State of New York

No. 66

IN SENATE

March 1, 1895

48TH ANNUAL REPORT

OF THE

NEW YORK STATE MUSEUM

To the Legislature of the State of New York

I have the honor to submit herewith, pursuant to law, as the 48th annual report of the regents of the University on the New York State Museum, the reports of the director of the museum, of the geologist and paleontologist, of the botanist and of the entomologist, with appendix.

ANSON JUDD UPSON
Chancellor

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Regents

March 1895

ANSON JUDD UPSON, D. D., LL. D., L. H. D., *Chancellor*	
WILLIAM CROSWELL DOANE, D. D., LL. D., *Vice-Chancellor*	
LEVI P. MORTON, LL. D., Governor	*Ex officio*
CHARLES T. SAXTON, LL. D., Lieut.-Governor	*Ex officio*
JOHN PALMER, Secretary of State	*Ex officio*
CHARLES R. SKINNER, M. A., Sup't of Pub. Inst.	*Ex officio*

In order of election by the legislature

ELECTED		
1873	MARTIN I. TOWNSEND, M. A., LL. D., L. H. D.	Troy
1874	ANSON JUDD UPSON, D. D., LL. D.	Glens Falls
1876	WILLIAM L. BOSTWICK, M. A.	Ithaca
1877	CHAUNCEY M. DEPEW, LL. D.	New York
1877	CHARLES E. FITCH, LL. B., M. A.	Rochester
1877	ORRIS H. WARREN, D. D.	Syracuse
1878	WHITELAW REID, LL. D.	New York
1881	WILLIAM H. WATSON, M. A., M. D.	Utica
1881	HENRY E. TURNER	Lowville
1883	ST CLAIR MCKELWAY, LL. D.	Brooklyn
1885	HAMILTON HARRIS, LL. D.	Albany
1885	DANIEL BEACH, Ph. D., LL. D.	Watkins
1888	CARROLL E. SMITH	Syracuse
1890	PLINY T. SEXTON, LL. D.	Palmyra
1890	T. GUILFORD SMITH, M. A., C. E.	Buffalo
1892	WILLIAM CROSWELL DOANE, D. D., LL. D.	Albany
1893	LEWIS A. STIMSON, B. A., M. D.	New York
1894	SYLVESTER MALONE	Brooklyn
1895	ALBERT VANDER VEER, M. D., Ph. D.	Albany

Elected by the regents

1888	MELVIL DEWEY, M. A., *Secretary*	Albany

Regents standing committee on the State Museum

T. Guilford Smith, *Chairman*

Lieutenant-Governor

Martin I. Townsend

William L. Bostwick

St Clair McKelway

Daniel Beach

Carroll E. Smith

State Museum Staff

Research division

James Hall, M. A. (Rensselaer Polytechnic), LL. D. (Harvard) *State geologist and paleontologist*

Charles H. Peck, M. A. (Union) - - - *State botanist*

J. A. Lintner, Ph. D. (N. Y.) - - - *State entomologist*

John M. Clarke, M. A. (Amherst) - *Assistant paleontologist*

E. Emmons - - - - - - - - *Draftsman*

Martin Sheehy - - - - - - - *Messenger*

Jacob Van Deloo - - - - - - - *Clerk*

Rose L. Davis - - - - - *Entomologist's assistant*

Administrative division

Frederick J. H. Merrill, Ph. D. (Columbia) - - *Director*

Joseph Morje - - - - - - - - *Page*

NEW YORK STATE MUSEUM

REPORT OF THE DIRECTOR, 1894

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REPORT OF THE DIRECTOR.

ALBANY, N. Y., *December* 11, 1894.

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

GENTLEMEN.— During the last fiscal year the attention of the Director has been chiefly given to the collation and discussion of data obtained in the work of preparing the Scientific Exhibit of the State of New York at the World's Columbian Exposition. Owing to the reduced condition of the Museum funds no new work has been undertaken and no purchases of material have been made. The Assistant Zoologist, Mr. William B. Marshall, has continued his work of identifying, labelling and arranging the collection of shells with which he has been occupied during the past two years, and has placed on exhibition with new labels and mounting cards all the specimens which have been thus far identified. Mr. Marshall's report is appended.

The turnstile which was placed at the entrance to Geological Hall in January, 1893, has given very satisfactory evidence of the public value of the museum as shown by the following table:

From February 1, 1893, to September 30, 1893, total attendance	52,819
Greatest monthly maxium, August	9,021
Greatest daily maximum, May 30	845
From February 1, 1894, to September 30, 1894, total attendance	49,681
Greatest monthly maximum, August	7,782
Greatest daily maximum, March 17	1,083
Total attendance for the fiscal year ending September 30, 1894	72,456

The collection of New York Woods purchased from Mr. Romeyn B. Hough has been completed and the specimens have been finished and placed in cases in the gallery of the agricultural exhibition rooms in the rear of Geological Hall. The specimens are seventy-six in number, and a catalogue of them is herewith annexed.

The Building Stone collection in Geological Hall has also been catalogued and the list is appended to this report.

As the specimens composing the Mineral Exhibit of New York at the World's Columbian Exposition are now the property of the State Museum a complete catalogue of them has been prepared which will soon be ready for publication.

The most important part of the work of the Director is contained in the accompanying scientific papers which represent the cumulative results of his work since he became connected with the Museum. They are to appear in advance of this report as bulletins of the New York State Museum, and are as follows:

Bulletin No. 12 — The Clay Industries of New York.

Bulletin No. 14 — Geology of Moriah and Essex Townships.

Bulletin No. 15 — The Mineral Resources of New York.

The first of these has been prepared by Mr. Heinrich Ries. The work began in 1892 with a study of the clay deposits of the Hudson River valley and the report on this preliminary investigation was published in the Report of the State Geologist for 1891. Subsequently in collecting clays for the exhibit of New York State at the World's Columbian Exposition much information was obtained and the bulletin above mentioned was prepared to publish this valuable material.

Bulletin No. 14 was prepared by Prof. J. F. Kemp as a report of his work done in eastern Essex county during the summer of 1892, under the auspices of the State Museum, and includes the results of a valuable and important investigation on the iron ore deposits of that region.

Bulletin No. 15 has been prepared by the Director to make public the information acquired in the work of preparing the Mineral Exhibit of New York at the World's Columbian Exposition and is intended to be a directory of the mineral resources of New York. It is illustrated by the Economic and Geologic Map of New York, which was prepared for the report of the Superintendent of the Scientific Exhibit of New York at the World's Columbian Exposition.

A check list of the fishes of New York has been prepared to meet the demand for such a catalogue, and will be printed as a bulletin of the Museum.

Respectfully submitted,

FREDERICK J. H. MERRILL,
Director

List of Accessions.

By Donation.

February 2, 1894.

Indian Utensil, made from a concretion, presented in the name of John Broeder, Medway, Greene co. N. Y.

Flint Arrowhead, Greene co., N. Y., Dr. A. W. Van Slyke.

February 6, 1894.

Mr. John Webb, Jr., of Gouverneur, presented in the name of the Northern New York Marble co. of Gouverneur, a specimen of marble from the quarries of the company. The specimen is in the form of a baluster.

September 20, 1894.

1 box black shale and quartz from Geo. C. Mercer, North Hillsdale, Columbia county.

September 24, 1894.

Mr. William Walter Jefferis of Philadelphia, Pa., presented to the State Museum 1 piece of Garnet from Avondale, Pa., 1 specimen of Calcite from Fall French Creek, Pa., 3 specimens of Vivianite from Mullica Hill, N. Y.

Fifteen boxes of drill cores from Retsof Salt Mining co.

From Mr. C. S. Lamont Lloyd, Ulster co., N. Y., 1 specimen of Calcite from West Shore R. R. at Cranstons, N. Y., and Nodule of Pyrite from Manchester, Dutchess co., N. Y.

From W. W. Jefferis, two specimens of Corundum from Buck Creek Clay co., North Carolina and from Hogback Mt., Jackson co., North Carolina.

World's Columbian Exposition Awards to the New York State Museum on New York State Mining Exhibits.

Group 42.

1. New York minerals.
2. Iron ores.
3. Magnetite.

Group 43.

4. Crude petroleum.
5. Building stone.
6. Slate for roofing and ornamental purposes.
7. Road materials.
8. Geologic obelisk.

Group 46.

9. Clays.

Group 47.

10. Road metal.
11. Lime and cement.

Group 48.

12. Collective exhibit of salt.
13. Mineral paint.
14. Collective exhibit of mineral waters.
15. Natural history of New York.
16. Bulletins of New York State Museum.

Awards to Firms Exhibiting in Connection with the New York State Museum.

Group 42.

Port Henry Iron Ore Co., Port Henry:

17. Magnetite Bessemer ore.

Chateaugay Ore & Iron Co., Lyon Mountain:

18. Magnetite.

Witherbee, Sherman & Co., Port Henry:

19. Magnetite.

Group 43.

Genesee Salt Co., Piffard:

20. Velvet grain and table salt.

Ornamental Slate Co., Whitehall:

21. Red roofing slate, etc.

Group 45.

Daniel Lynch, Minerva:

22. Massive garnet.

Group 46.

Staten Island Kaolin Co.:

23. Kaolin.

Group 47.

Lawrence Cement Co., Rosendale:

24. Cement.

Buffalo Cement Co., Buffalo:

25. Hydraulic cement.

Persbacher Bros. & Co., Callicoon:

26. Flagstone.

Horan Bros., Medina:

27. Flagstone.

Group 48.

Clinton Metallic Paint Co., Clinton:

28. Hematite and mineral paint.

Catalogue of Specimens of New York Woods in Geological Hall.

BOTANICAL NAME.	Common Name.	Locality.
	MAGNOLIACEÆ.	
Magnolia acuminata, L.	Cucumber Tree	Steuben county.
Liriodendron Tulipifera, L	Tulip Tree, White-wood	Cayuga county.
	TILIACEÆ.	
Tilia Americana, L	Basswood	Lewis county.
	SIMARUBACEÆ.	
Ailanthus glandul sus, Desf	Tree of Heaven	Tompkins county.
	SAPINDACEÆ.	
Æsculus Hippocastanum, L.	Horse Chestnut	Chemung county.
Acer Pennsylvanicum, L	Striped Maple	Lewis county.
Acer saccharinum, Wang	Sugar Maple	Lewis county.
Acer rubrum, L.	Red Maple	Lewis county.
	ANACARDIACEÆ.	
Rhus typhina, L	Stag-horn Sumach	Tompkins county.
	LEGUMINOSÆ.	
Robinia Pseudacacia, L	Locust	Lewis county.
Gymnocladus Canadensis, Lam	Coffee-tree	Tompkins county.

	ROSACEÆ.	
Prunus Pennsylvanica, Lf	Pigeon Cherry	Lewis county.
Prunus serotina, Ehrh	Wild Black Cherry	Lewis county.
Prunus Avium, L	Ox-heart Cherry	Cayuga county.
Cratægus punctata, Jaq	Black Thorn	Lewis county.
Amélanchier Canadensis, T. & G	Shad-bush	Chemung county.
	HAMAMELACEÆ.	
Liquidambar Styraciflua, L	Sweet Gum	Queens county.
	ARALIACEÆ.	
Aralia spinosa, L	Hercules-Club	Cayuga county.
	CORNACEÆ.	
Cornus florida	Flowering Dogwood	Cayuga county.
Nyssa multiflora, Wang	Tupelo, Sour Gum	Steuben county.
	EBENACEÆ.	
Diospyros Virginiana, L	Persimmon	Queens county.
	OLEACEÆ.	
Fraxinus Americana, L	White Ash	Lewis county.
Fraxinus pubescens, Lam	Red Ash	Lewis county.
Fraxinus sambucifolia	Black Ash Burl	Lewis county.
	LAURACEÆ.	
Sassafras officinale, Nees	Sassafras	Tompkins county.

Catalogue of Specimens of New York Woods — (*Continued*).

BOTANICAL NAME.	Common Name.	Locality.
Urticaceæ.		
Ulmus fulva, Michx	Red Elm, Slippery Elm	Lewis county.
Ulmus Americana, L	White Elm	Lewis county.
Ulmus racemosa, Thos	Cork Elm, Rock Elm	Lewis county.
Celtis occidentalis, L	Hackberry	Lewis county.
Morus rubra, L	Red Mulberry	Tompkins county.
Platanaceæ.		
Platanus occidentalis, L	Sycamore, Buttonwood	Cayuga county.
Juglandaceæ.		
Juglans cinerea, L	Butternut	Lewis county.
Juglans nigra	Black walnut	Steuben county.
Carya alba, Nutt	Shell-bark Hickory	Cayuga county.
Carya sulcata, Nutt	Big Shell-bark Hickory	Livingston county.
Carya microcarpa, Nutt	Small-fruited Hickory	Tompkins county.
Carya porcina, Nutt	Pig-nut Hickory	Cayuga county.
Carya amara, Nutt	Bitter-nut Hickory	Lewis county.
Cupuliferæ.		
Betula lenta, L	Cherry Birch	Tompkins county.
Betula lutea, Michx, f	Yellow Birch	Lewis county.
Betula populifolia, Marshall	White Birch	Richmond county.
Betula papyracea, Ait	Canoe Birch	Lewis county.

Betula nigra, L	River Birch	Richmond county.
Alnus incana	Wild Hoary Alder	Steuben county.
Ostrya Virginica, Willd	Hop Hornbeam	Lewis county.
Carpinus Caroliniana, Walt	Iron Wood	Steuben county.
Quercus alba, L	White Oak	Montgomery county.
Quercus obtusiloba, Michx	Post Oak	Queens county.
Quercus bicolor, Willd	Swamp White Oak	Tompkins county.
Quercus Prinus, L	Rock Oak	Tompkins county.
Quercus Muhlenbergii, Englem	Chinquapin Oak	Cayuga county.
Quercus rubra, L	Red Oak	Lewis county.
Quercus coccinea, Wang	Scarlet Oak	Tompkins county.
Quercus tinctoria, Bartram	Yellow Oak	Tompkins county.
Quercus palustris, Du Roi	Pin Oak	Queens county.
Quercus nigra, L	Black Jack Oak	Queens county.
Castanea vesca, Var. Americana	Chestnut	Tompkins county.
Fagus ferruginea, Ait	Beech	Lewis county.

SALICACEÆ.

Salix nigra, Marshall	Black Willow	Tompkins county.
Salix amygdaloides, Anders	Peach Willow	Tompkins county.
Populus grandidentata, Michx	Large-toothed Poplar	Lewis county.
Populus heterophylla, L	Swamp Poplar	Richmond county.
Populus balsamifera, L. var. candicans	Balm of Gilead	Lewis county.
Populus monilifera, Ait	Eastern Cottonwood	Cayuga county.
Populus dilatata, Ait	Poplar	Lewis county.
Pinus Strobus L	White Pine	Lewis county.
Pinus rigida, Miller	Pitch Pine	Tompkins county.
Pinus mitis, Michx	Yellow Pine	Richmond county.
Picea nigra, Poir	Black Spruce	Lewis county.

Catalogue of Specimens of New York Woods — (*Concluded*).

Coniferæ.

BOTANICAL NAME.	Common Name.	Locality.
Tsuga Canadensis, Michx	Hemlock Fir	Lewis county.
Abies balsamea, Marshall	Balsam Fir	Lewis county.
Larix Americana, Michx	Tamarack	Lewis county.
Chamæcyparis sphæroidea Spach	White Cedar, Cypress	Queens county.
Thuja occidentalis, L	White Cedar, Arbor Vitæ	Lewis county.
Juniperus Virginiana, L	Red Cedar	Montgomery county.

Catalogue of Building Stone in the State Museum (Old Collection).

SANDSTONES.

NAME.	Source.	Dimension.
Sandstone	Medina, N. Y., from J. Ryan	12x12x22.
"	" "	12x14x9.
"	Medina, N. Y., from Ezra Cornell	11x9x9.
"	Amherst, Ohio, from R. P. Wilson, New York	12x12x9.
"	Amherst, Ohio (cylinder), from R. P. Wilson, New York	14x7.
Potsdam sandstone	Bass Island, Lake Superior, from Alanson Sweet	12x12x12.
"	Potsdam, N. Y	12x12x12.
Medina sandstone	Medina, N Y	11½x11½x9.
Hudson River bluestone	Schenectady, N. Y., from Benedict & Gill	8½x7x19.
Portage sandstone	Schoharie county, N. Y., from J. M. Scribner	10x6x25.
Flagstone	Roxbury, Delaware county, N. Y., from George Crawford	8½x9x2½.
Bluestone	Kingston, N. Y., from George Crawford	10x8x3.
"	Fox Hollow, Ulster county, N. Y., from George Crawford	10x5x5.
"	Oxford, Chenango county, N. Y., from F. G. Clarke & Son	8½x6x5½.
"	Chenango county, N. Y., from George Crawford	5x3½x8.
"	Oxford, Chenango county, N. Y., from New York State Capitol	5½x7x5½.
"	East of Malden, N. Y	8½x7x8.
"	Malden, N. Y., from Bigelow Bluestone Co	10½x8x4½.
Hudson River bluestone	Schenectady, N. Y., from J. H. Benedict & Son	6½x8x2½.
Sandstone	Medina, N. Y., from J. Ryan	12x10x7.
Medina sandstone	Lockport, N. Y	7½x10½x20.
Potsdam sandstone	Potsdam, N. Y., from D. Parmeter	12x12x16.
Sandstone	Seneca Creek, Md., from George Wrightson, New York	12x12x12.
Bluestone	Malden, N. Y., Bigelow Bluestone Co	12x12x18.

CATALOGUE OF BUILDING STONE IN THE STATE MUSEUM — (*Continued*).

NAME.	Source.	Dimensions.
Kibbe stone	East Longmeadow, Mass., from James & Marra, Springfield, Mass.	4′ cube.
Brownstone	" " " "	4′ cube.
"	East Longmeadow, Mass., from A. D. Stone & Co., Springfield, Mass.	4x5x5.
Brownstone freestone	Trenton, N. J., from Charles E. Keeler	4.5x5.5x4.
Sandstone	Corsehill, Scotland, from Hon. D. J. Johnson	4x6.5x4.75.
Triassic sandstone	Seneca county, Md	8.5x9.5x2.5.
Potsdam sandstone	Bass Island, Lake Superior, from Alanson Sweet	12x9½x3.
Portage sandstone	Rondout, N. Y., from James Hall	12x9x5.
Sandstone	Dorchester, N. S., from Hon D. J. Johnson	5½x4½x3½.
Clinton sandstone	Herkimer county, N. Y., from A. C. McGowan	3x13x7.
"	" " "	8x6½x5.
Potsdam sandstone	Potsdam, N. Y., New York State Capitol	6x6x6.
Brownstone	Oswego Falls, N. Y., from Hughes Brothers	6x6x6.
Medina sandstone	Fulton, Oswego county, N. Y., from E. W. Leavenworth	12x5½x7.
"	Albion, N. Y., from Albion Stone Company	5¾x7x7.2.
Sandstone (triassic)	Nyack, N. Y., from Daniel T. Smith	10½x7x8.
Bluestone	Warsaw, N. Y., from E. E. Farman, New York	12x4.1x4.
"	Schenectady, N. Y	10½x9½x13.
Worcester sandstone	East Longmeadow, Mass., from Norcross Brothers, Worcester, Mass	10x10x10.
Kibbe sandstone	" " "	10x10x10.
Maynard sandstone	" " "	10x10x10.
Sandstone (Chemung)	Ithaca, N. Y	10x13x13.
"	" collected by James Hall	12x8x18.
Sandstone	Plato, Ohio	10½x10½x32.
"	"	17x17x12.

"	"	12x12x12.
"	Columbiana, Ohio, from B. Clough	12x12x12.
"	Amherst, Ohio, from Hon. D. J. Johnson	4x4x5.

GRANITES.

Granite	Prospect, Maine	$10\frac{1}{2}$x$10\frac{1}{2}$x21.
"	Penobscot Bay, Maine	12x12x28.
"	Luzerne, Saratoga county, N. Y	12x12x24.
"	Barre, Vt	12x12x12.
"	Saratoga, N. Y	12x12x12.
"	Rockport, Mass	7x9x7.
"	Factory Point, Vt., from Fullerton's Marble & Granite Works	12x12x12.
"	Garrisons, N. Y., from G. Howard Ellers	6x6x6.
Syenite	Greenfield, Saratoga county, N. Y	12x12x12.
"	Greenfield, N. Y., from J. H. White & R. L. Allen	6x6x6.
"	Greenfield, N. Y., from J. H. White & R. L. Allen	$5\frac{1}{2}$x$6\frac{1}{2}$x$4\frac{1}{2}$.
Granite	Greenfield, N. Y., from R. L. Allen & J. H. White	$5\frac{1}{2}$x$5\frac{1}{2}$x$5\frac{1}{2}$.
"	Greenfield, N. Y., from R L. Allen & J. H. White	6x6x2.
"	Vista, Saratoga county, New York State Capitol	6x6x3.
"	Milford, Mass., from Norcross Bros., Worchester, Mass	12x12x12.
"	Brandford, Ct., from Norcross Bros., Worchester, Mass	12x12x12.
"	Fall River, Mass., from George Wrightson, N. Y	12x5x$5\frac{1}{2}$.
"	Adirondack, N. Y., New York State Capitol	12x7,x$8\frac{1}{2}$.
"	Saratoga, N. Y., from R. L. Allen & J. H. White	$8\frac{1}{2}$x$7\frac{1}{2}$x$7\frac{1}{2}$.
"	Quincy, Mass., from Rogers & Co	10x10x9.
"	Stony Creek, Ct., piece of column of Assembly Chamber, New York State Capitol	$6\frac{1}{2}$x$6\frac{1}{2}$x$6\frac{1}{2}$.
"	Fitzwilliam, N. H., Collection of Museum	10x$5\frac{1}{2}$x2.
"	Concord. N. H., New York State Library	$5\frac{1}{2}$x$5\frac{1}{2}$x$5\frac{1}{2}$.
"	Concord, N. H., from Granite Railway Co	6x6x6.
"	Mt. Waldo, Maine, New York State Capitol	6x6x6.

CATALOGUE OF BUILDING STONE IN THE STATE MUSEUM — (*Concluded*).

GRANITE.

NAME.	Source.	Dimensions.
Granite (no. 69)		$5\frac{1}{2}$x7x6.
" (no. 6)		$6\frac{1}{2}$x$5\frac{1}{2}$x6.
"	Dix Island, Maine, from Learned & Dickson	12x12x12.
"	Concord, N H., from Granite Railway Co	12x12x12.
"	Fitzwilliam, N. H., Runels, Clough & Co	12x12x12.
"	Barre, Vt, M. E. Howard	10x10x10.
"	Barre, Vt, J. P. Harrington	12x12x12.
"	Quincy, Mass., Granite Railroad Co	12x12x12.
"	Quincy, Mass., New York State Capitol	6x6x12.
"	Garrisons, N Y., from A. Gracie King	10x10x10.
"	Sing Sing, N. Y	12x14x$8\frac{1}{2}$.
"	Jefferson county, N. Y., New York State Capitol	5x5x5.
"	Ramapo, Rockland county, from H L. Pierson	5x6x6.
" (norite)	Keeseville, N. Y., Ausable Granite Co.	$7\frac{1}{2}$x15x$4\frac{1}{2}$.
" (norite)	Keeseville, N. Y., A. G. Co	8x5x4.
"	Fox Island, Me., No. 11, New York State Capitol	6x6x6.
"	Racklief Island, Me., New York State Capitol	6x6x4.
"	Saratoga county, N. Y	5x5x6.
"	Breakneck mountain, Putnam county, from Lewis J. Bailey	12x$8\frac{1}{2}$x4.
Quincy granite (no. 3)	Rogers & Co	$7\frac{1}{2}$x12x6.
Granite	Concord, N. H., Granite Railway Co	8x10x$5\frac{1}{2}$.
"	Hallowell, Me., New York State Capitol	6x6x6.
Red slate	East Whitehall, N. Y., from R. A. Hall	72x18x$1\frac{1}{2}$.

Catalogue of Building Stone in the State Museum.

Limestones and Marbles.

