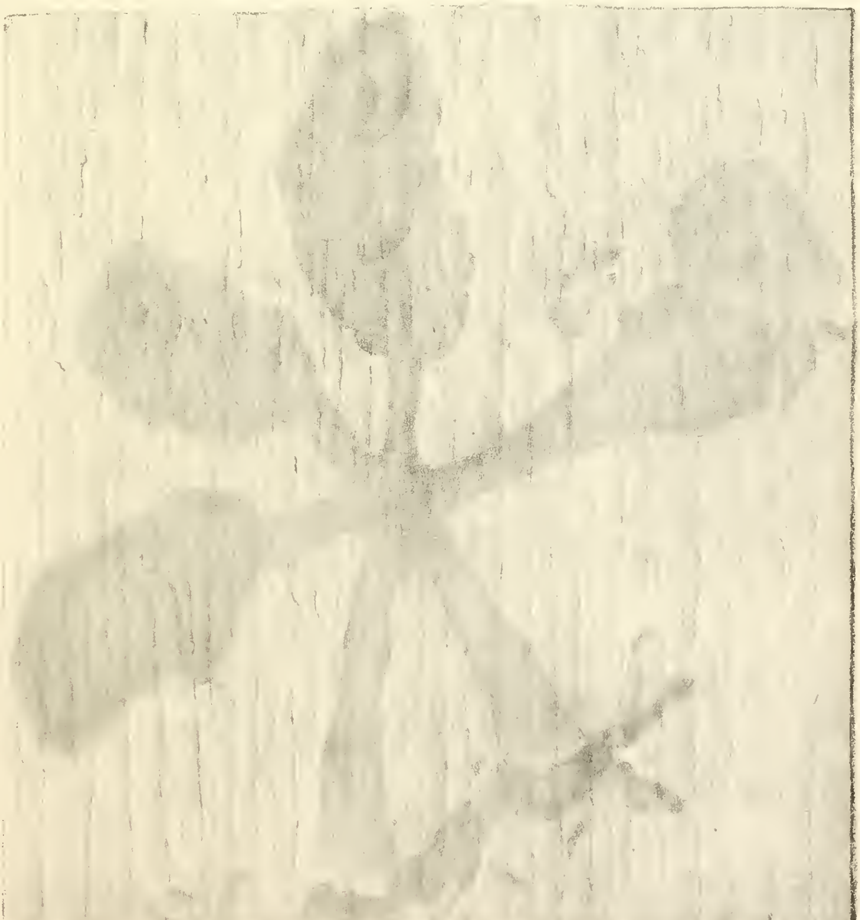

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EXPLANATION OF PLATE 12.

SPIRODOMUS INSIGNIS, Beecher.

Page 162.

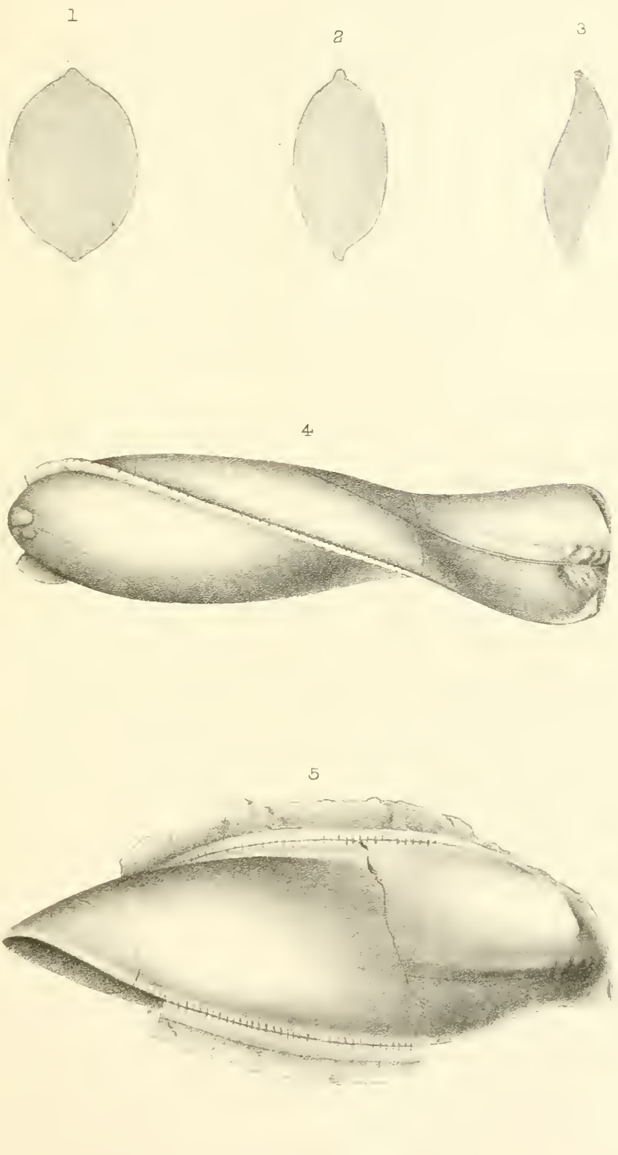
Fig. 1. A transverse section, taken from about 45^{mm} from the anterior end of a specimen.

Fig. 2. A transverse section, posterior to the middle of the specimen fig. 4.

Fig. 3. *Id.* Section of the conjoined valves, at about the posterior quarter of their length.

Fig. 4. *Id.* Ventral aspect of a specimen, which is a partial cast of the interior, showing the form of the shell, the muscular scars, pallial line and crenulated margins.

Fig. 5. *Id.* The left side of the embedded specimen in the rock, showing the expanded crenulate margins of the valves and the pallial line. Waverly group. *Warren, Pennsylvania.*



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