NAME.	Source.	Dimensions.
Marble, Knoxville, Tenn	Hon. D. J. Johnston	$4x3\frac{1}{2}x3\frac{1}{2}$.
Lepanto marble	Burlington Manufacturing Co., near Plattsburg, N. Y.	$7x3\frac{1}{2}x5\frac{1}{2}$.
Shell marble, Hudson, N. Y	Hon. D. J. Johnston	$5x2x4\frac{1}{2}$.
Marble, Wakefield, Vt		$10x2\frac{1}{2}x5\frac{1}{2}$.
Marble, South Dover, Dutchess Co. N.Y.		9x6x9.
Verd Antique marble, Bolton, N. Y	Hon. D. J. Johnston	$11\frac{1}{2}x2x9$.
Verd Antique marble, Bolton, N. Y	Hon. D. J. Johnston	$4\frac{1}{2}x4\frac{1}{2}x13\frac{1}{2}$.
Serpentine, near Port Douglass, Essex Co., N.Y.		$9x1\frac{1}{2}x5$.
Baluster	Northern New York Marble Co	20 in. high.
Black marble, Glens Falls, N. Y	Hon. D. J. Johnston	$5\frac{3}{4}x2\frac{1}{2}x7$.
Serpentine, near Whitehall, N. Y	E. W. Hall	$4\frac{1}{2}x6x6$.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	$5\frac{3}{4}x5\frac{1}{2}x5\frac{3}{4}$.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	$6x5\frac{1}{2}x5\frac{3}{4}$.
Marble (clouded), Alford, Mass	Berkshire Marble Co	6x6x6.
Marble (clouded), South Dover, Dutchess Co., N. Y		$7x5x10\frac{1}{4}$.
Marble, Tuckahoe, N. Y	Masterton & Hall	8x8x8.
Marble (Georgia)	Norcross Bros., Worcester, Mass.	10x10x10.
Serpentine marble, Gouverneur, N. Y	Daniel Church	$8\frac{3}{4}x6\frac{1}{4}x11$.
Precious serpentine, Hartford Co, Md	R. McMichael	6x4x12.
Limestone (black marble), Cobleskill, N. Y	Howe's Cave Lime and Cement Co	$6\frac{3}{4}x6\frac{3}{4}x11\frac{1}{2}$.
Marble, Sheffield, Mass	Chester Goodale	$11x11x11\frac{1}{4}$.
Marble, Tuckahoe, N. Y		$7\frac{3}{4}x5\frac{1}{2}x11\frac{1}{2}$.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co., fluted	$14\frac{1}{4}x8x14$.
Marble (clouded), Rutland, Vt	North Rutland Marble Co., fluted	$17\frac{1}{4}x8\frac{3}{4}x14$.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	12x6x12.

LIMESTONES AND MARBLES — (*Concluded*).

NAME.	Source.	Dimensions.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	12x6x12$\frac{1}{4}$.
Serpentine marble, Port Henry, Essex Co., N.Y.	M. Sherman	About 3$\frac{1}{2}$ ft.
Steatite, Francestown, N. H	Francestown Soap-stone Co	10x10x10.
Whitney Marble Co., Gouverneur, St. Lawrence county, N. Y		10$\frac{1}{2}$x10x10$\frac{1}{2}$.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	15$\frac{3}{4}$x5$\frac{1}{2}$x15.
Marble, West Rutland, Vt	Sheldon & Slawson	12x12x12.
Marble, Sheffield, Mass	Museum collection	12x12x12.
Marble, West Rutland, Vt	Sheldon & Slawson	12x12x12.
(Brocatelle) marble, West Rutland, Vt	Sheldon & Slawson	12x12x12.
Marble (muddy layer), West Rutland, Vt	Sheldon & Slawson	12x12x12.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	12x12x12.
(Statuary) marble, West Rutland, Vt.		12x12x12.
Marble (Vermont Italian), E Dorset, Vt	Field Marble Co	12x12x13.
Berkshire Marble Co , Alford, Mass		12x12x12.
Marble, Lakeville, Conn	H. Tudor Brownell	12x12x12.
Marble, Hastings, N. Y	Museum collection	10x10x10.
Marble, Lakeville, Conn	H. Tudor Brownell	11$\frac{1}{2}$x12x12.
Marble, Sheffield, Mass	Quarry of Chester Goodale (same as used in Girard Col.)	12x12x12.
Limestone, Charles G. Slade's quarry, near Saratoga Springs, N. Y		6x6x6.
Limestone, D. R. & H. Fogelsonger, Williamsville, N. Y		7$\frac{1}{4}$x4$\frac{3}{4}$x4$\frac{3}{4}$.
Limestone, Tribes Hill, Montgomery Co., N. Y.	Hon. D. J. Johnson	7$\frac{1}{2}$x5x5.
Limestone, B. & J. Carpenter, Lockport, N. Y.		10x10x10.
Marble, Stockbridge, Mass	William J. McAlpine.	12$\frac{1}{2}$x12x16.

Marble (clouded)		6x6½x9½.
Onondaga (limestone)		9½x7½x10½.
Onondaga (limestone), Split Rock, near Syracuse		18x3¼x12.
Marble Scutella limestone (Lower Helderberg)	John Higgins	10x5¾x11½.
Onondaga limestone, Syracuse, N. Y	J. Hughes	9x9x9.
Onondaga limestone, Split Rock quarries, near Syracuse, N. Y	Museum collection	18x2½x12.
Limestone (Encrinal), Lockport, N. Y	Geological Survey	15¾x5½x12½
Onondaga limestone		10¾x8x8.
Marble, Sutherland Falls, Vt	Otter Creek Marble Co	11½x9½x11½.
Limestone		10½x9x11.
Limestone (Trenton), Willsborough, Essex Co., N. Y	J. W. Clark	9x9x13.
Limestone (Trenton), Jacksonburg, N. Y	J. Critzer	10½x6½x14.
Limestone (Onondaga), Perryville, Madison Co., N. Y	E. A. Ransom	12¾x5½x7½.
Limestone, Trenton Grove, Tribes Hill, N. Y	James Shanahan	12x12¼x12.
Limestone (Chazy), Isle La Motte, Lake Champlain	Geological Survey	18x2x2½.
Syenite, Warren county, N. Y	John Higgins, Troy	15x2x11½.
Serpentine marble, Minerva, Essex county, N.Y.	O. Richards & D. Lynch	2 ft. high.
Serpentine marble, Minerva, Essex county, N.Y.	O. Richards & D. Lynch	18½ in. high.

Ten-inch Cubes of Building Stone Exhibited at the World's Columbian Exposition.

Now in Geological Hall.

Marks on specimens	NAME.	Formation.	Locality. Town or village.	Locality. County.	Source.
X 26	Granite		Breakneck	Putnam	James E. Bailey.
X 29	"		Cold Spring	"	"
X 24	"		Garrison	"	A. Gracie King.
XVIII	"		"	"	"
	"		Greenfield Cen.	Saratoga	
	"		Grindstone Id.	Jefferson	R. Forsyth.
	"		"	"	"
	"		Luzerne	Warren	
	"		Mt. Eve	Orange	Mt. Eve Granite Co.
	"		Sing Sing	Westchester	Francis Larkins.
XXII.	Gneissoid granite			Saratoga	J. H. White & R. L. Allen.
X 21	Norite		Keeseville	Essex	B. B. Mason.
X 14	Trap	Triassic	Staten Island	Richmond	Frank Bennet.
	Sandstone	Catskill	Roxbury	Delaware	A. F. Bouton
X 13	"	Chemung	Belvidere	Alleghany	Alfred Dibble.
X 32	"	"	Elmira	Chemung	A. D. Symonds.
	"	"	Ithaca	Tompkins	G. C. McClune.
	"	"	"	"	
X 15	"	Hamilton		Sullivan	S. F. Kilgour.
	"	"	Malden	Ulster	
	"	"	"	"	Ulster Bluestone Co.
X 31	"	"	Saugerties	"	Burhans & Brainard.
X 17	"	"	Walton	Delaware	James Nevins & Sons.

	Sandstone	2 Ham unidentified			
	"	Ham. Portage	Rondout	Ulster	H. Boice.
	"	"	"	"	H. Boice.
X 18	"	"	Walton?	Delaware	
	"	"			
X 6	"	Hudson river	Schenectady	Schenectady	A. Shear & Co.
X 19	"	Medina	Lewiston	Niagara	L. W. Hotchkiss.
X 12	"	"	Medina	Orleans	Mrs. John Holloway.
X 2	"	"	"	"	Horan Bros.
	"				
	"	Portage ?	Oxford	Chenango	F.G.Clarke B'stone Co.
	"	1 Med, unidentified	Portageville	Wyoming	Peter Pitkins.
	"	"	Rock Glen	"	Warsaw Bluestone Co.
X 22	"	Potsdam	Keeseville	Essex	B. B. Mason.
X 22	"	"	Port Henry	"	
XVII	"	"	Potsdam	St. Lawrence	D. Parmeter.
	"	"	"	"	Mr. Clarkson.
XIX	"	"	"	"	D. Parmeter.
X 28	Limestone	Calciferous	Amsterdam	Montgomery	D. C. Hewitt.
X 16	"	"	Canajoharie	"	A. E. Shaper.
XII	"	"	Tribes Hill	"	James Shanahan.
X 7	"	Chazy	Willsboro Point	Essex	S. W. Clark.
X 10	"	Corniferous	Buffalo	Erie	D. R. & H Fogelsonger.
X 27	"	"	Cobleskill	Schoharie	Wm. Reilly.
XII	"	"	Le Roy	Genesee	Morris & Stroebel.
VIII	"	"	Onondaga	Onondaga	
X 34	"	"	Union Springs	Cayuga	B. P. Smith.
X 30	"	"	Waterloo	Seneca	Loren Thomas.
X 25	"	Lower Helderberg	So. Bethlehem	Albany	Callanan Bros.
VII	"	Niagara	Lockport	Niagara	B. & J. Carpenter.
XVI	"	"	"	"	"
VI	"	"	"	"	J. & C. Carpenter.

Ten-inch Cubes of Building Stone Exhibited at the World's Columbian Exposition — (*Concluded*).

Marks on specimens.	NAME.	Formation.	Locality. Town or village.	Locality. County.	Source.
X 5	Limestone	Niagara	Rochester	Monroe	Foery & Kastner.
X 8	"	Trenton	Chaumont	Jefferson	Duford & Sons.
	"	"	"	"	"
X 33	"	"	"	"	
X 9	"	"	Glens Falls	Warren	Glens Falls Co.
X 3	"	"	Prospect	Oneida	Evan T. Thomas.
XV	"	"	"	"	R. Jones.
X 35	"	"	3 Mile Bay	Jefferson	J. J. Barron.
XIV	"	"	Tribes Hill	Montgomery	Jas. Shanahan.
V	Marble		Gouverneur	St. Lawrence	St. L. Marble Co.
	"		"	"	Whitney Marble Co.
I	"	Trenton-Calciferous	Hastings	Westchester	(Museum Collection.)
	"	"	Pleasantville	"	A. L. Pritchard.
X	"	"	Sing Sing	"	N. Y. State Quarries.
II	"	"	Tuckahoe	"	Masterton & Hall.
IV	Marble, coral shell	Lower Helderberg	Hudson	Columbia	J. B. Berridge.
XI	Marble, serpentine		Port Henry	Essex	Walton?
III	"	Pre Cambrian	Thurman	Warren	Verd Antique Marble Co

*Four-inch Cubes.**

In Geological Hall.

NO.

50 Bluestone, Kingston, N. Y.

51 Bluestone, Hewitt Boice, Rondout, N. Y.

52 Sandstone, B. B. Mason, Keeseville, N. Y.

53 Medina sandstone, L. W. Hotchkiss, Lewiston, N. Y.

61 Chemung sandstone, A. D. Symonds, Elmira, N. Y.

63 Hudson river bluestone, Burhans & Brainard, Saugerties, N. Y.

69 Sandstone, Baldwin & Hinds, Hindsburgh, N. Y.

70 Clinton sandstone, Clinton, N. Y.

41 Bluestone, Jas. Nevins & Sons, Walton, N. Y.

56 Bluestone, Olean Bluestone Co., Olean, N. Y.

67 Bluestone, D. S. Biggs & Son, Taughannock, N. Y.

72 Bluestone.

45 Granite,(norite), Ausable Granite Co., Keeseville, N. Y.

48 Granite, James E. Bailey, Breakneck.

54 Granite, King Granite Co., Garrison, N. Y.

60 Granite, Cold Spring, N. Y.

73 Granite, R. Forsyth, Grindstone I. Jefferson county, N. Y.

74 Granite, R. Forsyth, Grindstone I. Jefferson county, N. Y.

47 Onondaga limestone, Onondaga, N. Y.

49 Niagara limestone, B. & J. Carpenter, Lockport, N. Y.

55 Lower Helderberg limestone, P. Callahan, Bethlehem, N. Y.

57 Limestone, Z. W. Vanderveer, Mapes Corners, Orange Co.

58 Corniferous limestone, Wm. Reilly, Cobleskill, N. Y.

59 Trenton limestone, D. C. Hewitt, Amsterdam, N. Y.

62 Corniferous limestone, Thomas & Babcock, Waterloo, N. Y.

65 Onondaga limestone, B. P. Smith, Union Springs, N. Y.

66 Blue Trenton limestone, John J. Barron, Three Mile Bay, N. Y.

68 Trenton limestone, J. M. Faulkner, Oneida, N. Y.

71 Limestone, Howe's Cave, N. Y.

64 St. Lawrence marble, St. Lawrence Marble Co., Gouverneur, N. Y.

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* This is only a part of the set of four-inch cubes exhibited at Chicago.

Catalogue of Specimens Collected by J. F. Kemp, for Report on Moriah and Westport Townships.

Number.	NAME.	Square of map.	Thin section.	Remarks.
1	Potsdam quartzite	O, 9		
2	Calciferous limestone	"		
3	Calciferous chert	"		
4, 4*a*	Foliated gabbro	N, 9		
5	Massive gabbro	"		
6	Gneiss	"		In the crystalline limestone series.
7	Crystalline limestone	"		
8	Silicate inclusion	"		From included mass in limestone.
9	"	"		
10	Limestone with coccolite	"		
11	See No. 8	"		
12	Brecciated gneiss	M, 9		Outcrop too small to show on map.
12*a*	Ophicalcite	O, 9		
13	Contact silicates	O, 8		
14	White limestone	O, 9		
15	Hornblende schist	"		
16	Trap dyke	"		One inch wide.
17	Garnetiferous gneiss	O, 8		
18	" "	"		
19	Mica schist	"		
20	White limestone	N, 8		
21	Included silicates	"		
22	Garnetiferous gneiss	"		
23	Lean ore	"		Pilfershire mine.

24	Pyroxenic gneiss	"	......	......	Wall-rock, Pilfershire mine.
25	Massive hornblende	"	......	......	Pilfershire mine.
26	Lean ore	M, 8	......	......	Pease pit.
27	Gneiss	"	......	......	
28	Gray gneiss	"	......	......	
29	Gneiss	M, 9	......	......	
30	"	"	......	......	
31	"	L, 9	......	......	
32	Crystalline limestone	"	......	......	
33	Gneiss	"	......	......	
34	Potsdam quartzite	"	......	......	
35	Trenton limestone	K, 9	......	......	
36	Gneiss	M, 9	......	......	
37	Ophicalcite	"	......	......	
38	Hornblende schist	N, 9	......	......	
39	Garnetiferous gneiss	"	......	......	
40	Gabbro	"	......	......	
41	Foliated gabbro	"	......	......	
42	Hornblendic rock	"	......	......	
43	Hornblendic gneiss	N, 8	......	......	
44	Gneiss	"	......	......	
45	Micaceous gneiss	"	......	......	
46	Garnetiferous gneiss	N, 7	......	......	
47	" gabbro	J. 7	......	......	
48	" "	"	......	......	
49	" "	"	......	......	
50	Anorthosite	"	......	......	
51	"	"	......	......	
52	"	"	......	......	
53	Gneiss	P, 5	......	......	
54	"	O, 5	......	......	

CATALOGUE OF SPECIMENS COLLECTED BY J. F. KEMP, ETC.—(*Continued*).

Number.	NAME.	Square of map.	Thin section.	Remarks.
55	Gneiss	O, 5		
56	Diabase dyke	"		
57	Gneiss	P, 5		
58	Pegmatite vein	"		
59	Gneiss	"		
60	Hornblendic gneiss	"		
61	" "	"		
62	Feldspathic gneiss	P, 9		
63	Hornblendic gneiss	O, 8		Foot-wall, Lee mine.
64	" "	"		Hanging-wall, Lee mine.
65	Ophicalcite	N, 9		
66	Crushed Potsdam quartzite	P, 9		Supposed red hematite ore.
67	Gneiss	Q, 9		
68	Metamorphosed dyke	"		
69	Gray gneiss	"		
70	Gneiss	"		
70*a*	Crushed gneiss	R, 8		Hanging-wall, Coot Hill mine.
71	So-called ore	"		Coot Hill mine.
72	Gneiss	"		Foot-wall, Coot Hill mine.
73	"	"		Coot Hill.
74	Pyroxenic gneiss	R, 6		
75	Ore	"		
75*a*	Hornblendic gneiss	O, 5		Near old Colburn furnace.
76	" "	"		With garnet.
77	Gneiss	O, 3		

78	"	"		
79	Gneiss	O, 3		
80	Red gneiss	N, 3		Near Crowfoot pond.
81	Gneiss	N, 2		
82	Garnetiferous gneiss	N, 2		
83	Gneiss	L, 5		Wall-rock Lovers' pit.
84	Feldspar	"		
85	Gneiss	K, 5		Barton hill.
86	"	L, 5		Foot-wall, Orchard slope.
87	Pyroxenic gneiss	"		Summit of Barton hill.
88	Gneiss	L, 6		Wall-rock, Mine No. 21.
89	"	K, 5		Fisher hill.
90	"	"		"
91	Dark gneiss	"		Burt lot.
92	Garnetiferous gneiss	"		
93	Gneiss	K, 4		
94	Hornblendic gneiss	"		
95	Garnetiferous gneiss	J, 4		
96	Gneiss	H, 4		
97	"	"		
98	Anorthosite	E, 6		
99	Garnetiferous anorthosite	E, 7		
100	Gneiss	G, 9		
101	"	"		
102	"	"		
102–108	Gabbro	H, 9		
109	Gneiss	"		
110	"	G, 8		
111	"	"		
112	Gabbro	H, 8		
113	Foliated gabbro	"		

CATALOGUE OF SPECIMENS COLLECTED BY J. F. KEMP, ETC. — (*Continued*).

Number.	NAME.	Square of map.	Thin section.	Remarks.
114	Gneiss	H, 7		Outcrop not shown on map.
115	Foliated anorthosite	"		
116	Hornblendic gneiss	H, 6		Outcrop not mapped.
117	Gabbro	"		
118				
119				
120				
121	Olivine gabbro	H, 6		
122	Gray gneiss	J, 6		
123	Ophicalcite	P, 4		
124	Hornblendic gneiss	"		
125	"	P, 5		
126	Gneiss	"		
127	Hornblendic gneiss	P, 4		
128	Mica gneiss	"		
129	Hornblendic gneiss	"		
130	Gneiss	"		
131	Hornblendic gneiss	P, 3		Decomposed foliated gabbro.
132	Foliated gabbro	P, 2		Contact of gneisses and anorthosites near here.
133	"	"		
134	Anorthosite	"		
135	"	"		
136	"	Q, 6		

137	Gabbro	"		
138	"	R, 7		
139	"	"		
140	"	"		
141	Gray gneiss	Q, 7		
142	Dark gneiss	Q, 5		
143	Gneiss	R, 5		
144	Hornblendic gneiss	Q, 4		
145	Gneiss	R, 5		
146	Gabbro	N, 9		Fine reaction veins; compare 4 and 5.
147	Foliated gabbro	"		
148	Brecciated gneiss	M, 10		
149	Metamorphosed dike	"		Diorite.
150	Gabbro	"		
151	"	"		
152	Foliated gabbro	"		
153	Gabbro	L, 10		
154	Brecciated gneiss	"		
155	"	"		
156–157	Diabase dike	M, 9		Cheever mine.
158	Lean ore	"		"
159	Pyroxene gneiss, hanging wall	"		"
160	Pyroxene gneiss	"		In hanging wall, Cheever mine.
161	Biotite gneiss	"		50 yards from ore; in hanging.
162	Hornblende schist	"		75 yards from ore; in hanging.
163	Foliated gabbro	"		50 feet from ore; in foot wall.
164	Massive gabbro	"		East of ore.
165–172	Various gneissic rocks between Cheever mine and Cheever dock	"		
173	Hornblende gneiss	L, 4		In hills west of Mineville; apparently altered gabbro.

CATALOGUE OF SPECIMENS COLLECTED BY J. F. KEMP, ETC.—(*Concluded*).

Number.	NAME.	Square of map.	Thin section.	Remarks.
174	Hornblende gneiss	L, 4	......	In hills west of Mineville; apparently altered gabbro.
175	" "	"	......	In hills west of Mineville; apparently altered gabbro.
176	Pyroxene gneiss	L, 5	......	Belfry Hill; related to the Norian series.
177	Garnetiferous gneiss	P, 2	......	Related to Norian series.
178	Trap dike	"	......	
179	Gray gneiss	"	......	
180	Anorthosite	"	......	
181	Gabbro	"	......	
182–190	Anorthosites and gabbros	"	......	Specimens in a detailed section west of Ensign Pond.
191–198	" "	"	......	Specimens in a detailed section, base of Mt. Harris.
199	Gneiss	P, 3	......	
200	"	M, 9	......	Hill west of Cheever mine.
201	"	"	......	" " "
202	Trap dike	"	......	Cheever mine.
203	Decomposed anorthosite	I, 10	......	
204–211	Contact gabbros on gneiss of section G. G.	G, 8	......	
212	Gabbro	F, 8	......	
213–229	Varieties of anorthosites and gabbros both gneissoid and massive	E, 9; E, 8; E, 7; E, 6.	......	Central and northwestern Westport.

230–235.	Varieties of anorthosites and gabbros both gneissoid and massive	E, 10; E, 9; B, 6; B, 7; B, 10; B, 11.	......	
236-241.	Gabbro and titaniferous ore	B, 14	......	Split Rock mine.
243–251.	Gabbro ore, etc	A, 14; B, 14; C, 13	......	
252–267.	Gabbro and titaniferous ore, Ledge Hill mines	F, 9; F, 8	......	
268	Calciferous limestone	H, 12	......	
269	" "	I, 11	......	
270	Gabbro	H, 7	......	Tramway to Nichols Pond mines.
273–275.	Gneiss	H, 6	......	Nichols Pond.
276–278.	Gabbro	"	......	"
279–285.	Ore and wall	"	......	"

REPORT

TO THE

Regents of the University of the State of New York.

OFFICE OF THE STATE GEOLOGIST,
ROOM 32, STATE HALL.
ALBANY, N. Y., *Dec.* 3, 1894.

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

GENTLEMEN.— I communicate herewith a report, in continuation of my report of last year, concerning the work in hand relating to the Palæontology of the State, the geologic map, and to the duplicate collections of fossils, their arrangement and distribution.

Owing to the fact that we have been so fully occupied with proof reading, for the report now in press, since early in September, it has left no opportunity of making a formal and complete report of the work which has been done, and it will be necessary to postpone this until the report for 1893 shall be out of press.

The very large amount of material which was accumulated during the period of ten years, while means were furnished for field collections, has never been fully overhauled and arranged up to the present time. During the past few years Mr. Emmons and Mr. Sheehy have been at work upon this very large amount of material, selecting the better specimens for the museum collections and for distribution to schools according to directions coming from the regents' office. Also in assorting and packing the inferior material in boxes which are labeled with the names of the class of fossils which they contain. Of the old material stored in the basement of the building in 1886, there yet remain 84 boxes, which are being opened and distributed as fast as time will allow.* Nearly all the available space in the drawers (3210) is already occupied, and we will need several hundred more drawers before the collection can be completely arranged. Of the material packed in boxes, resulting from the selection and assorting of museum and school collections, and which are arranged in the rotunda, there are the following:

	Boxes.
Corals, including those mentioned in the report of 1892....	47
Bryozoa....	34
Graptolites....	14
Brachiopoda....	41
Crinoids and miscellaneous....	16

Of the later accumulations from the Livonia salt shaft the better material has been selected and arranged in drawers for museum purposes and the remainder packed in boxes. These duplicate fossils from the Livonia salt shaft occupy 16 boxes.

The collection of fossils presented to the museum by the Albany Institute has been arranged and catalogued by Prof. J. M. Clarke, the assistant palæontologist. This collection is of great historical interest, as being the original collection made by the institute in the earlier years of the century, and is well deserving of careful preservation.†

Of the types and illustrated specimens of the general collection the crustacea, the annelida and cephalopoda have been arranged and catalogued by Mr. Clarke. This catalogue has appeared in the successive reports of 1891 and 1892, the entire number of specimens recorded being 937. In order that these catalogues may be accessible without the trouble of turning to these reports, I append copies of each one with this communication. This work of cataloguing will be continued until the entire collection shall be recorded.

Mr. Emmons and Mr. Sheehy have occupied a large portion of their time during the past two years in selecting from the duplicate collections, as already mentioned, and in arranging specimens

* For a description of these boxes and their contents, see Report of the State Museum for 1892, pp. 66–70

† These lists of types and typical specimens were communicated with this report, but were not delivered to the printer with the copy. They were published in the report of the State Geologist for 1891 and 1892.

for school collections. Of these school collections there have been sent out during the past year to the

	Species.	Specimens.
State Normal College, Albany, N. Y.........	436	530
Manlius Union School, Manlius, N. Y	373	442
Forestville Free Academy, Forestville, N. Y..	363	429
Owego Free Academy, Owego, N. Y........	409	450
Port Jervis Union School, Port Jervis, N. Y ..	386	456

We have received acknowledgment of the reception of these collections from the State Normal College at Albany, and from the Forestville Free Academy.

At the present time there is in progress of preparation for cataloguing a collection for the High School at Buffalo, N. Y., and another for the Morris Union School. These will contain about 365 species and 415 specimens each. As soon as the present reports are out of press and we are relieved from proof reading these collections will be catalogued and forwarded.

Geologic Map.

Since there was no appropriation for the geologic map for 1894, very little field work has been done. One small area in Oswego county, which had never been properly mapped, has been explored, and another in the south-eastern part of the State, in Orange county, has been explored and mapped; also, the north-eastern portion of Clinton county, showing the junction of the crystalline rocks with the stratified fossiliferous formations. The results of this work, together with the work of 1893, has already been or will be transferred to the base map immediately; and through the good-will of the director of the United States Geological Survey we will have some colored maps in hand before the end of January. It must be understood, however, that these maps will not be complete, as there are still considerable areas on the east of the Hudson river which have not been sufficiently explored to be mapped geologically. There are also some portions in the central part of the State where the relations of the Oneonta sandstone, Portage and Chemung groups have not been determined. The southern limit of the crystalline formations of the Adirondacks on the south and their junction with the stratified rocks was determined in 1893, and has already been transferred to the geographic base.

Palæontology.

The work of printing the Palæontology of New York, volume 8, part 2, was suspended in December, 1893, owing to the exhaustion of the appropriation for that purpose, and the appropriation proposed at the session of 1894 failed through causes beyond the control of the author.* The manuscript for the completion of the volume has long been in the hands of the printer, except that for the index, which can not be completed until the last form of the text shall have been put into pages, in order to make reference to the page number. It is greatly to be regretted that a volume which was completed, with the exception of a few pages, in December, 1893, should remain unpublished until 1895, and I have endeavored to make such arrangements as will secure the publication of a few copies during the present year.

Work in palæontology generally has progressed very satisfactorily. The plates for the second part of the hand book have been either lithographed or are in the hands of the lithographer, and the text is nearly all in type, so that there will be no delay in this publication.

The work upon the fossil sponges has been carried on so that the drawings are essentially completed, and fourteen plates have already been lithographed but not printed.

There is also in progress a paper upon the fauna of the upper members of the Oriskany sandstone as occurring in the neighborhood of Hudson and along the west side of the Hudson river in the neighborhood of Kingston and Rondout. This paper will form a subject for a future report.

A memoir of the fossil Bryozoa, which has been in preparation for some years, will also be communicated in a future report.

The report upon the Livonia salt shaft, which was communicated in the report of 1892, and withdrawn for revision and completion, was communicated with the report for 1893, and in every aspect forms a very valuable paper concerning the geology and palæontology as well as of the economic products of the formations passed through in the progress of the work.

Very respectfully submitted.

JAMES HALL,

State Geologist.

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* See Documents.

GEOGRAPHICAL DISTRIBUTION OF NEW YORK UNIONIDÆ.

BY

WILLIAM B. MARSHALL, M. S.,

ASSISTANT ZOOLOGIST.

Geographical Distribution of New York Unionidæ.

In Bulletin Number 1 of the New York State Museum, March, 1892, the writer published a preliminary list of species of Unionidæ inhabiting the State of New York. The following extracts from the introduction to the preliminary list will serve to show the objects for which the list was published, and the authority upon which each species was entitled to be considered an inhabitant of the State.

"Unless otherwise stated all the species in the following list are represented in the collection of the New York State Museum by specimens from localities within the limits of the State of New York or from the Allegheny river at Warren, Penn., just south of the New York boundary. A name printed in *italics* indicates that the species has been included without positive evidence that it inhabits New York.

"This list has been prepared for distribution among conchologists with a view to obtaining data bearing upon the geographical distribution of the Unionidæ inhabiting the State of New York."

Recipients were requested to furnish the writer with all information in their possession regarding:

"1. The general distribution of each species.

"2. The distribution of each species in the State of New York.

"3. The causes which tend to restrict or extend the habitat of each species in the State of New York.

"4. The reasons why there are numerous species in the waters of the western part of the State and few species in the waters of the eastern part."

The present paper will consider the first two questions only, leaving the last two for future consideration.

The preliminary list contained forty-eight species on the authority of the New York State Museum collections, two species on the authority of De Kay (Zoology of New York), three species on the authority of Lea, and ten species were hypothetically included in the list, making sixty-three species in all, as follows:

Preliminary List of New York Unionidæ.

1 alatus (Unio), Say.
2 *anodontoides* (*Unio*), *Lea*.
3 Benedictii (Anodonta), Lea.
4 Boydianus (Unio), Lea.
5 cariosus (Unio), Say.
6 clavus (Unio), Lamarck.
7 *coccineus* (*Unio*), *Lea*.
8 *complanata* (*Margaritana*), *Barnes*.
9 complanatus (Unio), Solander.
10 crassidens (Unio), Lamarck.
11 *deltoidea* (*Margaritana*), *Lea*.
12 edentula (Anodonta), Say.
13 *elegans* (*Unio*), *Lea*.
14 *ellipsis* (*Unio*), *Lea*.
15 fabalis (Unio), Lea.
16 Ferussaciana (Anodonta), Lea.(1)
17 fluviatilis (Anodonta), Dillwyn.
18 Footiana (Anodonta), Lea.
19 fragilis (Anodonta), Lamarck.
20 gibbosus (Unio), Barnes.
21 gigantea (Anodonta), Lea.
22 gracilis (Unio), Barnes.
23 heterodon (Unio), Lea.
24 *Hildrethiana* (*Margaritana*), *Lea*.
25 hippopæus (Unio), Lea.(2)
26 imbecillis (Anodonta), Say.
27 implicata (Anodonta), Say.
28 iris (Unio), Lea.
29 lacustris (Anodonta), Lea.
30 lævissimus (Unio), Lea.
31 Lewisii (Anodonta), Lea.
32 ligamentinus (Unio), Lamarck.
33 luteolus (Unio), Lamarck.
34 margaritifera (Margaritana), Linnæus.
35 marginata (Margaritana), Say.
36 multiradiatus (Unio), Lea.
37 nasutus (Unio), Say.
38 Novi-Eboraci (Unio), Lea.
39 occidens (Unio), Lea.
40 ochraceus (Unio), Say.
41 ovatus (Unio), Say.
42 parvus (Unio), Barnes.
43 patulus (Unio), Lea.
44 pavonia (Anodonta), Lea.(3)
45 perplexus (Unio), Lea.
46 phaseolus (Unio), Hildreth.
47 plana (Anodonta), Lea.(3)
48 pressus (Unio), Lea.
49 *pustulatus* (*Unio*), *Lea*.
50 radiatus (Unio), Lamarck.
51 rectus (Unio) Lamarck.
52 rubiginosus (Unio), Lea.
53 rugosa (Margaritana), Barnes.
54 *spatulatus* (*Unio*), *Lea*.
55 subcylindracea (Anodonta), Lea.
56 Tappanianus (Unio), Lea.
57 triangularis (Unio), Barnes.(4)
58 *trigonus* (*Unio*), *Lea*.
59 undulata (Anodonta), Say.
60 undulata (Margaritana), Say.
61 undulatus (Unio), Barnes.
62 ventricosus (Unio), Barnes.
63 verrucosus (Unio), Barnes.

Unio coccineus, Unio ellipsis, Margaritana deltoidea and Margaritana Hildrethiana, which were hypothetically included in the preliminary list, have since been reported from New York localities and are undoubtedly inhabitants of the States. The Museum collection contains specimens of Unio coccineus from the Allegheny river at Warren, Pa., collected by Dr. C. E. Beecher. Mr. S. M. Luther has presented a specimen of Unio

(1) Erie Canal.— De Kay.
(2) Lake Erie.— Lea. Typical locality.
(3) Onondaga Lake.— De Kay.
(4) Niagara River.— Lea.

ellipsis collected in the Niagara river. Specimens of Margaritana deltoidea from New York localities have been received from James Delaney and Rev. John Walton. Messrs. Hinkley, Simpson and Marsh have reported specimens of Margaritana Hildrethiana from the vicinity of Buffalo, N. Y.

Mr. Chas. T. Simpson has given me the following note concerning Unio triangularis, a species included in the preliminary list, on the authority of Isaac Lea, as occurring in the Niagara river: "Unio triangularis is in the Lea collection from Grand Rapids, Mich., and in Lea record book one specimen presented by T. C. Robinson is credited to Buffalo, N. Y. I do not find this shell, though it has been checked off as having been in the collection when it was overhauled here."

Bryant Walker has reported U. triangularis from several localities in the St. Lawrence drainage system in eastern Michigan, and there is good reason to believe that the species inhabits the St. Lawrence system in western New York.

In the Bulletin of the Buffalo Society of Natural Sciences for August, 1874, Dr. James Lewis published a list of the land and fresh water shells of New York. Several species of Unionidæ were included in that list upon the authority of Coleman T. Robinson, as inhabiting western New York. At that time Mr. Robinson was the only one who had reported these species from any locality in New York. Some of these species have since been reported from New York localities by other collectors, and I am disposed to believe that Mr. Robinson's records are trustworthy. Speaking of Mr. Robinson's list Dr. Lewis says: "About thirteen years ago, assisted by Hon. G. W. Clinton, Mr. W. W. Stewart and others, the late Coleman T. Robinson (one of the founders and early patrons of the Buffalo Society of Natural Sciences) compiled a list of species collected in the western part of the State, principally in the immediate vicinity of Buffalo. Mr. Robinson's manuscript appears to be very faithfully compiled and leaves very little to be done to complete the work in the part of the State to which it relates." In view of the fact that Dr. Lewis considered Mr. Robinson's records trustworthy, and as several of those records have been confirmed by other collectors, I have deemed it proper to accept Mr. Robinson's records. Thus, U. anodontoides, U. elegans, Unio spatulatus, U. trigonus, U. postulatus and Margaritana complanata, which were hypothetically included in the preliminary list, are retained in this list, although they have not been reported to me from any locality in New York, and their claim to be considered inhabitants of New York rests upon the lists published by Mr. Robinson. In the case of U. trigonus additional evidence has been supplied by Mr. Charles T. Simpson, who reports the species as occurring fossil in the drift at Toronto, Can. (Proc. U. S. Nat. Mus. p. 593, 1893.)

There is some confusion concerning U. pustulatus and U. pustulosus. Simpson (Loc. cit.) reports U. pustulosus as occurring fossil at Toronto.

Prof. R. Ellsworth Call suggests that Unio hippopæus "is a depauperate Unio undulatus or U. plicatus, Le S." The New York State Museum collection contains a specimen of Unio hippopæus from Buffalo, N. Y, which is certainly referable to U. undulatus. The shell described under the name of hippopæus has not been generally recognized by collectors, and its distribution seems to be limited to the neighborhood of Buffalo, N. Y.

I consider the following names synonymous, and have treated them as such in this paper:

Unio Novi-eboraci, Lea = Unio iris, Lea.
Unio patulus, Lea = Unio clavus, Lamarck.
Anodonta subcylindracea, Lea = Anodonta Ferussaciana, Lea.

Unio lævissimus and Anodonta gigantea are not entitled to be considered inhabitants of New York. The specimens, upon authority of which these two species were included in the preliminary list, were probably incorrectly identified.

No additional evidence in support of De Kay's statement that Anodonta pavonia inhabits New York has been received. The same is true of Anodonta plana, unless it be considered synonymous with Anodonta decora, which Mr. Chas. T. Simpson reports in the Lea collection from Mohawk, N. Y., and from Buffalo, N. Y.

Several species which do not appear in the preliminary list have been reported to me from New York or from near by extra-limital localities. A list of these species is given further on, but they are not discussed in this paper. But little information concerning them has been received, as attention was not called to them in the preliminary list, and some of them, as, for example, Unio Liebii, Anodonta cepiniana, Tryonii, salmonia and decora have not been generally recognized by collectors.

After making the changes proposed above, the list contains 54 species which were contained in the original list, and 10 species which have been reported in addition, as follows:

Unionidæ inhabiting New York.

alatus (Unio) Say.
anodontoides (Unio) Lea.
Benedictii (Anodonta) Lea.
Boydianus (Unio) Lea.
cariosus (Unio) Say.
clavus (Unio) Lamarck.
*U. patulus, Lea.
coccineus (Unio) Lea.
complanata (Margaritana) Barnes.
complanatus (Unio) Solander.
crassidens (Unio) Lamarck.
deltoidea (Margaritana) Lea.
edentula (Anodonta) Say.
elegans (Unio) Lea.
ellipsis (Unio) Lea.
fabalis (Unio) Lea.
Ferussaciana (Anodonta) Lea.
*A. Subcylindracea, Lea.
fluviatilis (Anodonta) Dillwyn.
Footiana (Anodonta) Lea.
fragilis (Anodonta) Lea.
gibbosus (Unio) Barnes.
gracilis (Unio) Barnes.
heterodon (Unio) Lea.
Hildrethiana (Margaritana) Lea.
imbecilis (Anodonta) Say.
implicata (Anodonta) Say.
Iris (Unio) Lea.
*Novi-Eboraci, Lea.
lacustris (Anodonta) Lea.
Lewisii (Anodonta) Lea.
ligamentinus (Unio) Lamarck.
luteolus (Unio) Lamarck.
margaritifera (Margaritana) Linnaeus.
marginata (Margaritana) Say.
multiradiatus (Unio) Lea.
nasutus (Unio) Say.
Occidens (Unio) Lea.
ochraceus (Unio) Say.
ovatus (Unio) Say.
parvus (Unio) Barnes.
perplexus (Unio) Lea.
phaseolus (Unio) Hildreth.
pressus (Unio) Lea.
radiatus (Unio) Lamarck.
rectus (Unio) Lamarck.
rubiginosus (Unio) Lea.
rugosa (Margaritana) Barnes.
spatulatus (Unio) Lea.
Tappanianus (Unio) Lea.
triangularis (Unio) Barnes.
trigonus (Unio) Lea.
undulata (Anodonta) Say.
undulata (Margaritana) Say.
undulatus (Unio) Barnes.
ventricosus (Unio) Barnes.
verrucosus (Unio) Barnes.

* Considered synonymous with the name preceding.

Species not contained in the preliminary list, which have since been reported as occurring in New York.

cornutus (Unio) Barnes.(1)
cylindricus (Unio) Say.(1)
Decora (Anodonta) Lea.(2)
Liebii (Unio) Lea.(3)
ovata (Anodonta) Lea.(4)
Pepiniana (Anodonta) Lea.(5)
Salmonia (Anodonta) Lea.(6)
securis (Unio) Lea.(1)
tenuissimus (Unio) Lea.(7)
Tryonii (Anodonta) Lea.(6)

In the United States there are five drainage systems as follows:

1. *The Eastern drainage system.*— This system includes all streams flowing into the Atlantic Ocean east of the Appalachian Mountains, from Maine to Alabama.

2. *The St. Lawrence or Northeastern drainage system.*— This system extends along the northern boundary of the United States from Minnesota eastward, and includes the Great Lakes and all other lakes and streams which find an outlet through the St. Lawrence river.

3. *The Mississippi or Central drainage system.*— This system includes the region lying between the Appalachian mountains and the Rocky mountains, and is drained by the Mississippi river and its tributaries and other streams which empty into the Gulf of Mexico.

4. *The Northern drainage system.*— This system includes a limited area in northern Minnesota and North Dakota, drained by the Red river of the North.

5. *The Pacific or Western drainage system.*— This system includes all streams emptying into the Pacific ocean, and drains the region lying west of the Rocky mountains.

Three of these drainage systems are represented in New York, viz.: *The Eastern system*, including the Housatonic, Hudson, Delaware and Susquehanna rivers and their tributaries.

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(1) Allegheny river, Warren, Pa. C. E. Beecher.

(2) Lea collection. Mohawk, N. Y., Dr. Lea. Rochester, N. Y., Dr. Dewey Simpson in letter.

(3) "Probably a variety of circulus. All specimens I know of are reported from Lake Erie without locality, with the exception of Lea's type which is from Michigan." Simpson in letter.
"Dr. Newcomb insisted that a curious shell from Onondaga lake, which I gave him was U. Liebii, and so labeled it in the Cornell University cabinet. I thought it erroneous as it doubtless is, but I had not then seen U. Liebii. It seems an abnormal U. radiatus or luteolus." Rev. W. M. Beauchamp

(4) "Lea collection, Buffalo, N. Y., Dr. Robinson, Canal, Rochester, N. Y., Dr. Dewey." Simpson in letter.

(5) "Lea collection. Skaneateles, N. Y., collected by Isaac Lea." Simpson in letter. "Dr. Newcomb called a small and fragile shell from Skaneateles and Cayuga lakes by this name, but I think it more than doubtful." Rev. W. M. Beauchamp

(6) "It is likely that these two species occur in southern New York. I have shells of both species with New York localities given, but can not vouch for their being correct." Wm. A. Marsh. "Raritan river, Somerville, N. J." Thomas Morgan.

(7) "Buffalo, N. Y. Lea collection. Collected by C. F. Robinson." Simpson in letter.

The St. Lawrence system, including the Great Lakes, the lakes of the central part of the State, the St Lawrence river and Lake Champlain.

The Mississippi system in the southwestern corner of the State, including Chautauqua lake, Allegheny river and its tributaries.

Much careful collecting has been done at various points along the boundaries of the three drainage systems represented in New York. Thus Dr. James Lewis and Prof. R. Ellsworth Call have made us thoroughly acquainted with the molluscan fauna of the neighborhood of Mohawk, N. Y., just within the border of the eastern drainage system. A few miles further west, Rev. W. M. Beauchamp has done much collecting in the counties of Onondaga and Oneida, just within the border of the St. Lawrence drainage system. It is worthy of note that some species found to be plentiful in Onondaga and Oneida are reported as very rare at Mohawk and are not found at all as far east as the Hudson river, for example, U. luteolus, U. rubiginosus. Dr. S. Hart Wright has collected in Yates county in the St. Lawrence system, nearly on the border, between this system and the Mississippi system. Shelley Crump and Rev. John Walton have collected in Monroe county, N. Y. For several years Dr. Charles E. Beecher collected from the Allegheny river and other streams at Warren, Warren county, Pennsylvania, almost the northeastern limit of the Mississippi drainage system. His collection was presented to the New York State Museum in 1886 and 1887, and has been largely used in the preparation of this paper. J. Allen collected in Chautauqua county, N. Y., and its neighborhood, on the dividing line between the Mississippi and St. Lawrence drainage systems. Dr. V. Sterki has done good work in Ohio, particularly in the Ohio river system. Bryant Walker has made a special study of the Unionidæ of Michigan, an area lying almost entirely in the St. Lawrence drainage system, but overlapping the Mississippi system. A. A. Hinkley has collected in Illinois, a region lying partly in the St. Lawrence and partly in the Mississippi drainage systems.

F. R. Latchford and Geo. M. Leslie have worked in Ontario, wholly within the St. Lawrence system.

Carpenter in Rhode Island, Gould in Massachusetts, Winkley and Morse in Maine, and others have made us acquainted with the mollusca of New England.

The New York State Museum has what may be considered an exhaustive collection of the mollusca of the Hudson river and Champlain and Erie canals in the vicinity of Albany and Troy.

J. B. Quintard has collected in Kansas and Indian Territory. The general localities supplied by William A. Marsh have enabled me to give an idea of the general distribution of the species.

In almost all cases the localities supplied by one correspondent have been verified and made trustworthy by being reported by one or more other correspondents. In many cases several have reported a species from the same locality, and in other cases the species while not reported by several from exactly the same locality have been reported from different points in the same river system. There are only a few instances in which the occurrence of a species in one of the drainage systems rests upon the authority of one person. The extensive series of exchanges made by most of the gentlemen who have been named, one with another, and with others not mentioned, has had the effect of defining most of the species. It has been a council in which collectors with limited opportunities have had the advice and criticism of those having greater facilities, such as access to literature and large collections, etc., and in which those already well equipped have been still more abundantly supplied with data from which to draw conclusions.

Several gentlemen to whom copies of the preliminary list were sent have given me much information bearing upon the questions asked. Rev. W. M. Beauchamp, of Baldwinsville, N. Y.; Shelley G. Crump, of Pittsford, N. Y., and James Delancy and Rev. John Walton, of Rochester, N. Y., have sent me large series of the shells of their respective localities.

Prof. R. Ellsworth Call, Mr. Bryant Walker, Dr. V. Sterki, Mr. A. A. Hinkley, Mr. S. M. Luther, Dr. W. D. Hartman, Mr. J. B. Quintard, Mr. William A. Marsh, Mr. Charles T. Simpson, Mr. Horace F. Carpenter, Mr. George M. Leslie, Dr. S. Hart Wright, Rev. Henry Winkley, Mr. Thomas Morgan and Mr. F. R. Latchford have sent me extensive lists of localities in which New York Unionidæ occur, and several of them have contributed specimens. To all these gentlemen I wish to express sincere thanks for the kind assistance they have afforded me.

The following lists of selected localities will serve to show the general distribution of each species and to show in what drainage systems each species occurs:

Unio alatus, Say.

New York.

Lake Champlain	
Erie canal, Troy. (Dead valve)	Call.
Champlain canal, Waterford.................	De Kay.
Champlain canal, Waterford. (Dead valve)...	Aldrich.
Oneida river	Beauchamp.
Seneca river	Beauchamp.
Erie canal, Cayuga county	Wright.
Genesee river...............................	Pickett coll.
Pittsford, Monroe county	Crump.
Tonawanda creek, Niagara county............	S. H. Wright.

Pennsylvania.

Allegheny river, Warren county	Beecher.

Ontario

Ottawa	Latchford.
Hamilton bay...............................	Leslie.
Lake Erie, Port Dover........................	Leslie.

Ohio.

Whetstone river	Beecher.
Ohio river, Cincinnati.........................	Beecher.

Michigan.

Detroit river	Walker.
Grand river, Kent county	Walker.

Illinois.

Several localities	Hinkley.

Indiana.

....	Marsh.

Wisconsin.

....	Marsh.

Iowa.

Muscatine	Walker.

Kansas.

Kansas river................................	Beecher.
Eastern portion..............................	Quintard.

Nebraska.

.... Marsh.

Missouri.

Missouri river, Kansas City.................. Beecher.

Tennessee.

Cumberland river, Nashville .... Hinkley.

Georgia.

Murray county.................... .... Coll. Phila. Acad.

Alabama.

.... Marsh.

Mississippi.

.... Marsh.

Indian Territory.

North Fork, Canadian river .... Quintard.

There seems to be no trustworthy record of the occurrence of living Unio alatus in the Champlain canal near Troy and Waterford, and, so far as known, there is no trustworthy record of its occurrence in any portion of the Hudson area. De Kay (Zoology of New York, Mollusca, page 195) says "Dr. Newcomb has obtained very fine specimens from the Northern canal, near Waterford." Truman H. Aldrich (Twenty-second Report New York State Cabinet, page 17), commenting upon De Kay's statement, says, "in the spring of 1867, the canal was searched for it, both above and below Waterford, for several miles, without success. Mr. H. Rousseau found a single valve in the canal at the weigh lock (West Troy)."

The Philadelphia Academy of Natural Sciences has specimens of this species presented by Dr. James Lewis and labeled "Mohawk, N. Y." The locality is almost certainly a mistake, as Dr. Lewis does not report the species from Mohawk in any of his publications.

Disregarding the dead valves reported from the Erie and Champlain canals, and De Kay's statement that fine specimens were obtained at Waterford, and the Academy specimens credited to Mohawk, N. Y., the above list of localities shows that the species is confined to the St. Lawrence and Mississippi drainage systems. The species occurs in both these systems in New York.

Unio anodontoides, Lea.

New York.
Near Buffalo .... Coleman T. Robinson.

Ohio.
Ohio river, Cincinnati .... Beecher.

Indiana.
.... Marsh.

Illinois.
Kaskaskia R. Pecatonica R.................. Hinkley.

Iowa.
Muscatine.................................. Walker.

Kansas.
Eastern part................................ Quintard.

Missouri.
.... Marsh.

Kentucky.
.... Marsh.

Tennessee.
Cumberland river .... Hinkley.

Indian Territory.
North Fork, Canadian river.... .... Quintard.

Arkansas.
.... Marsh.

Louisiana.
Bienville parish .... Vaughan.

Georgia.
.... Marsh.

Alabama.
... . Marsh.

Texas.
Houston ... . Leslie.

Occurs in the St. Lawrence and Mississippi drainage area

Anodonta Benedictii, Lea.

New York.
Lake Champlain.............................. Hudson.
Oneida lake .... Call.
Onondaga lake.............................. Beauchamp.
Seneca river .... Beauchamp,

Yates county .... Hinkley.
Canandaigua lake .... Morgan.
Erie canal, Rochester .... Walton.
Lake Ontario . ... Walker.

Ontario.
Ottawa................................. Latchford.
Lake Erie, Port Dover .... Leslie.
Hamilton bay .... Leslie.

Michigan.
Detroit river .... Hinkley.
Various localities; all in Great Lake basin..... Walker.

According to the localities reported above, the species is confined to the St. Lawrence drainage system.

Unio Boydianus, Lea.

New York.
Oak Orchard Creek, Orleans county .... Lea.
Lake Ontario .... Marsh.

This species has not been generally recognized by collectors. Wm. A. Marsh and Chas. T. Simpson suggest that it is a small variety of Unio radiatus. So far as reported it is confined to a very limited area in the St. Lawrence drainage system.

Unio cariosus, Say.

Maine.
.... Winkley.

New England.
.... Gould.

Connecticut.
Connecticut river .... State Coll.

New York.
Hudson river system....... ....
Delaware river system ....
Schoharie Creek.................. ......Gebhard.
Erie canal, Mohawk .... Call.
Onondaga county .... Beauchamp.
Honeoye Lake, Ontario county............... S. H. Wright.

Ontario.
Ottawa .... Latchford.

New Jersey.
Raritan river, Somerville .... Walker.

Pennsylvania.
Philadelphia .... Coll. Phila. Acad.

Delaware.
.... Marsh.

District of Columbia.
Potomac river .... Sterki, Hinkley.

Virginia.
Canal at Alexandria .... Sterki.

Occurs in the eastern and St. Lawrence drainage systems. One of the most characteristic of our eastern species.

Unio clavus, Lam.

Ontario.
Toronto — occurs fossil .... Simpson.

Pennsylvania.
Allegheny river, Warren county .... Beecher.

Ohio.
Scioto river .... Walker.
Mahoning river .... Walker.
Ohio river system .... Sterki.

Indiana.
Wabash river .... Hinkley.
Shelby county .... Hinkley.
White river .... Walker.

Illinois.
.. .. Marsh.

Tennessee.
.... Marsh.

Alabama.
.... Marsh.

In all probability U. patulus is a synonym of this species. In the living state U. clavus is found only in the Mississippi drainage system. Mr. Chas. T. Simpson has recorded it as occurring fossil at Toronto, Ontario—in the St. Lawrence drainage system.

Unio coccineus, Lea

New York.

Lake Erie, Erie county .... Marsh.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Scioto river .... Beecher.

Ohio river system .... Sterki.

Michigan.

Grand river, Grand Rapids .... State coll.

Various localities, all in great lake basin .... Walker.

Indiana.

.... Marsh.

Illinois.

Mercer and Winnebago counties. .... Hinkley.

Spoon river .... Strode.

Wisconsin.

.... Marsh.

Iowa.

Coon river, Dallas county .... Walker.

Missouri.

.... Marsh.

Kansas.

Cottonwood river, Emporia .... Quintard.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems Found in both systems in New York.

Margaritana complanata, Barnes.

New York.

Near Buffalo .... Coleman T. Robinson.

Ohio.

Ohio river system .... Sterki.

Indiana.

.... Marsh.

Michigan.

Rouge river, Wayne county .... Walker.

Illinois.
Winnebago county .... Hinkley.

Iowa.
Muscatine .... Walker.

Missouri.
.... Marsh.

Kansas.
Eastern Part.............................. Quintard.

Indian Territory.
North Fork, Canadian river.................. Quintard.

Arkansas.
.... Marsh.

Louisiana.
Mt. Lebanon.............................. Hinkley.

Occurs in the St. Lawrence and Mississippi drainage areas.

Unio complanatus, Solander.

New England.
Generally distributed ....

New York.
Hudson river system...
Mohawk river .... Beecher.
Delaware river system ....
Long lake, Herkimer county................. Beecher.
Susquehanna river system ....
Oswego river .... Beecher.
Cortland .... Beecher.
Chenango river .... Beecher.
Cayuga lake.............................. Wright.
Keuka lake............................... Wright.
Conhocton river, Steuben county............ Beecher.
Honeoye lake............................. Wright.
Genesee river .... Dewey.
Pittsford, Monroe county .... Crump.
Lake Ontario .... Hinkley.

Ontario.
Ottawa .... Latchford.

Pennsylvania.
Philadelphia .... Coll. Phila. Acad.

Maryland.
.... Anthony.

Virginia.

.... Marsh.

Ohio.

Ohio river system. (May be a mistake). ...... Sterki.

Michigan.

St. Mary's river, Lime Island .... Walker.

Presque Isle county........................ Walker.

Ocqueoc lake .... Walker.

Wisconsin ?

Lake Superior............................ Gould.

North Carolina.

.... Marsh.

Reported from many localities in the Eastern and St. Lawrence drainage systems. Dr. Sterki reports it from the Ohio river system in Ohio, the only report of the occurrence of the species in any part of the Mississippi drainage system.

Unio crassidens, Lam.

Pennsylvania.

Allegheny river, Warren county............ . Beecher.

Ohio.

Scioto river................................ Hinckley.

Ohio river, Cincinnati...................... Beecher.

Indiana.

Ohio river.................................. Hinkley.

Illinois.

.... Marsh.

Iowa.

.... Marsh.

Missouri.

.... Marsh.

Kentucky.

.... Marsh.

Tennessee.

Duck and Cumberland rivers .... Hinkley.

Tennessee river............................ State coll.

Alabama.

Selma...................................... Aldrich.

Coosa river................................ Hinkley.

Black Warrior river .... Walker.

Louisiana.

.... Marsh.

Texas.

.... Marsh.

Confined to the Mississippi drainage system.

Margaritana deltoidea, Lea.

New York.

Mud creek .... Delaney.
Erie canal, Monroe county .... Walton.

Ohio.

Miami river .... Beecher.
Lake Erie, Put-in-Bay .... Walker.
Ohio river system .... Sterki.

Michigan.

Generally distributed .... Walker.

Indiana.

St. Joseph river .... Walker.

Illinois.

Mercer county .... Hinkley.
Kent's creek, Winnebago county .... Hinkley.

Iowa.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. In New York the species is apparently confined to the St. Lawrence system.

Anodonta edentula, Say.

New York.

Mohawk river, Mohawk .... Call.
Unadilla river, Otsego county .... Call.
Little lakes, Otsego county .... Call.
Onondaga county .... Beauchamp.
Seneca river .... Beecher.
Honeoye creek, Monroe county .... Delaney.
Pittsford, Monroe county .... Crump.
Genesee river .... Walton.
Cuba, Allegany county .... Beecher.
Ischua creek, Cattaraugus county .... Beecher.
Chautauqua lake .... Beecher.

Pennsylvania.

Allegany river, Warren county .... Beecher.

Ohio.

Ohio river, Cinn. . . . . Beecher.

Michigan.

Grand Rapids . . . . State coll.

Generally distributed . . . . Walker.

Indiana.

. . . . Marsh.

Illinois.

Several localities . . . . Hinkley.

Wisconsin.

. . . . Marsh.

Iowa.

Boone . . . . Beecher.

Muscatine . . . . Walker.

Kansas.

Eastern portion . . . . Quintard.

Missouri.

. . . . Marsh.

Kentucky.

. . . . Marsh.

Anodonta edentula and Anodonta undulata will, I think, eventually be united as one species. The usual custom has been to call specimens from eastern localities An. undulata, and to call western specimens An. edentula. But several correspondents have given eastern localities for the western species, and western localities for the eastern species, showing that opinions vary as to the validity of the geographical distinction. In making up the lists of localities for these two species I have rejected several localities reported to me outside of the generally accepted limits for the two species respectively. An exception has been made for edentula in the case of the localities reported by Prof. R. Ellsworth Call, who has reported An. edentula as occurring in Otsego county and Mohawk river, just within the boundary between the St. Lawrence and Eastern drainage systems, and for An. undulata in the case of Onondaga lake, reported by Rev. W. M. Beauchamp, a locality just within the boundary of the St. Lawrence drainage system. If the two species are to be considered as the same, the two lists of localities will show the distribution of the united species.

Unio elegans, Lea.

New York.
Near Buffalo .... Coleman T. Robinson.

Ohio.
Ohio river, Cincinnati .... Beecher.
Ohio river system .... Sterki.

Indiana.
.... Marsh.

Michigan.
Otter creek, Monroe county .... Walker.

Illinois.
Kaskaskia river .... Hinkley.

Wisconsin.
.... Marsh.

Iowa.
Muscatine .... Walker.

Kansas.
Eastern part .... Quintard.

Missouri.
.... Marsh.

Tennessee.
Duck river .... Hinkley.

Indian Territory.
.... Marsh.

Arkansas.
.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage areas.

Unio ellipsis, Lea.

Quebec.
St. Lawrence river cap range .... Walker.

New York.
Cayuga lake .... Morgan.
Niagara river, Grand .... Hinkley.

Ontario.
Ottawa .... Latchford.

Ohio.
Ohio river, Cincinnati .... Beecher.
Ohio river system .... Sterki.

Michigan.

Detroit river .... Walker.

Illinois.

Wabash river .... Hinkley.

Mercer county .... Hinkley.

Wisconsin.

.... Marsh.

Iowa.

Mississippi river, Davenport .... Walker.

Muscatine .... Walker.

Kentucky.

.... Marsh.

Tennessee.

Nashville .... Hinkley.

Occurs in the St. Lawrence and Mississippi drainage area. In New York, so far as known, the species is confined to the St. Lawrence system.

Unio fabalis, Lea.

New York.

Chautauqua lake .... Beauchamp.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Sciota river .... Beecher.

Ohio river system .... Sterki.

Michigan.

Rouge river, Wayne county .... Walker.

Indiana.

White river .... Hinkley.

Iowa.

.... Marsh.

Tennessee.

.... Emmons.

Duck river, Columbia .... Hinkley.

Occurs in the St. Lawrence drainage system (in Wayne county, Mich) and in the Mississippi system. In New York the species is apparently confined to the Mississippi system.

Anodonta Ferussaciana, Lea.

New York.

Hudson river system.................... ....

Delaware system ....

Susquehanna system ....

Little lakes, Otsego county .... Call.

Chemung river, Chemung county............ Walker.

Erie canal, Onondaga county................. Beauchamp.

Seneca lake .... S. H. Wright.

Cayuga lake.............................. Morgan.

Keuka lake............................... Wright.

Penn Yan................................ Wright.

Oak Orchard creek .... Newcomb.

Pittsford, Monroe county .... Crump.

Nine Mile creek, Camillus-Marcellus .... Beecher.

New Jersey.

.... Sterki.

Ontario.

Ottawa .... Latchford.

Ohio.

Ohio river, Cinn.......................... Leslie.

Ohio river system.......................... Sterki.

Michigan.

Detroit river .... Beecher.

Grand Rapids............................. State Coll.

Indiana.

Connorsville.............................. Walker.

Illinois.

Kishwaukee river.......................... Hinkley.

Winnebago county......................... Hinkley.

Wisconsin.

Twin lakes............................... Walker.

Iowa.

.... Marsh.

An. subcylindracea is a synonym of the species. The above list includes localities reported for Ferussaciana and subcylindracea.

The combined species occur in the eastern St. Lawrence and Mississippi drainage systems.

Anodonta fluviatilis, Dillwyn.

Maine.	
....	Winkley.
Rhode Island.	
....	Carpenter.
Connecticut.	
Cheshire	Beecher.
Vermont.	
Benson	Walker.
New York.	
Hudson system	....
Susquehanna system	....
Richfield, Otsego county	Beecher.
West Mission, Steuben county	Beecher.
Onondaga county	Beauchamp.
Yates county	Wright.
Andover, Allegany county	Beecher.
Buffalo creek, Erie county	Beecher.
Pennsylvania.	
Tributary of Genesee river	Walker.
New York.	
Ischua creek, Cattaraugus county	Beecher.
Ontario.	
Ottawa	Latchford.
Hamilton bay...	Leslie.
Pennsylvania.	
Juniata river	Walker.
Virginia.	
Canal, Alexandria	Sterki.

Occurs in the Eastern and St. Lawrence drainage systems.

Anodonta footiana, Lea.

New York.	
Oneida lake	Call.
Seneca river	Beauchamp.
Canandaigua lake	Pickett.
Erie canal, Rochester	Walker.
Ontario.	
Ottawa	Latchford.

Michigan.

Lenawee county.............................. Beecher.
Saginaw river.............................. Walker.
Houghton lake.............................. Hinkley.
Lake Michigan.............................. Marsh.

Wisconsin.

Lake Michigan.............................. Marsh.

Apparently confined to the St. Lawrence drainage system.

Anodonta fragilis, Lamarck.

New York.

Plattsburg, Clinton county.................. Walker.
Loon lake, Franklin county.................. Walker.
Wilmont, Herkimer county.................. Call.
Richfield Springs, Otsego county............. Call.
Little lakes, Otsego county.................. Call.
Beaver lake, Onondaga county............... Beauchamp.
Seneca lake.............................. Wright.
Cayuga lake.............................. State Col.
Keuka lake.............................. Wright.

Ontario.

Ottawa.............................. Latchford.

Ohio.

Hudson.............................. Walker.

Michigan.

Otsego lake, Otsego county.................. Beecher.
Lenawee county.............................. Beecher.
Generally distributed...................... Walker.

Occurs in the Eastern and St. Lawrence drainage systems. It is widely distributed in the St. Lawrence system, but in the Eastern system it has been reported only from the immediate neighborhood of the boundary between the Eastern and St. Lawrence systems in Central New York, i. e. Wilmont, Richfield Springs, Little lakes and Otsego lakes.

Unio gibbosus, Barnes.

New York.

Lake Keuka.............................. Marsh.
Pittsford, Monroe county.................. Crump.
Tonawanda creek, Niagara county............ Wright.
Niagara river.............................. Beauchamp.
Chautauqua lake.............................. Beecher.

Pennsylvania.

Allegheny river, Warren county.............. Beecher.

Ontario.

Ottawa .... Latchford.

Grand river, Brant county.................. Leslie.

Ohio.

Ohio river, Cincinnati. .... Beecher.

Michigan.

Ann Arbor........................... ..... Beecher.

Generally distributed .... Walker.

Grand Rapids .... Beecher.

Indiana.

St. Joseph river.......................... Walker.

Illinois.

Several localities .... Hinkley.

Wisconsin.

.... Marsh.

Iowa.

Boone .... Beecher.

Dallas county............................ Walker.

Kansas.

Osage county............................ Quintard.

Nebraska.

.... Marsh.

Missouri.

Kansas City............................ Beecher.

Tennessee.

.... State coll.

Georgia.

.... Marsh.

Alabama.

.... Marsh.

Mississippi.

.... Marsh.

Arkansas.

.... Marsh.

Louisiana.

Mt. Lebanon............................. Hinkley.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Unio gracilis, Barnes.

New York.

Onondaga lake .... Beauchamp.
Cross lake, Onondaga county .... Beauchamp.
Pittsford, Monroe county .... Crump.
Erie canal, Rochester .... Delaney.

Ontario.

Ottawa .... Latchford.
Hamilton bay .... Leslie.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river, Cincinnati .... Beecher.
Ohio river system .... Sterki.

Michigan.

Detroit river .... Walker.

Indiana.

.... Marsh.

Illinois.

Spoon river .... Strode.
Several localities .... Hinkley.

Iowa.

Muscatine .... Walker.

Kansas.

Eastern portion .... Quintard.

Missouri.

.... Marsh.

Tennessee.

Cumberland river .... Hinkley.

Alabama.

Coosa river .... Hinkley.

Mississippi.

.... Marsh.

Indian Territory.

North Fork Canadian river .... Quintard.

Louisiana.

Bienville parish .... Vaughan.

Texas.

.... Hinkley.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Unio heterodon, Lea.

Massachusetts.

.... Anthony.

Connecticut.

Mixville .... Beecher.

.... State coll.

Vermont.

Connecticut river, Hartland .... Walker.

New York.

Eastern part.................................. Anthony.

Southeastern portion......................... Beauchamp.

Pennsylvania.

Philadelphia.................................. Coll. Phila. Acad.

Confined to the Eastern drainage system.

Margaritana Hildrethiana, Lea.

New York.

Buffalo creek, Erie county.................... Marsh.

Buffalo .... Hinkley, Simpson.

Ohio.

Ohio river system .... Sterki.

Michigan.

Rouge river, Wayne county.................. Walker.

Indiana.

.... Marsh.

Illinois.

.... Marsh.

Iowa.

Iowa City.................................... Hinkley.

Missouri.

.... Marsh.

Tennessee.

.... Walker.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage system. In New York it has been reported from the St. Lawrence system only.

Anodonta imbecillis, Say.

New York.

Oswego canal	Beauchamp.
Beaver lake	Beauchamp.
Irondequoit creek, Monroe county	Walton.
Chautauqua lake	Beauchamp.

Ohio.

Ohio river, Cincinnati	Beecher.
Ohio river system	Sterki.

Michigan.

Grand river, Kent county	Walker.

Indiana.

White river	Walker.

Illinois.

Several localities	Hinkley.

Iowa.

Muscatine	Walker.

Kansas.

Little Walnut river, Douglas	Quintard.

Tennessee.

	Marsh.

South Carolina.

	Coll. Phila. Acad.

Georgia.

	Marsh.

Alabama.

	Marsh.

Indian Territory.

Pawnee Reservation	Quintard.

Arkansas.

	Marsh.

Louisiana.

Bienville parish	Vaughan.

Texas.

	Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Anodonta implicata, Say.

Maine.

... . Winkley.

Rhode Island.

Generally distributed.... .... Carpenter.

Connecticut.

Housatonic river.......................... Gould.

Massachusetts.

Lynn .... Walker.

Arlington .... Walker.

New York.

Hudson river system......................

Jordanville, Herkimer county............... Call.

Richfield Springs, Otsego county............ Call.

Erie canal, Yates county .... Wright.

Starkey, Yates county...................... Wright.

Ontario.

Ottawa...................................... Latchford.

Lake Erie, Port Dover...................... Leslie.

Pennsylvania.

Philadelphia................................ Coll. Acad. Nat. Sci.

Occurs in the Eastern and St. Lawrence drainage systems. Found in both systems in New York.

Unio Iris and Novi-Eboraci.

New York.

Schenandoah creek, Oneida Castle............ Beecher.

Schenandoah creek, Oneida Castle............ Call.

Oneida river................................ Beauchamp.

Erie canal, Onondaga county .... Beauchamp.

Seneca river................................ Call.

Cayuga lake................................. Beecher.

Canandaigua lake .... Wright.

Pittsford, Monroe county.................... Crump.

Pennsylvania.

Allegheny river, Warren county.............. Beecher.

Ohio.

Miami river .... Beecher.

Tuscarawas river...................... .... Sterki.

Iris and Novi-Eboraci.

Michigan.

Huron river, Ann Arbor .... Beecher.
Generally distributed........................ Walker.
Grand Rapids .... State Coll.

Indiana.

St. Joseph river............................ Hinkley.

Illinois.

Illinois river.................................. Marsh.
Fox river .... Call.

Unio Novi-Eboraci is a synonym of Unio iris. The above list includes localities reported for iris and Novi-Eboraci.

The species occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Anodonta lacustris, Lea.

New York.

Lake Champlain............................ Morgan.
Cedar lake, Herkimer county .... Beecher.
Beaver creek, Herkimer county .... Lewis.
Little lakes, Otsego county.................. Call.
Canisteo river, Steuben county............... Beecher.
Oswego county .... Hinkley.
Oneida lake .... Beauchamp.
Seneca lake .... Wright.
Cayuga lake............................... Wright.
Keuka lake................................ Morgan.

Ontario.

Ottawa .... Latchford.

Occurs in the Eastern and St. Lawrence drainage systems. Found in both systems in New York. Confined to a limited area in the Eastern system. Generally distributed in the St. Lawrence system.

Anodonta Lewisii, Lea.

New York.

Hudson river system.......................................
Schoharie .... Simms' coll.
Mohawk .... Beecher.
Erie canal, Onondaga county .... Beauchamp.
Seneca lake................................ Wright.
Pittsford, Monroe county .... Crump.
Lake Ontario, Port bay...................... State coll.

Ontario.

Ottawa .... Latchford.

Occurs in the Eastern and St. Lawrence drainage systems.

Unio ligamentinus, Lamarck.

New York.

Cross lake, Canandaigua county .... Beauchamp.

Olean .... Pickett coll.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river, Cincinnati .... Beecher.

Ohio river system .... Sterki.

Michigan.

Grand river, Kent county .... Walker.

Raisin river, Monroe county .... Walker.

Indiana.

White river .... Walker.

Illinois.

Rock river, Rockford .... Beecher.

Several localities .... Hinkley.

Wisconsin.

.... Marsh.

Minnesota.

.... Marsh.

Iowa.

Des Moines river, Boone .... Beecher.

Kansas.

Cottonwood river, Emporia .... Quintard.

Nebraska.

.... Marsh.

Missouri.

.... Marsh.

Tennessee.

.... Marsh.

Alabama.

.... Marsh.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. Reported from both systems in New York.

Unio luteolus, Lamarck.

New York.

Lake Champlain	Gebhard.
Cohoes Falls, Mohawk river	Simpson.

Erie Canal.

Ilion to Utica	Bailey.

New York.

Mohawk river, Mohawk	Beecher.
Onondaga lake	Beecher.
Cross lake, Onondaga county	Beauchamp.
Seneca river	Pickett.
Yates county	Wright.
Genesee river	Walton.
In moist clay in bottom of abandoned Genesee canal	Wright.
Niagara Falls	Simpson.
Chautauqua lake	Beecher.
Ischua creek, Cattaraugus county	Beecher.

Ontario.

Ottawa	Latchford.
Hamilton bay	Leslie.

West Virginia.

New Salem	Walker.

Ohio.

Ohio river, Cincinnati	Beecher.

Michigan.

Generally distributed	Walker.

Indiana.

White river	Beecher.

Illinois.

Several localities	Hinkley.

Wisconsin.

Twin lakes	Beecher.
Lake Superior	Gould.

Iowa.

Boone	Beecher.
Red River of the North	Simpson.

Kansas.

Eastern part .... Quintard.
Lake Winnipeg .... Simpson.
Small Lakes, Mackenzie river .... Simpson.
Athabaska Lake............................. Simpson.

Kentucky.

.... Marsh.

Colorado.

Eastern part .... Simpson.

New Mexico.

.... Simpson.

Texas.

.... Simpson.

Occurs in the Eastern, St. Lawrence and Mississippi drainage systems. In the St. Lawrence and Mississippi systems the species is generally distributed, but in the Eastern system it is confined to the neighborhood of the boundary between the Eastern and St. Lawrence systems, in Central New York. The species seems to have come into the Eastern system quite recently, and has been, and perhaps is yet, of rare occurrence. Our collection contains one specimen from Mohawk, Herkimer county; Prof. R. E. Call reports two specimens from the same place, and Mr. Charles T. Simpson reports one specimen in the National collection from the same place and sends me the following note: "No. 85435 is a shell sent by Dr. James Lewis from Mohawk, N. Y., and in a note Dr. Lewis says 'The only living specimen I ever found here,' and he has labeled it U. luteolus, Lam. Lea has done the same thing, and yet I should pronounce it rather an inflated female U. radiatus. It is luteolus in everything but the epidermis, which has that peculiar greenish tint and is roughened after the manner of radiatus."

Mr. Simpson has also given me the following note concerning a specimen from Cohoes Falls: "Specimen No. 85437 in the Isaac Lea collection is labeled 'Unio luteolus, Lam., Cohoes Falls, Hudson River.' The name is in Dr. Lea's writing, but I think the locality is marked by some one else. In the record no statement is made as to who collected it or of whom he received it, but Dr. Lea evidently believed it to be from that locality."

Mr. Albert Bailey (Nautilus V, 23) reports that he found the species between Ilion and Utica, and collected 27 specimens in one day. If he has not made a mistake in identifying the specimens, it would seem that the species is becoming more abundant in the Eastern drainage system than it formerly was.

Margaritana margaritifera, Linn.

Newfoundland.
.... State coll.

Maine.
.... Emmons coll.

Massachusetts.
Haydenville.................................... Hinkley.

Rhode Island.
.... Carpenter.

Vermont.
Connecticut river, Hartland.................. Beecher.
Winooski river .... Walker.

New York.
Lake Champlain.............................. State coll.
Tributaries of Mohawk, Oneida county........ Beauchamp.

Pennsylvania.
Chester county.............................. Hartman.

Illinois.
Joliet .... Hinkley.
Upper Missouri river........................ Simpson.

Oregon.
Columbia river .... Smithsonian coll.

California
.... Walker.

France.
.... State coll.

Germany.
.... State coll.

Occurs in the Eastern, St. Lawrence and Mississippi drainage systems. In New York it has been reported only from the Eastern and St. Lawrence systems. This species has a wide distribution, being found in the northern portions of Europe, Asia and North America.

The following interesting note concerning this species is taken from a paper by Charles T. Simpson, published in the proceedings of the U. S. National Museum, p. 593, 1893 :

" It is an oriental species, having its metropolis in northern Europe and Asia, which has crossed over into North America in all probability by a now submerged landway, and to-day is found in British Columbia, Washington, Oregon, Northern California, and in the upper waters of the Missouri. It is again met with in Eastern Canada, New England, Pennsylvania and New York, but has not been reported from any of the intervening territory. The suggestion made several years ago by Prof. A. G. Witherby, that it had been destroyed in this region by glacial action, seems the most reasonable, and it is possible that at the eastern side of the continent it might have survived in the area not covered by the ice cap or that it may have been driven to the south ward before it.

"This is the only naiad now found living within the Mississippi drainage area that may be said to belong to the Atlantic system, and it is undoubtedly an immigrant. It probably entered the Missouri through streams which connected that river with the northwestern lake system "

Margaritana Marginata, Say.

Maine.

.... Morse.

Rhode Island.

.... Carpenter.

New York.

Hudson river system ....

Oak Creek, Otsego county.................... Morgan.

Seneca river .... Beecher.

Chemung river .... Walker.

Tioga river................................ Wright.

Canandaigua lake .... Wright.

Allegheny river, Olean...................... Pickett coll.

Ontario.

Ottawa .... Latchford.

Pennsylvania.

Philadelphia .... Coll. Phila. Acad.

Allegheny river, Warren county.............. Beecher.

Ohio.

Ohio river system .... Sterki.

Michigan.

Huron river .... Beecher.
Several localities .... Walker.

Wisconsin.

Geneva lake .... Pickett coll.

Illinois.

Rock river, Rockford .... Beecher.

Iowa.

Iowa City .... Hinkley.

Kansas.

.... Marsh.

North Carolina.

.... Anthony.

South Carolina.

Abbeville .... Coll. Phila. Acad.

Tennessee.

Duck river .... Hinkley.

Arkansas.

.... Marsh.

Occurs in the eastern, St. Lawrence and Mississippi drainage systems. Found in all three systems in New York.

Unio multiradiatus, Lea.

New York.

Butternut creek, Otsego county .... State coll.
Medina, Orleans county .... Pickett coll.
Genesee river, Monroe county .... Walton.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river, Cincinnati .... Beecher.
Ohio river system .... Sterki.

Michigan.

Huron river .... Beecher.
Clinton river, Macomb county .... Walker.

Indiana.

Blue river .... Walker.

Illinois.

Rock river, Rockford........................ Beecher.

Tennessee.

Columbia.................................. Hinkley.

Occurs abundantly in various parts of the St. Lawrence and Mississippi drainage systems, and the Museum collection contains one specimen from Butternut creek, Otsego county, N. Y.— a locality in the Eastern system just within the boundary between the Eastern and St. Lawrence systems.

Unio nasutus, Say.

Massachusetts.

Lynn .... Walker.

Rhode Island.

.... Carpenter.

New York.

Hudson river system........................ ....

Delaware river............................. Beauchamp.

Niagara river.............................. Hinkley.

Erie canal, Rochester...................... Delaney.

Pittsford, Monroe county .... Crump.

Ontario.

Hamilton bay............................... Leslie.

Pennsylvania.

Philadelphia .... Coll. Phila. Acad.

Ohio.

Northern part.............................. Sterki.

Michigan.

Detroit river .... Walker.

Presque Isle county .... Walker.

Virginia.

Canal at Alexander......................... Sterki.

Occurs in the Eastern and St. Lawrence drainage systems. Found in both systems in New York.

Unio occidens, Lea.

New York.

Oswego river .... Beauchamp.
Seneca river, Onondaga county. .... Beauchamp.
Pittsford, Monroe county .... Crump.
Tonawanda creek, Niagara county............. Wright.

Ontario.

Ottawa .... Latchford.
Hamilton bay................................ Leslie.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river, Cinn .... Beecher.
Ohio river system .... Sterki.

Michigan.

Detroit river................................ Beecher.
Several localities .... Walker.

Indiana.

White river .... Walker.

Illinois.

Kaskaskia river .... Hinkley.

Iowa.

Muscatine .... Walker.

Kansas.

Eastern portion .... Quintard.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Unio ochraceus, Say.

Maine.

.... Morse.

New England.

.... Gould.

Massachusetts.

Plymouth .... Walker.

New York.

Hudson river system....................... ....
Mohawk, Herkimer county.................. Lewis.

Pennsylvania.

Philadelphia .... Coll. Phila. Acad.

Delaware.

.... Marsh.

Maryland.

.... Marsh.

District of Columbia.

Potomac river .... Sterki.

Virginia.

Alexandria .... Sterki.

Apparently confined to the eastern drainage system.

Unio ovatus, Say.

Ontario.

Hamilton bay .... Leslie (as subovatus).

Ottawa .... Latchford "

Pennsylvania.

Allegheny river, Warren .... Beecher.

Ohio.

Little Miami river .... Walker.

Ohio river .... Anthony.

Whetstone river, Delaware .... Beecher.

Kentucky.

.... Marsh.

Tennessee.

Cumberland river .... Hinkley.

Alabama.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage system.

Unio parvus, Barnes.

New York.

Erie canal, Onondaga county .... Beauchamp.

Genesee canal .... Wright.

Ohio.

Miami canal .... Beecher.

Ohio river system .... Sterki.

Michigan.

Rouge river, Wayne county .... Walker.

Indiana.
Connorsville .... Walker.

Illinois.
Washington county .... Hinkley.
Winnebago county .... Hinkley.

Iowa.
DesMoines river, Fort Dodge................ Walker.

Kansas.
.... Quintard.

Missouri.
.... Marsh.

Indian Territory.
Northern part .... Quintard.

Arkansas.
.... Marsh.

Louisiana.
.... Marsh.

Texas.
.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems.

Unio perplexus, Lea.

Pennsylvania.
Allegheny river, Warren county .... Beecher.

Ohio.
Sciota river, Columbus..................... Beecher.
Ohio river system .... Sterki.

Indiana.
.... Marsh.

Tennessee.
Clinch river .... Beecher.

Alabama.
.... Marsh.

Reported from the Mississippi drainage system only.

Unio phaseolus, Hildreth.

New York.
Near Buffalo .... C. T. Robinson.
Buffalo .... F. K. Mixer.
Chautauqua lake. .... Beecher.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river, Cincinnati........................ Beecher.

Ohio river system .... Sterki.

Michigan.

Huron river, Ann Arbor .... Beecher.

Clinton river, Macomb county .... Walker.

Black river, Cheboygan county .... Walker.

Illinois.

.... Marsh.

Kansas.

Neosho river, Burlington.................... Quintard.

Tennessee.

.... Marsh.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Unio pressus, Lea.

New York.

Hudson river system........................ ....

Normanskill, Albany......................... Beecher.

Herkimer county............................. Call.

Erie canal, Onondaga county .... Beauchamp.

West river, Yates county.................... Sartwell.

Mannsville, Jefferson county................. Fry.

Genesee river, Allegany county .... Walker.

Wellsville, Allegany county.................. Beecher.

Ontario.

Ottawa...................................... Latchford.

Wentworth county .... Leslie.

Ohio.

Ohio river system .... Sterki.

Michigan.

Huron river .... Beecher.

Detroit river................................. Walker.

Indiana.

White river, Indianapolis .... Walker.

Illinois.

Winnebago county .... Hinkley.

Occurs in the Eastern, St. Lawrence and Mississippi drainage systems. Found in all three systems in New York.

"Two specimens (*of Unio pressus, Lea*) were taken from a small lake near Herkimer, New York. The lake lies between high hills and receives as its water supply an artificial branch of West Canada creek, a mountain stream having no connection with the Erie canal, or any stream that could possibly reach it from the west or south. It empties into the Mohawk, but over a very rocky bed, and after a considerable fall. The species is essentially western, but is recorded at Troy, N. Y. (Vide Lewis in Bulletin Buff. Soc. Nat. Sci., Aug, 1874, p. 127.) Its occurrence in the latter locality may be explained, perhaps, in a manner similar to the preceding (*i. e., that it migrated from the west through the Erie canal*), though at no known intermediate localities has it been found." (R. E. Call, Amer. Nat., p. 473 1878.) Prof. Call is probably mistaken in supposing that this species reached Troy by way of the Erie canal. Some of Dr. Lea's type specimens of *Lymphynota compressa*, the name under which the species was originally described, were obtained from Normanskill, a small stream entering the Hudson just south of Albany. Dr. Lea's description of the species was published in 1829, only four years after the opening of the Erie canal.

Unio radiatus, Lamarck.

Maine.

.... Winkley.

Rhode Island.

.... Carpenter.

Connecticut.

Connecticut river .... Gebhard.

New York.

Lake Champlain .... Walker.

Hudson river system ....

Saratoga lake .... Simpson.

Delaware river system ....

Crooked lake .... Sartwell.
Onondaga county .... Beauchamp.
Keuka lake................................ Wright.
Schuyler's lake, Otsego county............... Beecher.
Cazenovia, Madison county.................. Call.
Chenango river .... Beecher.
Tioga river, Steuben county .... Beecher.

Ontario.

Ottawa.................................. Latchford.

Michigan.

Diamond lake.............................. Hinkley.

Indiana.

Flat Rock creek .... Marsh.

Illinois.

Rock river .... Marsh.

Virginia.

Canal, Alexandria......................... Sterki.
Potomac river .... State coll.

South Carolina.

Camden................................... Simpson.

Georgia.

Ogeechee river .... Simpson.

Widely distributed in the Eastern and St. Lawrence drainage systems, and reported by Wm. A. Marsh from Rock river, Ill., and Flat Rock creek, Ind., localities just within the border of the Mississippi system.

Unio rectus, Lamarck.

New York.

Oneida river.............................. Beauchamp.
Seneca river.............................. Beecher.
Erie canal, Monroe county .... Walton.
Tonawanda creek, Niagara county .... Wright.

Ontario.

Ottawa .... Latchford.
Lake Erie, Port Dover...................... Leslie.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.
Ohio river, Cincinnati .... Beecher.
Ohio river system.......................... Sterki.

Michigan.
Detroit river .... Walker.
Grand river, Kent county.................... Walker.

Indiana.
.... Marsh.

Illinois.
Winnebago county.......................... Hinkley.
Rock river .... Beecher.

Iowa.
Des Moines river, Fort Dodge................ Walker.

Kansas.
Eastern part................................ Quintard.

Missouri.
.... Marsh.

Tennessee.
Cumberland river .... Hinkley.

Alabama.
.... Marsh.

Arkansas.
Clinton .... Hinkley.

Texas.
.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

Unio rubiginosus, Lea.

New York.
Erie canal, Mohawk .... Call.
Erie canal, Utica-Ilion .... Bailey.
Utica .... Hinkley.
Erie canal, Onondaga county .... Beauchamp.
Pittsford, Monroe county..................... Crump.
Genesee river, Monroe county................ Walton.

Ontario.
Lake Erie, Port Dover........................ Leslie.

Pennsylvania.

Allegheny river, Warren county .... Beecher.

Ohio.

Ohio river system .... Sterki.

Michigan.

Rouge river, Wayne county .... Walker.

Grand river, Kent county .... Walker.

Indiana.

St. Joseph river........................... Walker.

White river .... Beecher.

Illinois.

Winnebago county .... Hinkley.

Wisconsin.

.... Marsh.

Minnesota.

.... Marsh.

Iowa.

Des Moines river........................... Walker.

Kansas.

Eastern part..... .... Quintard.

Missouri.

.... Marsh.

Widely distributed in the St. Lawrence and Mississippi drainage systems. In the eastern system it has been reported from Mohawk and Utica, just within the border of the system.

"On April 17, 1877, the writer, while exploring that portion of the Erie canal known as the Wide Water, near Mohawk, N. Y., unexpectedly came across *Unio rubiginosus*, Lea. Five specimens in all were secured during this and two succeeding expeditions. The species has not hitherto been found on the Atlantic slope, but belongs to the Ohio basin, and, hence, to the western fauna. It has been recorded at Buffalo (*teste* Prof. C. Dewey), and at Rochester (*teste* C. T. Robinson), in Western New York, but only in streams flowing into the great lakes. Between Mohawk and the latter localities is a water shed sloping to the west and the east. The Erie canal passes over this ridge, and through it the species has probably been introduced and colonized." (R. Ellsworth Call, Amer. Nat., p. 472, 1878.)

Margaritana rugosa, Barnes.

New York.	
Hudson river system	
Onondaga lake	Beecher.
Onondaga county	Beauchamp.
Canandaigua lake	Wright.
Pittsford, Monroe county	Crump.
Genesee river	Dewey.
Genesee canal, Olean	Beecher.
Pennsylvania.	
Allegheny river, Warren county	Beecher.
Ontario.	
Ottawa	Latchford.
Ohio.	
Ohio river, Cincinnati	Beecher.
Ohio river system	Sterki.
Michigan.	
Detroit river	Walker.
Grand river, Kent county	Walker.
Indiana.	
White river	Walker.
Illinois.	
Rock river, Rockford	Beecher.
Winnebago county, etc	Hinkley.
Iowa.	
Iowa river, Marshalltown	Quintard.
Wisconsin.	
	Marsh.
Kansas.	
Cottonwood river, Emporia	Quintard.
Missouri.	
	Marsh.
Tennessee.	
	Marsh.
Duck river	Hinkley.
Arkansas.	
Clinton	Hinkley.
Louisiana.	
Mt. Lebanon	Hinkley.

Occurs in the Eastern, St. Lawrence and Mississippi drainage systems. Found in all three systems in New York.

Unio spatulatus, Lea.

New York.	
Near Buffalo	Coleman T. Robinson.
Ohio.	
	Marsh.
Indiana.	
	Marsh.
Michigan.	
Sheawassee river, Genesee county	Walker.
Swaitz creek, Gratiot county	Walker.
Grand river, Kent county	Walker.
Illinois.	
Winnebago county	Hinkley.
Wisconsin.	
	Marsh.
Iowa.	
Coon river, Dallas county	Walker.

Occurs in the St. Lawrence and Mississippi drainage systems. In New York it is found in the St. Lawrence system only.

Unio tappanianus, Lea.

New York.	
Hudson river system	
Erie canal, Mohawk	Beecher.
Canisteo river	Walker.
Chemung river	Morgan.
Chemung river	Walker.
Erie canal, Onondaga	Beauchamp.
Canandaigua lake	Wright.
Genesee canal	Walker.
Pennsylvania.	
Philadelphia	Coll. Phila. Acad.
Juniata river	Lea.
	Marsh.
North Carolina?	
	Anthony.

Confined to the Eastern drainage system.

Unio triangularis, Barnes.

New York.	
Niagara river	Lea.
Buffalo (Lea Record Book)	Simpson
Near Buffalo	Coleman T. Robinson.

Ohio.

Sciotc river .... Walker.
Delaware.. Hinkley.

Michigan.

Three Mile lake, Oakland county........... Walker.
Otter creek, Monroe county.................. Walker.

Indiana.

White river .... Hinkley.

Illinois.

.... Marsh.

Iowa.

Muscatine .... Walker.

Missouri.

.... Marsh.

Tennessee.

Duck river .... Hinkley.

Arkansas.

.... Marsh.

Occurs in the St. Lawrence and Mississippi drainage systems. In New York it has been reported from the St. Lawrence system only.

Unio trigonus, Lea.

New York.

Near Buffalo...................................... Coleman T. Robinson.

Ontario.

Toronto, occurs fossil .... Simpson.

Ohio.

Ohio river... Walker.

Indiana.

Wabash river..................................... Walker.

Illinois.

Several localities .... Hinkley.

Iowa.

Muscatine .... Walker.

Kansas.

.... Marsh.

Missouri.
.... Marsh.

Kentucky.
.... Marsh.

Arkansas.
.... Marsh.

Louisiana.
Bienville Parish.............................. Vaughn.

Occurs in the St. Lawrence and Mississippi drainage areas. In New York it has been reported from the St. Lawrence system only.

Anodonta undulata, Say.

Rhode Island.
.... Carpenter.

Connecticut.
Mixville, Cheshire......................... Beecher.

Vermont.
Connecticut River, Hartland................. Walker.

New York.
Hudson River system..
Westchester county .... Wright.
Cedar Lake creek.............. ... . Beecher.
Delaware river................... .... State coll.
Little lakes, Otsego county .... Call.
Canisteo river, Steuben county.............. Walker.
Onondaga county .... Beauchamp.

Ontario.
Ottawa.................................... Latchford.

New Jersey.
Newmarket..... .... Beecher.

Pennsylvania.
Philadelphia .... Coll. Phila. Acad.

Virginia.
.... Marsh.

Occurs in the Eastern and St. Lawrence drainage systems. See remarks under Anodonta edentula.

Margaritana undulata, Say.

Maine.

.... Winkley.

Rhode Island.

.... Carpenter.

Massachusetts.

Leominster .... Walker.

Vermont.

Connecticut river, Hartland.................. Walker.

New York.

Norman's Kill, Albany..................... Beecher.

Hudson River system........................ ....

Herkimer county........................... Beecher.

Chenango river .... Beecher.

Canisteo river, Steuben county............... Beecher.

Conhocton river, Steuben county............. Beecher.

Tioga river, Corning........................ Wright.

Onondaga county — rare .... Beauchamp.

Pennsylvania.

Philadelphia .... Coll. Phila. Acad.

Maryland.

.... Anthony.

Virginia.

.... Marsh.

North Carolina.

Near Raleigh .... Coll. Phila. Acad.

Quebec.

Cape Rouge .... Leslie.

Ontario.

Ottawa.................................... Latchford.

Occurs in the Eastern and St. Lawrence drainage systems. Occurs in both systems in New York.

Unio undulatus, Barnes.

New York.

Erie canal, Onondaga county (one specimen)... Beauchamp.

Pittsford, Monroe county..................... Crump.

Tonawanda creek, Niagara county............ Wright.

Pennsylvania.

Allegheny river, Warren county.............. Beecher.

Ohio.

Ohio river system .... Sterki.

Michigan.

Rouge river, Wayne county .... Walker.

Indiana.

Wabash river .... Beecher.

White Water river, Muncie .... Walker.

Illinois.

Mississippi river, Moline .... Beecher.

Several localities .... Hinkley.

Iowa.

Des Moines river, Boone .... Beecher.

Kansas.

Eastern part .... Quintard.

Tennessee.

Columbia .... Hinkley.

Indian Territory.

Pawnee reservation .... Quintard.

Arkansas.

.... Marsh.

Texas.

.... Singley.

Occurs in the St. Lawrence and Mississippi drainage systems. Found in both systems in New York.

The Philadelphia Academy of Natural Sciences has specimens of this species, presented by Dr. James Lewis. They are labeled "Mohawk, N. Y." The locality is probably a mistake as Dr. Lewis does not record the species from Mohawk in any of his publications.

Unio ventricosus, Barnes

New York.

Oswego river .... Beauchamp.

Onondaga lake .... Beauchamp.

Seneca river, Onondaga county .... Beauchamp.

Tonawanda creek, Niagara county .... Wright.

Quebec.

Cape Rouge .... Walker.

Ohio.

Little Miami river .... Walker.

Michigan.

Detroit river .... Beecher.

Illinois.

Winnebago county .... Hinkley.

Indiana.

St. Joseph river .... Walker.

Iowa.

Des Moines river .... Walker.

Kansas.

Wabaunsee county .... Quintard.

Tennessee.

.... Marsh.

Arkansas.

.... Marsh.

Occurs in St. Lawrence and Mississippi drainage systems. In New York reported from the St. Lawrence system only.

Unio verrucosus, Barnes.

Pennsylvania.

Allegheny River, Warren county .... Beecher.

Ohio.

Ohio River, Cincinnati .... Beecher.

Ohio River system .... Sterki.

Michigan.

Huron River, Ann Arbor .... Beecher.

Grand River, Kent county .... Walker.

Indiana.

Wabash River .... Walker.

Illinois.

Rock River, Rockford .... Beecher.

Wisconsin.

.... Marsh.

Kansas.

.... Marsh.

Missouri.

.... Marsh.

Kentucky.

.... Marsh.

Tennessee.

Holstein river .... Walker.

Arkansas.

.... Marsh.

Occurs in St. Lawrence and Mississippi drainage systems. In New York reported from the Mississippi system only.

Recapitulation.

The following table shows the distribution of the foregoing fifty-four species in the three drainage systems represented in New York. An asterisk opposite the name of a species indicates that the species occurs in the drainage system under which the asterisk is placed:

	Eastern.	St. Lawrence.	Mississippi.	Eastern only.	St. Lawrence only.	Mississippi only.	Eastern and St. Lawrence.	Eastern and Mississippi.	St. Lawrence and Mississippi.	Eastern St. Lawrence and Mississippi.
alatus (Unio), Say		*	*						*	
anodontoides (Unio), Lea		*	*						*	
Benedictii (Anodonta), Lea		*			*					
Boydianus (Unio), Lea		*			*					
cariosus (Unio), Say	*	*					*			
clavus (Unio), Lamarck			*			*				
coccineus (Unio), Lea		*	*						*	
complanata (Margaritana), Barnes		*	*						*	
complanatus (Unio), Solander	*	*	*							*
crassidens (Unio), Lamarck			*			*				
deltoidea (Margaritana), Lea		*	*						*	
edentula (Anodonta), Say	*	*	*							*
elegans (Unio), Lea		*	*						*	
ellipsis (Unio), Lea		*	*						*	
fabalis (Unio), Lea		*	*						*	
Ferussaciana (Anodonta), Lea	*	*	*							*
fluviatilis (Anodonta), Dillwyn	*	*					*			
Footiana (Anodonta), Lea		*			*					
fragilis (Anodonta), Lamarck	*	*					*			
gibbosus (Unio), Barnes		*	*						*	
gracilis (Unio), Barnes		*	*						*	
heterodon (Unio), Lea	*			*						
Hildrethiana (Margaritana)		*	*						*	
imbecillis (Anodonta), Say		*	*						*	
implicata (Anodonta), Say	*	*					*			
iris (Unio), Lea	*	*	*							*
lacustris (Anodonta), Lea	*	*					*			
Lewisii (Anodonta), Lea	*	*					*			
ligamentinus (Unio), Lamarck		*	*						*	
luteolus (Unio), Lamarck	*	*	*							*
margaritifera (Margaritana), L.	*	*	*							*
marginata (Margaritana), Say	*	*	*							*
multiradiatus (Unio), Lea	*	*	*							*
nasutus (Unio), Say	*	*					*			
occidens (Unio), Lea		*	*						*	
ochraceus (Unio), Say	*			*						
ovatus (Unio), Say		*	*						*	
parvus (Unio), Barnes		*	*						*	
perplexus (Unio), Lea			*			*				
phaseolus (Unio), Hildreth		*	*						*	*
pressus (Unio), Lea	*	*	*							*
radiatus (Unio), Lamarck	*	*	*							
rectus (Unio), Lamarck		*	*						*	
rubiginosus (Unio), Lea	*	*	*							*
rugosa (Margaritana), Barnes	*	*	*							*
spatulatus (Unio), Lea		*	*						*	
Tappanianus (Unio), Lea	*	*					*			
triangularis (Unio), Barnes		*	*						*	
trigonus (Unio), Lea		*	*						*	
undulata (Anodonta), Say	*	*					*			
undulata (Margaritana), Say	*	*					*			
undulatus (Unio), Barnes		*	*						*	
ventricosus (Unio), Barnes		*	*						*	
verrucosus (Unio), Barnes		*	*						*	
Totals	24	49	39	2	3	3	10	......	24	12

Anodonta edentula, Unio iris, Unio multiradiatus, and Unio rubiginosus are not to be considered as indigenous inhabitants of the Eastern drainage system, as they occur only near the boundary of the system and probably are immigrants from the St. Lawrence system.

Unio fabalis can not be considered a normal inhabitant of the St. Lawrence system. Unio complanatus is doubtfully included in the Mississippi system.

The most striking feature of the above table is the fact that no species is found in both the Eastern and Mississippi systems unless it is also found in the St. Lawrence system. Of the fifty-four species considered only eight are confined to a single drainage system, and only five are not found in the St. Lawrence system. The presence of forty-nine of the fifty-four species in some part of the St. Lawrence system, together with the fact that forty-six of these forty-nine are found in one or both of the other two systems, may indicate that the St. Lawrence system was probably the place of origin of some of the species, or the route over which they migrated, or the center from which some species developed into eastern forms and others into western forms.

REPORT

OF THE

STATE BOTANIST.

1894.

REPORT.

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

Gentlemen.— I have the honor of communicating to you the following report, covering the time from September, 1893, to July, 1894.

Specimens of plants for the State Herbarium have been collected by the Botanist in the counties of Albany, Clinton, Essex, Oneida, Rensselaer, Suffolk, Ulster and Washington.

The number of species of which specimens have been added to the Herbarium is 115, of which 24 were not previously represented therein. The species described as new are 10. A list of added species is marked A.

Correspondents to the number of 11 have contributed specimens. Most of these specimens represent extra-limital species, but five species new to the State are represented by them and four new to science. A list of the contributors and of their contributions is marked B.

A record of species not previously recognized as belonging to our flora, together with descriptions of new species, is marked C.

Notes and observations on species already recorded will be found under D.

The genus Carex is one of the largest, and at the same time one of the most distinct and most easily recognized, of all our plant genera. In the Flora of the State of New York, Dr. John Torrey records 91 species belonging to this genus. In 1881 the number of New York species had increased to 119. At the present time we have more than 130 species. Only 29 are recorded in the Manual that have not been found in our State, and six of these are introduced species and yet quite limited in their range. The genus is a most interesting one to botanists who have acquired even a limited knowledge of it, but many pass it by as unworthy their attention or too full of difficulties to permit of the easy identification of the species. To many beginners in the study of botany these plants have been a kind of botanical bugbear. The difficulties attending their study seem to have been needlessly increased by defective descriptions, by a failure in some cases to detect the proper limits of species, and by throwing together and describing as one species forms that should be kept separate. In the last edition of the Manual there are many instances of the reduction of forms which in earlier years were considered good species by our most eminent botanists, so that they now stand as mere varieties to other related forms. Such a grouping of distinct forms seems to me to be opposed to that clear and accurate discrimination which the study of natural science ought to cultivate, and its tendency seems to be to encourage habits of careless observation and loose generalization. Some carices, it is true, resemble each other closely, but so long as they have constant characteristic differences, even though these may be slight, it seems to me much better to recognize these differences and give them their just value in classification. And just here appears to be one cause for the absorbing interest with which the study of these plants is invested. The close observation and the nice discrimination requisite in distinguishing closely allied species is most gratifying to an ardent student of nature intent on finding her hidden truths and solving her most intricate problems. And it is no mean accomplishment to be able to recognize accurately the characters that require the separation of closely related species of this genus.

One species not recognized in the Manual has recently been detected by Dr. Howe, others that have hitherto been regarded as mere varieties are, I am confident, worthy of specific value, and still other forms that have not been recorded have occurred. Influenced by these facts, and having in view the large number of species that belong to our flora, it has seemed desirable to me to bring together in one report the revised descriptions of all our New York species and varieties of the genus Carex.

This will facilitate the study of the carices of our State and give to New York botanists an additional incentive to the study of these interesting plants. I deem myself fortunate in having enlisted the interest and the aid of Dr. E. C. Howe in this work. Dr. Howe has long made a special study of the carices and his thorough knowledge of our species eminently qualifies him to speak and write about them with authority. He has prepared the monograph of our species which is here submitted and marked E.

In consequence of unexpected delay and difficulty in issuing the descriptions and illustrations of our edible and poisonous mushrooms in a separate publication, as was at first contemplated, it has been thought best to include them with other matter in the present report. The edition will be somewhat limited and may not be sufficient to supply the demand unless the issue of extra copies shall be authorized, but it will be better than a longer delay, and is apparently the best that can be done at present. This part of the Report is marked F.

The specimens of fungi that were taken from the Herbarium and placed on exhibition at the World's Fair in Chicago last year have been returned. None were lost, but owing to dampness a few were injured by mold. They are yet in the boxes in which they were returned, not having been removed because of the possibility that the New York State exhibits might be required for a permanent exhibit at home.

Respectfully submitted.

CHARLES H. PECK.

ALBANY, *July* 1, 1894.

(A.)

ADDITIONS TO THE HERBARIUM.

New to the Herbarium.

Aster longifolius *Lam.*
Stachys palustris *L.*
Carex littoralis *Schw.*
Inocybe subtomentosa *Pk.*
Cortinarius rimosus *Pk.*
Gomphidius nigricans *Pk.*
Hydnum scabripes *Pk.*
Radulum molare *Fr.*
Pyrenochæta collabens *Pk.*
Vermiculare Hepaticæ *Pk.*
V. Schœnoprasi *Auers.*
Sphæropsis ulmicola *E. & E.*
Diplodia subtectoides *Pk.*
Septoria centaureicola *Brun.*
S. Divaricatæ *E. & E.*
Tolyposporium bullatum *Schrœt.*
Ovularia decipiens *Sacc.*
Cylindrosporium Padi *Karst.*
Cladosporium carpophilum *Thum.*
Dendryphium nodulosum *Sacc.*
Coniothecium Rubi *Pk.*
Sphærella rubina *Pk.*
Diaporthe robusta *Pk.*
Cucurbitaria Comptoniæ *E. & E.*

Not New to the Herbarium.

Nasturtium officinale *R. Br.*
Hypericum perforatum *L.*
Rhus Toxicodendron *L.*
Ailanthus glandulosus *Desf.*
Vitis riparia *Mx.*
Rosa blanda *Ait.*
R. humilis *Marsh.*
Pyrus arbutifolia *L.*
Lonicera hirsuta *Eaton.*
Spiræa salicifolia *L.*
Sium cicutæfolium *Gmel.*
Eupatorium perfoliatum *L.*
Solidago cæsia *L.*
S. Canadensis *L.*
S. nemoralis *Ait.*
Aster linariifolius *L.*
A. lævis *L.*
A. ericoides *L.*
A. multiflorus *Ait.*
A. diffusus *Ait.*
A. Tradescanti *L.*
A. paniculatus *Lam.*
A. prenanthoides *Muhl.*
A. puniceus *L.*
Bidens connata *Muhl.*
B. cernua *L.*
Xanthium Strumarium *L.*
X. Canadense *Mill.*
Hieracium aurantiacum *L.*
Verbascum Blattaria *L.*
Cuscuta Gronovii *Willd.*
Sonchus arvensis *L.*
S. oleraceus *L.*
Ipomæa purpurea *Lam.*
Callitriche verna *L.*
Potamogeton Spirillus *Tuckm.*
P. heterophyllus *Schrad.*
Urtica gracilis *Ait.*
Amaranthus retroflexus *L.*
A. chlorostachys *Willd.*
Polygonella articulata *Meisn.*
Polygonum aviculare *L.*
P. erectum *L.*
P. Douglassii *Greene.*
P. Hydropiper *L.*
P. lapathifolium *L.*
P. Muhlenbergii *Wats.*
P. Virginianum *L.*
P. dumetorum *L.*
Fraxinus Americana *L.*
Hedeoma pulegioides *Pers.*
Thymus Serpyllum *L.*
Smilax herbacea *L.*
Eleocharis acicularis *R. Br.*
Carex varia *Muhl.*
C. prasina *Wahl.*
C. arctata *Boott.*
C. aurea *Nutt.*
Panicum capillare *L.*
Agrostis perennans *Tuckm.*

Zizania aquatica *L.*
Muhlenbergia sobolifera *Trin.*
M. Mexicana *Trin.*
M. sylvatica *T. & G.*
Avena sativa *L.*
Sporobolus vaginæflorus *Vasey.*
Agropyrum caninum *R. & G.*
Glyceria grandis *Wats.*
G. nervata *Trin.*
Hordeum vulgare *L.*
H. distichum *L.*
Lycopodium clavatum *L.*
Tricholoma terreum *Schæff.*
Hebeloma Colvini *Pk.*
Stereum sericeum *Schw.*
Cæoma nitens *Schw.*
Uromyces Desmodii *Cke.*
Puccinia Convolvuli (*Pers*).
P. graminis *Pers.*
Ustilago neglecta *Niessl.*
Urocystis Waldsteiniæ *Pk.*
Septoria Lobeliæ *Pk.*
S. Dentariæ *Pk.*
S. Scrophulariæ *Pk.*
Cercospora clavata (*Ger.*).
Plasmopara viticola (*B. & C.*).
Taphrina rubrobrunnea (*Pk.*).
Helvella crispa *Fr.*
Leotia marcida *Pers.*
L. circinans *Pers.*
Diatrypella prominens (*Howe*).

(B.)

CONTRIBUTORS AND THEIR CONTRIBUTIONS.

E. J. Durand, Ithaca, N. Y.

Blephilia ciliata *Raf.*

Wm. T. Davis, New Brighton, N. Y.

Populus heterophylla *L.*
Quercus Brittoni *Davis.*
Pinus inops *Ait.*

E. W. D. Holway, Decorah, Iowa.

Ravenelia Holwayi *Diet.*
Puccinia Cryptanthes *D. & H.*

J. Dearness, London, Can.

Calamintha acinos *Benth.*
Armillaria mellea *Vahl.*
Phoma paniculata *E. & D.*
Septoria Negundinis *E. & E.*
Rabenhorstia Tiliaceæ *E. & E.*
Hendersonia discosioides *E. & D.*
Strumella stagonosporioides *E. & E.*
Aschersonia carpinicola *E. & D.*
Cylindrosporium Chrysanthemi *E. & D.*
Cercospora Lespedezæ *E. & D.*
C. Symphoricarpi *E. & E.*
C. racemosa *E. & M.*
Botrytis affinis *E. & E.*
Didymosphæria vagans *E. & E.*
Lasiosphæria striata *E. & E.*
Teichosphæria subcalva *E. & E.*
Massariovalsa caudata *E. & E.*

A. P. Morgan, Preston, Ohio.

Cladotrichum polysporum *Cd.*
Sporotrichum mirabile *B. & Br.*
Synthetospora electa *Morg.*
Cylindrocladium scoparium *Morg.*
Ophiocera Ohiense *E. & E.*
Ceratostoma setigerum *E. & E.*
Hypoxylon Morgani *E. & E.*
H. albocinctum *E. & E.*
Hypocrea tremellicola *E. & E.*

Wright Rives, Washington, D. C.

Agaricus subrufescens *Pk.*

C. V. Piper, Pullman, Wash.

Æcidium porosum *Pk.*
Æ. Clematidis *DC.*
Æ. Hydrophylli *Pk.*
Æ. Pentastemonis *Sacc.*
Uromyces Erythronii (DC.).
U. Fabæ (Pers.).
U. Glycyrrhizæ (Rabh.)
Puccinia Caricis (Schum.).
P. suaveolens (Pers.).
P. Symphoricarpi *Hark.*
P. congregata *E. & H.*
P. Galii Pers.
P. Scirpi DC.
P. Balsamorhizæ *Pk.*
P. Circææ *Pers.*
P. Saxifragæ *Schlect.*
P. Troximontis *Pk.*
P. McClatchiana *D. & Hal.*
P. Ziziæ *E. & E.*
P. mirabilissima *Pk.*
Chrysomyxa Ledi *A. & S.*
C. Rhododendri (DC.)
Calyptospora Gœppertiana *Kuhn.*
Coleosporium Solidaginis (Schw.).
Melampsora Tremulæ *Tul.*
Dasyscypha Gaultheriæ *E. & E.*
Rhytisma punctatum *Fr.*
R. Salicis (Pers.).
Coccomyces coronatus Schum.
Phyllactinia suffulta (Reb.)
Uncinula Salicis (DC.).
Ascochyta achlyicola *E. & E.*
Marsonia Veratri *E. & E.*
Phyllosticta rhamnigena *Sacc.*
Septoglæum Nuttallii *Hark.*
Septoria Rubi *West.*
S. Populi *Desm.*
S. saccharina *E. & E.*
S. Œnanthis *E. & E.*
S. alnifolia *E. & E.*
S. Megarrhizæ *E. & E.*
S. cornicola *Desm.*
S. circinata *E. & E.*
S. Symphoricarpi *E. & E.*
S. Brunellæ *E. & H.*
S. Rudbeckiæ *E. & Hal.*
Macrosporium hybridum *E. & E.*
Ramularia Philadelphi *Sacc.*
Cercospora rosicola *Pass.*
C. ribicola *E. & E.*
C. sambucina *E. & K.*
Cylindrosporium Filipendulæ *Thum.*
Peronospora ribicola *Schrœt.*
Physoderma Menyanthis *De By.*
Physarum papaveraceum *McB.*
Linospora Brunellæ *E. & E.*
Sphærella arbuticola *Pk.*
Sphærotheca Humuli *DC.*
Microsphæria Alni (DC.)
M. Symphoricarpi *Howe.*
Erysiphe Cichoreacearum *DC.*

Arthur K. Harrison, Lebanon Springs, N. Y.

Stachys palustris *L.*
Thymus Serpyllum *L.*
Potamogeton Spirillus *Tuckm.*
Lycopodium clavatum *L.*
Geaster limbatus *Fr.*
Hymenochæta rubiginosa *Lev.*

L. M. Underwood, Greencastle, Ind.

Gyromitra brunnea *Undw.*

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

Carex deflexa *Hornem.*
C. Emmonsii *Dew.*
C. Pennsylvanica *Lam.*
Carex sterilis *Willd.*
C. crus-corvi *Shutt.*
C. torta *Boott.*

C. L. Shear, Alcove, N. Y.

Pyrenochæte collabens *Pk.*
Diplodia subtectoides *Pk.*
Ovularia decipiens *Sacc.*
Diaporthe robusta *Pk.*

(C.)

SPECIES NOT BEFORE REPORTED.

Carex littoralis *Schw.*

Wet places near Islip, Long Island. May.

Volvaria Peckii *Atk. n. sp.*

Pileus thin, convex, glabrous, viscid, finely striate on the margin, whitish; lamellæ rather close, thin, pale-flesh color; stem slightly tapering upward, glabrous, solid, whitish, with a loose, well-developed membranous volva at the base; spores even, subelliptical, .0003 to .0004 in. long, .0002 to .00024 broad, usually containing a single large nucleus.

Pileus about 3 in. broad; stem 3 to 3.5 in. long, 3 to 4 lines thick.

Decaying wood. Ithaca. Sept. *G. F. Atkinson.*

This species differs from *V. speciosa* in its striate margin and smaller spores. It is probably very rare and but one specimen is known to be in existence.

Inocybe subtomentosa *n. sp.*

Gregarious or subcæspitose; pileus thin, dry, convex or plane, minutely hairy-tomentose, brownish-tawny; lamellæ thin, close, adnate, slightly emarginate, at first whitish, then tinged with yellowish green, finally brownish-tawny; stem short, solid, slightly silky-fibrillose, colored like or a little paler than the pileus, often with a conspicuous white mycelium at the base; spores subelliptical, .0003 to .0004 in. long, .0002 to .00024 broad.

Pileus 6 to 12 lines broad; stem about 1 in. long, 1 line thick.

Gravelly soil among fallen leaves Rouses Point. Sept.

This species differs from *I. tomentosa* by its darker color, larger spores and the entire absence of an umbo. Its prominent features are its small size, minutely tomentose pileus and nearly uniform brownish-tawny color when mature. The lamellæ are usually whitish and minutely crenulate or beaded on the edge. The species appears to belong to the section *Laceræ,* although the pileus scarcely shows any laceration, and even the tomentose hairiness is hardly noticeable except on close inspection. It is distinguished from *I. fibrillosa* by its solid merely fibrillose stem and by the absence of scales on the disk of the pileus.

Cortinarius rimosus *n. sp.*

Pileus fleshy, firm, convex or plane, glabrous, at first pale grayish violaceous, then tinged with reddish-brown, the surface cracking into appressed scales or becoming variously rimose, flesh whitish; lamellæ rather broad, distant, subventricose, emarginate, violaceous when young, becoming brownish-ochraceous with age; stem equal or slightly thickened at the base, white and silky with the white veil, tinged with violaceous within; spores subelliptical, .0004 to .0005 in. long, .00024 to .00028 broad, usually containing a single large nucleus.

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

Grassy ground in open places in thin woods. Westport. September.

This species belongs to the subgenus Dermocybe. It is a rather large and stout plant and remarkable for the tendency of the epidermis to crack in areas. The thin margin is often split. The species belongs to the same group as *C. caninus* and *C. azureus*, from both of which it differs in its rimose pileus and distant lamellæ. The color of the young pileus is suggestive of that of *Tricholoma personatum*.

Gomphidius nigricans *n. sp.*

Pileus convex or nearly plane, pale brownish-red, covered with a tough gluten which becomes black in drying, flesh firm, whitish; lamellæ distant, decurrent, some of them forked, white becoming smoky-brown, black in the dried plant; stem subequal, longer than the diameter of the pileus, glutinous, solid, at first whitish especially at the top, soon blackish by the drying of the gluten, whitish within, slightly tinged with red toward the base; spores oblong-fusoid, .0006 to .001 in. long, .00024 to .0003 broad.

Pileus 1 to 2 in. broad; stem 1.5 to 2.5 in. long, 2 to 4 lines thick.

Under pine trees. Westport. September.

This species is easily known by the blackening gluten which smears both pileus and stem and even forms a veil by which the lamellæ in the young plant are concealed. In the dried state the whole plant is black.

Hydnum scabripes *n. sp.*

Pileus fleshy, firm, convex, glabrous, pinkish-gray, the decurved margin extending beyond the aculei, flesh white; aculei whitish or subcinereous, becoming ferruginous-brown, decurrent; stem stout, nearly equal, scabrous-dotted; spores subglobose or irregular, somewhat nodulose, colored, .0003 in. broad.

Pileus 4 to 5 in. broad; stem 4 to 5 in. long, about 1 in. thick.

Under hemlock trees, *Tsuga Canadensis*. Elizabethtown. September.

The prominent characters of this species are its peculiar color and its scabrous or rough-dotted stem.

Radulum molare *Fr.*

Dead bark of elm, *Ulmus Americana*. Cooperstown Junction. June.

I have seen no description of this species which gives the spore characters. In our specimens the spores are naviculoid-elliptical, .0003 in. long, .00016 to .0002 broad. Sometimes the plant is effuso-reflexed, in which case the upper surface of the pileus is coarsely strigose or fibrous and somewhat resembles the pileus of *Merulius tremellosus*.

Pyrenochaeta collabens *n. sp.*

Perithecia .014 to .018 in. broad, superficial, crowded or closely gregarious, submembranous, subglobose, often collapsing when old, the upper part sometimes falling away and leaving a cup-shaped base, black, the setæ few, black, mostly near the base of the perithecia; spores narrowly elliptical, nearly colorless, .0003 to .00045 in. long, .00016 to .0002 broad.

Bark and wood of apple tree. Alcove. October to January. *C. L. Shear.*

Vermicularia Hepaticæ *n. sp.*

Perithecia minute, .003 to .004 in. broad, epiphyllous, furnished with black diverging setæ which sometimes have one or two septa near the base; spores narrowly fusiform, slightly curved, acute at each end, .0007 to .0009 in. long, sometimes appearing to be spuriously septate in the middle.

Dead spots on leaves of *Hepatica acutiloba*.

Helderberg mountains. July.

This fungus sometimes occurs in company with *Protomyces fuscus*. It is so small that it is scarcely visible to the naked eye.

Vermicularia Schœnoprasi *Auers.*

Dead leaves of wild leek, *Allium tricoccum.*
Pierrepont Manor. June.

Sphæropsis ulmicola *E. & E.*

Dead branches of elm, *Ulmus Americana.* Cooperstown Junction. June.

In our specimens the perithecia are sometimes collected in clusters of two or three as in the genus Haplosporella, and they are erumpent and exposed, not covered by the epidermis. The spores are very pale, almost hyaline. But in other respects they agree well with the description of the typical form.

Diplodia subtectoides *n. sp.*

Perithecia small, numerous, erumpent, arranged in a somewhat seriate manner or in short interrupted straight or flexuous lines; spores obovate or elliptical, continuous or uniseptate, .0005 to .0006 in. long, .00025 to .0003 broad.

Dead bark of maple, *Acer saccharinum.* Alcove. November. *Shear.*

This species may be separated from its near relative, *D. subtecta,* by its smaller spores, with simple ones often intermingled with those of normal form.

Septoria centaureicola *Brun.*

Living leaves of seedling plants of bluebottle, *Centaurea Cyanus.* Menands. November and December.

In our specimens the spores are a little shorter and broader than the dimensions given in the description of the typical form. The plant is therefore designated Variety *brevispora.* Spores .0012 to .0016 in. long, .00012 broad.

Septoria Divaricatæ *E. & E.*

Living or languishing leaves of divaricate phlox, *Phlox divaricata.* Pierrepont Manor. June.

Tolyposporium bullatum (*Schrœt.*)

In the ovaries of barnyard grass, *Panicum crus-galli* var. *muticum.* Whitehall. September.

In our specimens only a few of the ovaries of a panicle are affected. These swell to an unusual size. They are green or greenish externally, and are filled with a mass of olive-brown spores collected in glomerules varying much in size and shape.

Ovularia decipiens *Sacc.*

Living or languishing leaves of buttercups, *Ranunculus acris.* Alcove. June and October. *Shear.*

Cylindrosporium Padi *Karst.*

Living leaves of cultivated plum, *Prunus domestica.* Helderberg mountains. September.

Some mycologists appear to have confused *Septoria cerasina* Peck, with this species, but the two are clearly distinct and may easily be separated at a glance. In *S. cerasina* the spores ooze out in a gelatinous mass or in tendrils; in this species they form a white flocculent mass on the surface of the matrix as do other species of this genus.

Cladosporium carpophilum *Thum.*

On peaches. Menands. August and September. The fungus forms small olive-green spots on the fruit. Sometimes these spots become confluent and form patches. They are often more numerous on one side of the peach than on the other, and the affected side fails to develop as rapidly as the other, giving the fruit a flattened or deformed appearance, and the flesh beneath the fungus is more tough and less succulent than the unaffected part. The fungus is, therefore, to be classed among the injurious species.

Dendryphium nodulosum *Sacc.*

Dead stems of bleeding heart, *Dicentra spectabilis.* Menands. April.

The fungus bears some resemblance to *Helminthosporium interseminatum,* but is separable even by the naked eye, by reason of its more ferruginous color.

Coniothecium Rubi *n. sp*

Thinly effused, olive-green; spores coalescing in glomerules varying much in size and in the number of component spores or cells, separate spores .0006 to .0007 in. broad, glomerules about .0016 in. broad.

Injured stems and branches of cultivated raspberry. Menands. April.

The fungus is found in places where the epidermis has been broken or removed by the swaying of the plants in the wind and rubbing against each other. Numerous hyaline elliptical spores about .0003 in. long, .0002 broad, are intermingled with the larger spores of the species.

Sphærella rubina *n. sp.*

Perithecia minute, .007 to .009 in. broad, commonly gregarious, sometimes forming extended patches, submembranous, obscurely papillate, pertuse, subglobose or depressed, at first covered by the epidermis, becoming superficial when the epidermis falls away, black; asci cylindrical, subsessile, .003 to .0035 in. long, .00045 to .0005 broad; spores uniseriate or subbiseriate, oblong, obtuse, uniseptate, generally constricted in the middle, hyaline, .0006 in. long, .00024 to .0003 broad, the upper cell often a little larger than the lower.

Stems of cultivated raspberries. Menands. April and May.

This species is injurious to the plants it attacks. The affected plants either die from the disease or are so weakened by it that they are winter-killed wholly or in part. Generally the epidermis is whitened over the patches of the fungus, but sometimes brown spots indicate the presence and location of the fungus. The mycelium consists of brown septate filaments. From *Didymella applanata*, which this fungus resembles in some respects, it is separated by the absence of paraphyses.

Diaporthe robusta *n. sp.*

Pustules numerous, erumpent, surrounded by a black circumscribing line and covered by a black crust; ostiola obscure or prominent and distinct; asci subfusiform, .003 to .0035 in. long, .0006 broad in the widest part; spores crowded or biseriate, oblong-elliptical, obtuse, strongly constricted in the middle, .0005 to .0007 in. long, .00025 to .0003 broad, each cell usually containing a single large nucleus.

Bark of maple, *Acer saccharinum* and *Acer dasycarpum*. Gansevoort. *Peck*. Alcove. *Shear*.

This species is allied to *D. acerina*, but is distinguished from it by the more numerous pustules, larger asci and larger, more obtuse and more strongly constricted spores.

Cucurbitaria Comptoniæ *E. & E.*

Dead stems of sweet fern, *Comptonia asplenifolia.* Cooperstown Junction. June.

(D.)

REMARKS AND OBSERVATIONS.

Hesperis matronalis *L.*

This introduced plant is abundant along the Susquehanna river near Binghamton. *W. N. Clute.*

Rosa blanda *Ait.*

The fruit of this species is described as globose. On the hills near Elizabethtown, specimens were found in which the fruit was pointed at the base and subpyriform. These were sometimes intermingled with fruit of the normal form, even on the same plant. The stems of some of the plants were quite prickly toward the base. The species is manifestly quite variable, and in this case the variation is toward the western *Rosa Sayi.*

Eupatorium perfoliatum.

A form of this plant occurs near Shokan, in which the flower heads are purplish.

Aster cordifolius *L.*

The white-rayed form occurs occasionally about Whitehall, also near Westport.

Aster lævis *L.*

The prevailing form of this beautiful aster, about Whitehall, has all the leaves, except the two or three lower ones, very narrow and tapering from the base to the apex. They are from three to six lines broad and three to six inches long.

Aster paniculatus *Lam.*

A form grows about Whitehall in which the stems and branches are slender and weak or half reclining, and the flower heads are more scattered than usual.

Aster longifolius *Lam.*

The plant reported under this name in the Thirty-fourth Rpeort proves to be another species, but what I now take to be the true species was found along the Oswegatchie river above Cranberry lake and between Sternbergs and "The Plains." It is a northern species, and will probably not be found as far south as the Catskill mountains.

Aster ptarmicoides *T. & G.*

Rocky ledges east of Whitehall. September.

Bidens connata *Muhl.*

In the description of this species in the last edition of the Manual, "rays none" is given as one of the prominent characters of the species, and in the description given in Torrey's Flora of New York, it is said that the rays are always wanting. Nevertheless plants of this species having conspicuous ray flowers were found about Whitehall. Also *Bidens cernua* without rays is common there and in other places farther north.

Senecio Robbinsii *Oakes.*

Rocky cliffs east of Whitehall, in company with *Aster ptarmicoides.*

Thymus Serpyllum *L.*

Stephentown, Rensselaer county. *A. K. Harrison.*

Stachys palustris *L.*

Dry gravelly hillsides. Lebanon Springs. August. *Harrison.*

This species, according to the botany and as indicated by the name, commonly grows in wet grounds. But in the locality mentioned it has been found only in patches on dry ground. The plants are small and starved in appearance, probably the result of uncongenial surroundings. The form previously referred to this species as variety *aspera* is now classed as a distinct species, and until now the typical form, or true *S. palustris*, has not been represented in the State Herbarium.

Polygonum Douglassii *Greene.*

This plant grows in thin soil covering rocks on Cobble hill near Elizabethtown. It was first found near the summit, but it occurs also near the base. Its branches are usually rather long, slender and somewhat straggling, bent or crooked. It blossoms as late as September. The sepals are greenish or red. The fruit is drooping and drops easily.

Polygonum nodosum *Pers.*

Shore of Lake Champlain near Rouses Point. September.

Potamogeton heterophyllus *Schreb.*

Both variety *maximus* and variety *minimus* are found in Warner's lake, near East Berne. The latter was in fruiting condition in September, but the former at the same time bore no fruit, although it had flower spikes.

Panicum capillare *L.* var. **flexile** *Gatt.*

Rocky places near Whitehall. September.

Muhlenbergia sobolifera *Trin.*

This grass is found as far north as Whitehall, where it grows in dry soil about rocky cliffs.

Lycopodium clavatum *L.*

A singular sterile form of this clubmoss was found by Mr. Harrison near Lebanon Springs. The usual peduncles, instead of terminating in fruiting spikes, are excessively prolonged, some of them being 12 or 14 inches long, and they remain wholly sterile, no fruit spike developing.

Tricholoma terreum *Schœff.* var. **fragrans** *Peck.*

Near Ticonderoga, also near Elizabethtown. September.

If this species was not very variable, the variety here noticed might easily be regarded as a distinct species. It has a decided farinaceous odor and flavor, the pileus becomes paler with age and the young moist flesh, which is brownish, fades to white when dry. The lamellæ are rather thin, close and adnate, and the stem, in some forms at least, is solid and white.

Hebeloma Colvini *Pk.* var. **velatum** *n. var.*

Scattered or cæspitose; pileus convex, plane or even slightly depressed, brittle, obtuse or umbonate, adorned with a tomentose veil, which either disappears with age or persists and makes the pileus obscurely floccose-scaly or its margin silky or floccose; lamellæ rather close, subventricose, adnexed; stem equal, brittle, hollow, silky-fibrillose and often somewhat floccose-squamose toward the base, sometimes annulate with a thick, soft, cottony ring; spores subelliptical, even, .0004 to .0005 inch long, .00024 to .0003 broad.

Pileus 1 to 2.5 inches broad; stem 1.5 to 2.5 inches long, 2 to 3 lines thick.

Gravelly ground under cottonwood trees, *Populus monilifera.* Rouses Point. September.

Three forms were found growing together. The first and most abundant has the mature pileus glabrous or slightly silky on the margin only; the second has the grayish or reddish-gray pileus adorned with appressed floccose scales; the third differs from the second only in the dark chestnut color of the pileus. The veil is grayish-white and when well developed it adheres partly in fragments to the margin of the pileus and partly as an annulus to the stem. The cavity of the stem is very small. A slight odor like that of radishes is perceptible. The species belongs to the section Indusiati. The variety differs from the type especially in its strongly developed veil.

Poria attenuata *Pk.* var. subincarnata *n. var.*

This differs from the typical form in the paler color of the pores. It grows on hemlock bark and forms small patches rarely more than one inch in diameter. Alcove. September. *Shear.*

Septoria Cucurbitacearum *Sacc.*

A form of this fungus sometimes develops on the fruit of squashes. It produces small orbicular whitish spots on which the perithecia develop. The epidermis on these spots sometimes ruptures in a stellate manner. Menands. November.

Septoria Dentariæ *Pk.* var. arida *n. var.*

Living leaves of *Dentaria diphylla.* Pierrepont Manor. June. Spots definite, arid, whitish. Otherwise like the type.

(E.)

NEW YORK SPECIES OF CAREX.

By E. C. Howe, M. D.

The object of the following monograph of the species of Carex hitherto found in the State of New York is to aid young botanists in acquiring a knowledge of these interesting but too often much neglected plants. It has been too much the custom to omit the study of them until nearly every other genus has received attention. That beginners in the study of botany should distrust their ability to cope with these plants is not strange, since both teacher and text-book have sometimes warned them to "beware of this extremely difficult genus, as none but the most experienced should approach it." This should not be so. There certainly are difficulties to be encountered, but they are no more formidable than those with which we meet in other genera, such as Aster, Euphorbia and Aspidium. If we except two or three groups containing two or three species each, and certain allied forms which have been considered good species in one generation and mere varieties in another, and which are now considered species by one botanist and varieties by another, if we except these which are less than a dozen in number, there are no serious difficulties in the study of the carices.

Specimens with mature fruit are desirable and even necessary for the satisfactory identification of species of this genus, for the descriptions are based upon such specimens, the fully developed spikes, perigynia and scales furnishing the most distinctive and reliable specific characters. The perigynia, or a few of them, should be removed from the rachis for study, for in this way their characters are more clearly seen. Ordinarily the achenia or seeds are neglected, but in some instances they furnish important distinguishing characters, and will be a valuable aid to a beginner in deciding upon the identity of certain closely related species. C. lupulina and C. lupuliformis are cases of this kind.

In the descriptions that follow, the plan is to define the characters of each species fully, clearly and minutely without reference to its likeness to other species. This has been done even at the risk of being thought unnecessarily repetitious. Measurements of the different parts of the plant have been freely given, and it is believed that in many instances they will be found a most satisfactory aid in the identification of the species.

Varieties are compared with the typical form of the species.

Carex *L.*

Flowers of two kinds, one staminate, consisting of three stamens in the axil of a scale-like bract (scale), the other pistillate, consisting of a pistil terminating in two or three stigmas and forming in maturity a dry hard lenticular or triangular seed (achenium) enclosed in a thin or membranous seed vessel (perigynium), which is also in the axil of a scale-like bract; both kinds of flowers arranged in spikes which are staminate (sterile) when composed of staminate flowers, pistillate (fertile) when composed of pistillate flowers, and androgynous when composed of both kinds. The spikes may be either sessile or borne on a peduncle, and they are usually subtended by scale-like or foliaceous bracts. When both kinds occur on the same plant the inflorescence is monœcious, on different plants, diœcious. The stems or culms are triangular and solid; leaves three-ranked, narrow, linear or setaceous, often rough on the margins, clasping the stem at the base and forming a closed sheath around it.

Perennial herbs growing chiefly in wet, moist or swampy places, and most of them perfecting their fruit in the first half of the summer season. They may be distinguished from the true grasses by their triangular solid stems, their closed sheaths and their seed being wholly and singly enclosed in a thin seed vessel.

For the sake of brevity the following characters have been employed:

The sign of degrees (°) stands for "foot" or "feet."

The sign of minutes (′) stands for "inch" or "inches."

The sign of seconds (″) stands for "line" or "lines."

The dash between two numbers stands for "to," and with the numbers indicates the degree of variation in measurement.

Synopsis of the Groups.

A. Staminate and pistillate flowers in small globose or oblong androgynous spikelets placed one above the other and forming clusters or interrupted spikes or heads at the summit of the culm, or panicled heads (decompound) in 3, 4 and 5. Sometimes the lower spikelets in several species are branched. ANDROGYNEÆ.

* Stigmas 2; achenium lenticular.

† Spikelets staminate at the apex, pistillate below.

Spikelets 2–5 flowered, capitate or in a short interrupted spike; *root-stock extensively creeping.* 1–2.

Spikelets in a close or open panicle or densely clustered in an interrupted spike 1′–4′ long or more; perigynia *blackish-brown or tawny.* 3–5.

Spikelets contiguous above, separate below, or all contiguous, sometimes the lower ones compound; perigynia lanceolate, *without a distinct margin*, divergent. 6–7.

Spikelets approximate above, separate below, or all contiguous, (capitate in 10); perigynia *with a distinct margin*, *widely divergent or reflexed at maturity.* 8–13.

† Spikelets staminate at the base, pistillate above.

Spikelets 3–8, 3–5 flowered, the upper ones approximate or subdistinct, the lowest distinct or remote (capitate in 15), or 12–30 flowered and disposed in an interrupted spike $1\frac{1}{2}'$–$2\frac{1}{2}'$ long, *silvery green and shining;* perigynia spreading but *not reflexed.* 14–17.

Spikelets 3–8, the upper 2 or 3 approximate, separate below, or all contiguous (spikelet single in 18); perigynia slightly concave, *widely divergent or reflexed at maturity*; plants *bright green becoming yellowish.* 18–21.

Spikelets 3–15 or more, aggregated or approximate, or the upper contiguous and the lower separate (clustered in 31); perigynia concave, thin, mostly wide winged-margined, the tips erect or spreading, *not reflexed.* 22–31.

† Staminate and pistillate flowers variously situated; spikelets often wholly sterile or wholly fertile. 32–34.

* Stigmas 3; achenium triangular.

Flowers borne in a *short spike* or *head*, staminate at the apex, pistillate below; pistillate *small, caducous*, the staminate mostly conspicuous. 35–36.

Pistillate scales *green and leaf-like*, *persistent*, the lowest as long as the spike; perigynia globular, with a long slender beak. 37–39.

B. Staminate and pistillate flowers disposed in separate spikes on the same culm or plant (monoecious), or on separate plants (diœcious), the former frequently androgynous.— Carex proper.

* Stigmas 2 (rarely 3); achenium lenticular.

Plant *diœcious.* Sterile spike linear, 5″ long or less; fertile spike 3″–5″ long, densely flowered; perigynia oblong, reflexed at maturity. 40.

Sterile spikes 1–4, stalked or sessile; fertile spikes 2–5, erect or recurved, sessile or short stalked, densely or subdensely flowered; perigynia with a short point or pointless; scales *blackish-purple or reddish-brown*, *not awned.* 41–46.

Fertile spikes 2′–4′ long, pendulous on stalks 1′–2′ in length or more; perigynia slightly turgid, scales *light brown with long rough awns.* 47–48.

* Stigmas 3; achenium triangular.

† Perigynia biconvex, without a beak.

Sterile spike single, (rarely 2 or 3) stalked; fertile spikes 2–4 on *filiform drooping peduncles*, the upper approximate, the lower sometimes distant; perigynia with a minute point or pointless; scales blackish-purple or brown. 49–51.

Spikes 2–5, the upper half or more of the terminal one fertile, sterile below, the others fertile, *sessile or short-stalked*, *erect*, green or dark purple; perigynia smooth or pubescent. 52–54.

† Perigynia obtusely 3-angled, not compressed, mostly contracted at each end; obtuse or acutish at the apex.

Sterile spike cylindrical, usually fertile at the apex; fertile spikes 2–5, linear or cylindrical, densely or loosely flowered, on *drooping or suberect partly included peduncles* (sessile or short-peduncled and mostly erect in 55); bracts leafy, *usually surpassing the culm;* perigynia ovate-oblong or elliptical, nerved, contracted at each end, the apex entire or pointed and notched. 55–58.

Sterile spike single (sometimes 2 or 3 in 59), clavate, *long-peduncled*; fertile spikes 2–4, *sessile or stalked*, *erect*, mostly distant, or remote (the upper 2 approximate in 60); bracts *shorter than the culm* or about equaling it in 59 and 63; perigynia with a short terete beak in 61. 59–63.

Sterile spike *short-stalked or sessile;* fertile spikes 2–5, cylindrical or oblong, densely or subdensely flowered, the upper 1 or 2 usually sessile at the base of the sterile spike, the others subdistant or the lowest remote, stalked and erect (all approximate in 64); bracts *leafy*, *longer than the culm;* perigynia oblong, obovate, or ovate, nerved, without a beak. 64–67.

† Perigynia with a distinct beak.

Sterile spike long or short-stalked; fertile spikes loosely 2–8 flowered, the upper 1 or 2 sessile near the base of the sterile spike, the others distant, sometimes remote, erect, subflexuose; perigynia densely striate-nerved, with a straight or oblique beak; leaves and bracts thin, bright or glaucous green. 68–69.

Sterile spike clavate or linear, sessile or stalked; fertile 2–5, usually the upper one or two sessile at the base of the sterile spike, the others scattered, the lowest often remote, all on short or long peduncles and erect, or sometimes the one or two lower ones spreading; densely or loosely flowered; bracts leafy, partly sheathing, mostly exceeding the culm; perigynia ovate, obovate or suboval, nerved, with a short, abruptly bent, or long tapering recurved bifid beak (the latter short and barely curved in 74; fruit easily detached. 70–74.

†† Perigynia acutely angled.

Sterile spike clavate, short or long-peduncled; fertile spikes 3–5, mostly scattered *on long filiform drooping or erect-spreading peduncles.* Leaves narrow, three-veined. 75–76.

Sterile spike clavate, stalked; fertile spikes 2–5, mostly distant *on erect, partly or wholly included stalks*, 3–8 flowered; bracts as long as the sheaths or obsolete. Leaves 3″–12″ wide or more, three-veined, (narrow and one-veined in 80). 77–80.

†† Perigynia obtusely angled.

Sterile spike linear, ½″ wide; fertile spikes small, erect or drooping; bracts obsolete, or leafy and equaling their sheaths; perigynia *minute, light or olive-brown.* Leaves setaceous, or involute when old 81–82.

Plant *diœcious* Fertile spike cylindrical, dark purple; perigynia ovate, *densely pubescent.* A mountain species. 83.

Sterile spike clavate or linear, sessile or short-peduncled; fertile spikes 1–5, the upper one or two near the sterile, the others subapproximate or sometimes subdistant and the lowest remote, (umbellate in 84), 3–10 densely or subloosely flowered, globose or short oblong, mostly sessile; perigynia subrotund, suboval, obovate or ovate, *densely or lightly pubescent*, with an abrupt bifid beak; bracts mostly scale-like, sometimes short leaf-like, (perigynia acutely angled in 93.) 84–93.

†† Perigynia slightly inflated.

Sterile spike clavate or linear, stalked, often fertile at the apex; fertile spikes 2–4, straight or flexuose, cylindrical or subclavate, densely or loosely flowered; bracts leaf-like, the lowest sheathing, mostly exceeding the culm, (the upper ones setaceous in 98); perigynia three-angled, ovate or spindle-shaped, with a long or short tapering beak. 94–98.

†† Perigynia moderately inflated.

Sterile spikes 1–5, stalked or sessile; fertile spikes 2–5, cylindrical or ovoid, densely flowered, approximate above and distant and remote below, short peduncled or sessile, erect or the lower sometimes long-peduncled and spreading; bracts shorter or longer than the culm; perigynia ovoid or oblong-conical, nerved, densely hairy or smooth, with a short bidentate beak; mostly coriaceous in texture, (granular dotted and thin in 103). 99–106.

Sterile spikes 1–5, stalked; fertile spikes 2–5, cylindrical, densely or subdensely flowered, erect on short stalks or sessile; perigynia ovate lanceolate, smooth or hairy, with a long tapering *deeply-cleft beak*, the awn-like teeth mostly recurved; perigynia *not reflexed*. 107–109.

Sterile spike single; fertile spikes 2–4, cylindrical, on long drooping peduncles; perigynia narrowly lanceolate, with a long deeply-cleft beak, the awn-like teeth spreading or recurved; perigynia *strongly reflexed* at maturity. 110–111.

†† Perigynia much inflated.

Sterile spike solitary, (very rarely 2), stalked; fertile spikes 2–5, cylindrical, densely flowered, the upper 2 sessile or nearly so, ascending, the others subdistant, short-stalked and horizontally spreading or all separate on drooping peduncles, the lowest sometimes remote, 2′ long or more, 5″–6″ wide; perigynia *ovoid*, nerved, with a long bifid beak, *horizontally spreading* at maturity, *having a comose appearance*. A mountain species (114) has 1–3 straw-colored spikes, sessile, erect or ascending, 3″ wide, with ascending perigynia. 112–114.

Sterile spike long and sometimes long-peduncled; fertile spikes $1\frac{1}{2}'$–$2\frac{1}{2}'$ long, 9″–12″ wide on stiff erect stalks or sessile; perigynia *ventricose and stipitate*, 6″ in length or more. Spikes *hop-like in aspect*. 115–116.

Sterile spike single (sometimes 2 in 122), stalked or sessile; fertile spikes 1–6, globular, ovoid or oblong, compactly or loosely flowered, the upper two sometimes contiguous, the others separate, or all distant or remote, sessile or pedunculate, rigidly erect, bright or yellowish green; bracts with or without sheaths, mostly surpassing the culm; perigynia ovoid or lanceolate from an ovate base, or awl-shaped, nerved, smooth, with a *long tapering bidentate, or short notched beak*, horizontally spreading or reflexed at maturity. 117–125.

Spikes 1–4, rarely 5, the *upper half or more of the terminal one fertile*, sterile below, the others all fertile, cylindrical, 9″–12″ long, 4″–6″ wide, stalked, erect; perigynia with *a slender beak longer than the body*, horizontally spreading when mature. 126.

Sterile spikes 1–5, clavate or cylindrical, stalked, sometimes androgynous; fertile spikes 1–5, clustered or scattered, or the upper 2 approximate, the others subdistant or distant, pedunculate or sessile, mostly erect or ascending (pendulous and loosely flowered in 133) the lowest sometimes spreading, densely flowered, frequently sterile at the apex, cylindrical or oblong; perigynia globular-ovoid or ovate-lanceolate, nerved or nerveless, mostly much-inflated and thin, straw-colored or tawny, ascending, widely divergent or reflexed, with a tapering bidentate beak, the latter needle shaped in 133. 127–133.

Descriptions of Groups and Species.

A. Staminate and pistillate flowers intermingled in small globular or oblong spikelets which form clusters, heads or spikes or are panicled in 3, 4 and 5.

Stigmas 2; *achenium lenticular.*

Spikelets staminate above, pistillate below.

Inflorescence simple, both staminate and pistillate flowers found in the same spike or spikelets.

Spikelets 2–6, 2–5 flowered, in a short interrupted spike, or aggregated in an ovoid head; perigynia ovate, nerved, of a thick coriaceous texture, with a minute entire or notched point; bracts scale-like, the lowest bristle pointed; rootstock extensively creeping.

Culms slender, leafy at base; spikelets distant.... ... tenella.
Culms rigid, naked; spikelets capitate............... chordorhiza.

1. Carex tenella *Schk.*

Stems 6′–18′ high, slender, erect or spreading, rough above; leaves about equaling the culm, ½″ wide or less, thin, slightly rough on the margins, the loosely tufted radical leaves longer, about 1″ wide, suberect or spreading; spike ½′–1′ long; spikelets 2–4, separate, the lowest usually with a bristle-shaped bract ½′–1′ in length, 1–4 flowered, the highest rarely 6-flowered; perigynia ovate or elliptical, subterete, 1½″ long, prominently finely nerved, the apex tipped with a short entire point; scale ovate, acute or mucronate, thin, white, about one-half the length of the perigynium.

Readily distinguished by the naked or unprotected appearance of the well-rounded perigynia.

A small form occurs which is 4′-6′ high, rather rigid, with 3–5 spikelets and the bristle shaped bract of the lowest spikelet often wanting.

Swamps and wet places. Not rare. June.

2. Carex chordorhiza *Ehrh.*

Stems 6′–18′ high, erect, smooth, naked, or the prominent basal sheaths terminating in narrow blades $\frac{1}{2}$′–1′ in length; leaf-stems branching and rooting at the base, springing from the large creeping rootstock, 3′–5′ high; leaves variable in length, the lower $\frac{1}{2}$′–2′ long, those above, usually partly tufted, 3′–6′ in length, erect or spreading, 1″ wide or less, flat or involute, rough margined; spikelets 3-5, aggregated in an ovoid head 3″–6″ long, brown; perigynia elliptical-ovate, biconvex, nerved, 1$\frac{1}{2}$″ long, contracted into a short entire or notched beak about the length of the ovate, acute brown scale; bracts scale-like and inconspicuous except the lowest which is sometimes short setaceous.

Easily determined by its chord-like, extensively creeping rootstock.

Sphagnous swamps and swampy shores of lakes and streams. Rare. July. Herkimer, Oneida and Seneca counties, and boggy margins of lakes in the North woods *Paine's Catalogue.*

Inflorescence branched, the spikelets panicled or densely clustered.

	Perigynia biconvex, blackish, shining.	1
	Perigynia compressed-ovate, not shining	vulpinoidea.
1	Perigynia ovate, stipitate	teretiuscula.
1	Perigynia obovate, sessile	decomposita.

3. Carex teretiuscula *Good.*

Stems 18′–30′ high, slender, erect, obtusely angled, rough near the spike; leaves usually shorter than the culm, 1″–1$\frac{1}{2}$″ wide, somewhat involute when dry, rough on the edges; spike panicled, 1′–2′ long, brown; spikelets small, crowded on short appressed branches, or the 2 lower sometimes distinct; bracts scale-like, acuminate, the lowest bristle pointed; perigynia stipitate, somewhat thick and corky, ovate, faintly nerved at the truncate base, dark-brown and shining, tapering above into a slender, bifid, greenish beak, nearly covered by the ovate acute brown scale.

The small, short-stalked, ovate, acuminate, shining perigynia, as well as the short, appressed branches of the narrow panicle distinguish this species. Not rare in swampy fields. June.

Var. ramosa *Boott.* Head longer and somewhat nodding, spikelets compound, sometimes on appressed branches, looser or more scattered. Albany county.

4. Carex decomposita *Muhl.*

Stems 20′–36′ high, flaccid, erect or spreading, smooth; leaves exceeding the culm, stiff, channeled below, 2″–3″ wide, rough-margined, filiform at the end; spike decompound, 2′–5′ long, dark or sometimes blackish-brown when mature; spikelets numerous on spreading branches, the lower of which are distinct or sometimes separated $\frac{1}{8}$′–$\frac{1}{4}$′ or more and 1′–2′ long, those above shorter and less distant, gradually tapering to the dense apex; bracts of the long branches green and filiform, the others scale-like and awn-pointed; perigynia sessile, thick, corky, rounded or obovate, biconvex, nerved on both sides, dark-brown and shining, abruptly contracted into a short bifid beak; scale thin, ovate, pointed or cuspidate, tawny or brownish.

This species differs from others of similar growth in its thick, nearly round stem, in its stiff, long, slender-pointed leaves, and especially in its panicled spikelets.

Swamps. July. Very rare or local. Yates and Seneca counties. *Paine's Catalogue.*

5. Carex vulpinoidea *Mx.*

Stems $1\frac{1}{2}$°–$2\frac{1}{2}$° high, firm and erect, acutely angled and rough above the smooth terete base; leaves rough-margined, $1\frac{1}{2}$″–2″ wide, slender-pointed and often surpassing the culm; spike $\frac{1}{2}$′–4′ long, dull brown or sometimes with a tinge of green; spikelets clustered on branches 3″–9″ long, usually densely aggregated above, in the lower half the clusters are mostly 3″–6″ apart;

bracts prominent, bristle-form or the lower filiform and sometimes exceeding the culm; perigynia ovate-acuminate or ovate-lanceolate, flat beneath, 2–3 nerved above, contracted into a narrow bifid rough-margined beak, about as long as the ovate awn-pointed scale, widely divergent at maturity.

A coarse, homely species, somewhat variable, but the main characters are too manifest to be confounded with any other species.

Common in swamps, ditches and fields. June.

Inflorescence simple or the lower spikelets sometimes branched; perigyna plano convex, stipitate, thin, spongy at the base, marginless.

Spikes brown, perigynia compressed-ovate........... alopecoidea.
Spikes green, perigynia teretish-lanceolate........... stipata.

6. Carex stipata *Muhl.*

Stems $1\frac{1}{2}°$–$3°$ high, erect, flaccid, the acute angles rough above the middle; leaves about as long as the culm, $1\frac{1}{2}''$–$2\frac{1}{2}''$ wide, smooth, rough-margined; spikes $1'$–$3'$ long or more, light green; spikelets 6–15, ovoid or oblong, contiguous above, the lower separate and sometimes branched, the lowest often $\frac{1}{2}'$–$1'$ in length; bracts bristle-form and inconspicuous or the lowest $\frac{1}{4}'$–$1'$ long; perigynia subterete, lanceolate, prominently nerved, $2''$ long, tapering from a stalked truncate base into a slender rough-margined bifid beak twice longer than the body, widely diverging at maturity; scale lanceolate, thin, light brown, about one-half the length of the perigynium.

Very easily determined by the fruit, or by the color and bristly appearance of the spikes.

Everywhere common in swampy fields. June.

Var. crassicurta *Peck n. var.* Spikelets 7–12, aggregated in an ovoid or oblong head $9''$–$12''$ long, the perigynia horizontally spreading or somewhat deflexed at the base, giving the spike an unusually bristly appearance. This well-marked variety is of a deeper green, and has a more rigid aspect than the type, whereby it may be readily recognized.

Var. subsecuta *Peck n. var.* Spikes $2\frac{1}{2}'$–$3\frac{1}{2}'$ long; spikelets 9–12, globular, or the lower short-oblong, all conspicuously distinct, pale green, mostly smaller than the type, but otherwise agreeing with it.

7. Carex alopecoidea *Tuckm.*

Stems 18′–30′ high, erect, acutely angled, flaccid, rough on the angles above; leaves about the length of the culm, erect-spreading, $1\frac{1}{2}''$–$2\frac{1}{2}''$ wide, rough beneath and on the margins; spike $\frac{1}{2}'$–$1\frac{1}{2}'$ long, brown; spikelets 6–10, mostly aggregated, or the lower 2 or 3 sometimes distinct, the lowest sometimes with a few-flowered branch, ovoid or oblong, $2\frac{1}{2}''$–3″ long; bracts bristle-shaped, the 1 or 2 lower $\frac{1}{4}'$–1′ in length; perigynia compressed-ovate, stalked and truncate or subcordate at the base, obscurely nerved on the upper surface, tapering into a flat rough-margined bifid beak, more or less divergent at maturity; scale ovate, acute or cuspidate, brown with whitish margins above the middle, nearly covering the brown, or sometimes greenish, perigynium.

Distinguished by its brown spike and compressed, stalked, obscurely nerved fruit. Not common. Mostly in the central and western part of the State; rare in the eastern part. June, July.

Spikelets more or less aggregated, light or deep green (brownish in 13 when mature); perigynia compressed, sessile, distinctly margined.

	Leaves 2″–4″ wide	1
	Leaves less than 2″ wide	2
1	Spikelets distinct below.........................	sparganioides.
1	Spikelets contiguous or aggregated	cephaloidea.
2	Spikelets densely aggregated in an ovoid head ...	cephalophora.
2	Spikelets contiguous in an oblong head or approximate above, distinct below..................	3
3	Perigynia orbicular-ovate..........................	Muhlenbergii.
3	Perigynia ovate-lanceolate.......................	4
4	Beak of perigynia rough-margined	rosea.
4	Beak of perigynia smooth	retroflexa.

8. Carex sparganioides *Muhl.*

Stems 18′–36′ high, erect, robust, smooth, except near the top; leaves numerous, light green, smooth except on the edges, 2″–4″ wide, shorter or longer than the culm, the longest with filiform extremities; spikes $2\frac{1}{2}'$–6′ long, strict; spikelets 5–12, the 3 or 4 upper globose, aggregated, the others more or less oblong, $\frac{1}{4}'$–1′

apart, the 2 or 3 lower 4″–8″ in length, 2½″–3″ thick, sometimes branched, slightly spreading on the straight or flexuose rachis; bracts bristle-shaped, inconspicuous; perigynia 1½″ long, broadly ovate, margined, nerveless, tapering or contracted into a short rough-edged, bidentate beak, usually divergent but not reflexed at maturity; scale thin, white, ovate, acute or cuspidate, about one-half as long as the perigynium.

A reduced form, 18′–20′ high, with closer spikelets, usually occurring in glades and on shaded rocky banks, is Var. minor *Boott.* This robust, handsome species is readily known by its ample graceful foliage and large strict spikes.

Common in rich soil about woods and in copses. June, July.

9. Carex cephaloidea *Dew.*

Stems 2°–3° high, slender, erect or weak and somewhat spreading, flaccid, the upper half rough on the angles, smooth below; leaves shorter than the culm, 2″–3″ wide, thin, smooth, rough-margined, dark green; spikes ½′–1′ in length, rarely capitate; spikelets 4–7, globose, contiguous, the two lower sometimes distinct or 2″ apart, 2½″ long and broad, ascending; bracts inconspicuous; perigynia 1½″ long or more, nerveless, dark green, soft, ovate-lanceolate, tapering into a flat, rough-edged, bidentate beak, spreading at maturity; scale thin, white, short-ovate, blunt, mucronate, about half as long as the perigynium; achenium obovate; style slightly enlarged at base.

Moist or swampy places, mostly in woods or copses. June, July.

In the eastern part of the State this species is less common than the preceding one to which it has sometimes been added as a variety, but from which it is easily separated by its spikelets being collected in an oblong head. From C. Muhlenbergii it is distinguished especially by its broader leaves.

10. Carex cephalophora *Muhl.*

Stems 10′–30′ high, stiff, erect, smooth or a little rough near the head, often branched at base as if stoloniferous; leaves rather stiff, the longest sometimes exceeding the culm, gradually tapering to a setaceous point, 1″–1½″ wide, smooth or the margins slightly rough; spike capitate, ovate or short oblong, 3″–9″ long, pale green; spikelets 4–6, globose, densely aggregated, spreading; bracts setaceous, 3″–6″ long, the upper mostly concealed by the crowded spikelets; perigynia 1½″ long, firm, sometimes faintly nerved near the distinct margin, round-ovate, tapering into a short, rough-edged, bidentate beak, widely spreading at maturity; scale white, thin, ovate, with a rough-awned point, a little smaller than the perigynium; achenium round-ovate, the short style with a conic base.

This is one of our commonest species and can not be confounded with any other. It grows in open fields and in and about woods and copses. June.

From forms of C. Muhlenbergii, which sometimes approach it in the shape and size of the head, it is easily separated by its smaller perigynia.

11. Carex Muhlenbergii *Schk.*

Stems 15′–30′ high, firm, erect, triangular, rough on the angles near the head, smooth below; leaves shorter than the culm, 1½″–2″ wide, open, flat, or sometimes slightly involute, smooth except on the margins, the ends slender and setaceous; spike ½′–1½′ in length, 3″ broad or more, green; spikelets 4–9, globose, contiguous, 2″–3″ long, spreading or the 3 upper erect; bracts bristle-shaped, conspicuous, 3″–6″ long; perigynia 1½″–2″ long, firm, broadly round-ovate, strongly nerved on both sides, terminating in a short, rough-margined, bidentate beak, spreading but not reflexed; scale ovate, pointed or rough-awned, about as long as the perigynium; achenium round-ovate, the short style with a conical base.

Common; growing in a variety of soil, but especially in light sandy or sterile places. In some forms the head is ovate, resembling that of the preceding species. June.

Var. enervis *Boott.* Differs from the type in its slender, spreading, sometimes reclining stems, its soft leaves 1″ wide, and its shorter spike and fewer-flowered spikelets, its smaller, less firm, exactly ovate, nerveless perigynia, the scale thin, mostly smooth-pointed or mucronate. This slender form is, perhaps, peculiar to south-eastern New York (Westchester county), where it inhabits open and slightly shaded grounds. The form which differs from the type only in its nerveless perigynia (Gray's Man.) occurs farther north. Rensselaer county.

12. Carex rosea *Schk.*

Stems usually clustered, 1°–2° high, slender, erect, smooth; leaves shorter or longer than the culm, ½″–1″ wide, smooth, rough-margined; spikes 1′–1¾′ long, green; spikelets 4–6, globose, the 2 or 3 upper contiguous, the others 2″–9″ apart, 5–12 flowered; bracts bristle-shaped or filiform, extending from an ovoid or deltoid base ¼′–2½′; perigynia lanceolate, thin, nerveless, gradually tapering to a flat rough-edged bidentate beak, twice longer than the broad blunt thin white scale; achenium ovate, apiculate.

The base of the beak above is usually clearly defined by an abrupt depression of the perigynium. The fruit is strongly divergent or reflexed at maturity.

Very common and variable. Woods and open places. June.

Var. radiata *Dew.* Culms almost capillary, 6′–12′ high, the leaves often longer, ½″–1″ wide, the spikelets 2–4 flowered, the 1 or 2 lower often distant, each subtended by a filiform bract exceeding the culm; perigynia oval-lanceolate, erect or spreading; scale broadly ovate, obtuse or acutish, sometimes mucronate.

Var. minor *Boott.* This differs from the last in its larger and longer culms, and its erect or ascending perigynia, their scales ovate, acute or mucronate, or sometimes rough-cuspidate.

Var. pusilla *Peck, n. var.* Stems 3′–8′ high, stiff, smooth; leaves a little longer than the culm, ½″ wide, rough-margined; spikelets 2–4, the upper 2 contiguous, the others ¼′ apart, the lowest usually with a setaceous bract ½′–1′ long, 3–9 flowered; perigynia ovate-oblong, about one-third longer than the ovate obtuse or acutish scale, divergent but not reflexed.

Var. staminata *Peck, n. var.* Stems 15′–20′ high, slender and somewhat spreading; leaves ½″–¾″ wide; spikelets 1–5 flowered, each with the staminate portion conspicuous and persistent, the mature perigynia horizontally spreading or reflexed.

13. Carex retroflexa *Muhl.*

Stems tufted, 6′–18′ high, firm, erect, smooth; leaves mostly shorter than the culm, ½″–1″ wide, smooth, rough-margined; spikes 4″–10″ or more in length, light green, becoming brown when mature; spikelets 3–8, globose, 3–9 flowered, the upper contiguous, the 1 or 2 lower sometimes 2″–3″ apart, the lowest with a setaceous or filiform bract 3″–2½′ long; perigynia ovate-acuminate or lanceolate, with a thick, spongy base, nerveless, tapering into a smooth-margined bifid beak, a little longer than the ovate obtuse or pointed brown scale, reflexed at maturity; achenium broadly ovate, apiculate.

Separated from the last by its more rigid culms, its more aggregate spikelets, and by its smooth-beaked fruit.

Open woods and fields. Infrequent. June. It occurs chiefly in the southern central and western parts of the State. It is rare or wanting in the northern and eastern parts.

Spikelets pistillate above, staminate at the base.

Leaves mostly narrow, soft and spreading, shorter than the culm; spikelets 3–8, approximate or more or less distant, (capitate in 15), silvery-green; perigynia plano-convex, ovate, somewhat coriaceous or thickened at the base, turning silvery or brownish when mature; bracts scale-like or bristleform.

	Spikelets commonly 10–30-flowered or more	canescens.
	Spikelets commonly 2-5-flowered	1
1	Spikelets aggregated in a dense head	tenuiflora.
1	Spikelets not aggregated	2
2	Leaves less than 1″ wide	trisperma.
2	Leaves more than 1″ wide	Deweyana.

14. Carex trisperma *Dew.*

Stems 1°–2° high, very slender, spreading, sometimes prostrate, smooth; leaves shorter than the culm, about ½″ wide, smooth except the margins, flat, soft and thin; spikelets 2–3, the 2 upper ¼′–1′ apart or all 1′–2½′ distant, the lower with filiform bracts ½′–2½′ long, the highest sometimes with a setaceous bract 3″–5″ in length, 2–4 flowered; perigynia oblong-ovate, prominently finely nerved on both sides, thick or coriaceous, suberect, terminating in a short entire beak; scale oblong-ovate, pointed or obtusish, usually shorter than the perigynium, achenium elliptical, the base tapering.

Swamps and wet places. Common. June, July.

A form is sometimes found in sphagnous swamps with almost filiform leaves.

15. Carex tenuiflora *Wahl.*

Stems 6′–18′ high, slender or capillary, erect or spreading, mostly naked, smooth; leaves smooth, flat and involute, $\frac{1}{2}''$–1″ wide, usually shorter than the culm; spike capitate, silvery-green, becoming whitish at maturity; spikelets 2–4, 3–5 flowered, aggregated in an ovoid head, or rarely the lowest 2″–3″ distant; bracts bristle-form, mostly shorter than the spike; perigynia ovate oblong, thick, nerved, light-brown, beakless, nearly covered by the ovate-oblong whitish scale.

Stems tufted and branched at base, the shortest often firm and erect, the longest flexile.

The silvery-green spikelets collected in a head distinguish this very rare or local species. It has been reported from Oneida and St. Lawrence counties. June.

16. Carex Deweyana *Schw.*

Stems 1°–2° high, slender, erect or diffuse, smooth; leaves numerous, smooth, slightly rough-edged, 1″–$1\frac{1}{2}''$ wide, shorter than the culm, pale green becoming yellowish with age; spikes 9″–2′ long, flexuous; spikelets 2–4, the 2 or 3 upper ones approximate, the lowest distant or subdistant, 2–6 flowered, silvery-green; bracts bristle-shaped or filiform, the 2 lower sometimes exceeding the culm; perigynia oblong-ovate, acuminate, obscurely nerved, thin, 2″ long, with a long, rough-margined, bidentate beak; scale thin, whitish, oblong-acuminate or rough awned, as long as the perigynium.

Woods and open places. Common. June.

Easily recognized by the somewhat bristly aspect of the soft silvery spikelets and the somewhat drooping or flexuous character of the spike.

17. Carex canescens *L.*

Stems 15′–30′ high, erect, rough above the middle; leaves glaucous, smooth, the margins rough, 1″–$1\frac{1}{2}''$ wide, the extremities filiform, shorter than the culm, or the radical ones sometimes exceeding it; spikes $1\frac{1}{4}'$–3′ long; spikelets 4–8, densely 10 to 30 flowered, ovoid or globose, the 2 or 3 upper ones approximate, the others 3″–12″ apart, all more or less contracted at the base, silvery-green; bracts scale-like, sometimes with a bristle-shaped prolongation, or the lowest setaceous or leaf-like; perigynia ovate, nerved at the base, minutely punctate, whitish, tapering into a short bifid or entire beak, divergent at maturity, a little longer than the ovate, acute or obtuse scale; achenium elliptical.

Swamps and low wet places. Very common. May, June.

Readily determined by its silvery spikes and glaucous-green foliage. Small, slender forms with fewer flowered spikelets, but glaucous foliage approach the following variety. A form occurs in Suffolk county in which the terminal spikelet is wholly staminate or bears but few perigynia.

Var. vulgaris *Bailey.* Differs from the type in its more slender, erect, or diffuse stems; its narrower, green, not glaucous, leaves; its fewer and smaller spikelets, with fewer flowers, and in its green, horizontally-spreading perigynia with more pronounced beaks and shorter scales.

Var. alpicola *Wahl.* Stems 6′–15′ high, firm, erect or spreading; leaves green, 1″ wide; spikelets 3–5, globular, 6–15 flowered, the lowest sometimes with a filiform bract 2′–2½′ long, sometimes the next above with a bristle-shaped bract ½′ or more in length; perigynia green with brown spots or tawny; otherwise as in the preceding. A lowland form has capillary stems 15′–20′ high, leaves ½″ wide or less; perigynia green slightly dashed with brown.

Spikelets 3–8 (single in 18) ovoid or oblong, approximate above, interrupted below, or all scattered; perigynia slightly concave, rough or smooth-margined, nerved or nerveless, usually strongly reflexed at maturity; bracts bristle-form or rarely the lowest leaf-like. Plants rather rigid, green, often becoming yellowish with age. In all the species of this group the terminal spikelet appears to be stalked, the lower part being much contracted and clothed with the scales of the staminate flowers.

	Perigynia ovate, small	1
	Perigynia ovate or ovate-lanceolate, large	2
1	Spikelets scattered; perigynia with a short smooth beak...	seorsa.
1	Spikelets contiguous or approximate, perigynia rough-beaked	interior.
2	Spikelet single, sometimes wholly fertile or wholly sterile,	exilis.
2	Spikelets approximate or scattered	sterilis.

18. Carex exilis *Dew.*

Stems 1°–2° high, firm, erect or suberect, rough above; leaves involute, stiff, smooth, as long as the culm, or much shorter; spikes densely flowered, cylindrical or short oblong, contracted at the base by the numerous scales of the staminate flowers, sometimes wholly staminate or wholly pistillate, $\frac{1}{4}'$–1′ long, light brown; perigynia ovate-lanceolate, few-nerved above, spreading, tapering to a flat, rough-margined bidentate beak, a little longer than the ovate-lanceolate scale.

Cold swamps in the northern and eastern parts of the State; also on Long Island. Rare. June, July.

This is a very distinct and easily recognized species. Sometimes an additional spike or two may develop at the base of the usual one.

19. Carex sterilis *Willd.*

Stems 15′–30′ high, firm, erect, rough above; leaves rough on the edges, longer or shorter than the culm, 1″–2″ broad, sometimes involute above; spike $\frac{1}{2}'$–$1\frac{1}{2}'$ long, strict or flexuous, yellowish-green or tawny; spikelets 3–6, globose, 2″–3″ in length and thickness, $1\frac{1}{2}''$–3″ apart, or the upper 2 or 3 contiguous, the terminal contracted below and stalk-like from the several staminate scales, or sometimes all staminate or again each spikelet partly or wholly sterile; bracts scale-like or bristleform, the latter $\frac{1}{4}'$–1′ in length; perigynia variable, ovate or evenly lanceolate, subcordate, one or both surfaces nerved, contracted into a short or long, narrow, rough-margined, sharply toothed beak, widely divergent at maturity; scale ovate, obtuse or acute, whitish or brown, shorter than the perigynium; achenium ovate.

Culms with a single sterile spike frequently occur, and more rarely with the lower half of the spike fertile. The perigynia are mostly thin, but sometimes spongy at the base, strongly divergent at maturity, their bristling tips occasionally bent or deflexed.

Swamps and wet places. Very common. May, June.

Var. excelsior *Bailey.* Differs from the type in its taller, more slender culms, mostly 2°–$2\frac{1}{2}$° high; its larger, greener, more scattered spikelets, 3″–4″ long; its larger perigynia prominently nerved on both sides, and in its oblong-ovate, acute or pointed scale.

This and the following varieties constitute the species C. stellulata *L.* of Gray's Man., 5th ed.

Common in swamps and wet meadows.

Var. cephalantha *Bailey.* Resembles the last, but has stouter, stiffer culms, 1°–2° high; spikes $1\frac{1}{2}'$–2′ long; spikelets 5–8, 15–30 flowered, 3″–4″ long, aggregated or approximate, sometimes becoming yellowish with age; perigynia horizontally spreading at maturity.

Long Island. May, June.

Var. æquidistans *Peck n. var.* Stems 12′–30′ high, rough, stout, or rarely slender; spikes $1\frac{1}{2}'$–$2\frac{1}{2}'$ long; spikelets 4–6, 15–30 flowered, globular or oblong, 3″–6″ apart; perigynia horizontally spreading, usually the lower ones deflexed.

Wet places. Oneida and Essex counties. June. July.

Var. angustata *Bailey.* Stems 3′–12′ high, very slender, wiry, erect, the setaceous or flat leaves less than $\frac{1}{2}''$ wide; the 2–4 spikelets 2″–3″ apart, 2–6 flowered, the terminal erect or oblique; perigynia lanceolate, nerved, tapering into a long, slender bifid beak much longer than the scale. Easily recognized by its spikelets. (C. stellulata var. angustata *Carey*).

In swamps and wet meadows. Infrequent except in the northern part of the State where it is common in swamps and wet places. June, July.

20. Carex interior *Bailey.*

Stems 8′–20′ high, erect, rough near the spike; leaves mostly shorter than the culm, $\frac{1}{2}''$–1″ wide, sometimes involute when dry; spikes 3″–6″ in length, greenish brown; spikelets 2–4, contiguous, or 2″–3″ distant, the terminal one plainly staminate at the base, 4–10 flowered, a little divergent at maturity; bracts scale-like or bristleform; perigynia widely spreading, small, ovate, nerved on the upper side, thick and spongy at the round or subcordate base, $\frac{3}{4}''$–1″ long, contracted into a slender rough-margined bifid beak, longer than the ovate, acute or obtuse brown white-margined scale.

Swamps and wet places. Common in the central counties of the State. June.

Var. capillacea *Bailey.* Slender, 6′–16′ high, stems and leaves capillary; "perigynia broader and more conspicuously nerved on both sides." In our specimens the two lower spikelets are often 3″–4″ apart, the perigynia nerveless or obscurely nerved on the upper surface only, and widely divergent at maturity, agreeing with a form occurring in West Albany and Junius, having slightly wider leaves (½″ wide or less) which connects the variety and the type.

Low grounds along streams and shores. Long Island. May, June.

21. Carex seorsa *Howe.*

Stems 1°–2° high, slender, erect, smooth; leaves mostly a little shorter than the culm, 1″–1½″ wide, rough-margined; spike 1′–2½′ long, erect, green; spikelets 4–6, 6–20 flowered, globular or oblong, 2″–2½″ long, the upper two approximate, the others scattered, the lowest ½′–1′ distant from the next above, usually subtended by a bristle form bract, rarely by a leafy one 1½′ long; the terminal spikelet pistillate at the apex, rarely wholly staminate; perigynia small, broadly ovate, nerved on both sides, contracted into a short, smooth-margined, bifid beak, much longer than the green and brown white-margined subacute scale.

Swampy woods and groves. May, June. Lansingburgh, Rensselaer county. *Howe.* East Islip, Suffolk county, and near Rome, Oneida county. *Peck.*

This species grows in tufts and is separated from C. interior by its taller, stouter culms, its longer spikes, more numerous and more scattered spikelets, and by its smooth-beaked perigynia.

Spikelets 2–15 or more, approximate or more or less aggregated, ovate, obovoid, globular or clavate, sessile, erect or spreading, green, fulvous or silvery-green, whitish or tawny; perigynia concavo-convex, ovate, obovate or lanceolate, mostly nerved, prominently wing-margined, with a flat mostly rough-margined bifid beak.

Perigynia ovate-lanceolate, narrowly winged....... mirabilis.
Perigynia linear-lanceolate or narrowly lanceolate .. 1
Perigynia orbicular-ovate, broadly winged......... 2
1 Spikelets in a dense cluster partly concealed by long bracts.. sychnocephala.
1 Spikelets contiguous, bracts not concealing them ... 3
3 Spikelets densely aggregated, perigynia widely spreading or reflexed........................ cristata.
3 Spikelets contiguous or aggregated, perigynia not reflexed 4

4 Spikelets 8–15 obovoid, tips of perigynia ascending.. tribuloides
4 Spikelets 4–8, ovate, acute, perigynia erect......... scoparia.
 2 Spikes often drooping, spikelets green or fulvous, perigynia loose, ascending.................... straminea.
 2 Spikes mostly erect, spikelets with a slight yellowish tinge, silvery-green, whitish or fulvous..... 5
5 Spikelets globose-ovate, acutish, perigynia erect.... albolutescens.
5 Spikelets whitish, silvery-green or fulvous......... 6
 6 Spikelets obovoid, perigynia somewhat spreading.. fœnea.
 6 Spikelets 5″–10″ long, ovoid or clavate........... 7
7 Spikelets whitish, perigynia appressed .... silicea.
7 Spikelets straw-colored, perigynia ascending .... alata.

22. Carex cristata *Schw.*

Stems 2°–3° high, stout, acutely angled, rough above the middle, prominently leafy; leaves shorter or longer than the culm, their sheaths enlarged upward, 2″–3″ wide, scabrous on the margins; spike $\frac{3}{4}$′–1$\frac{1}{2}$′ in length, erect or oblique, cristate; spikelets 7–12 or more, globular, densely aggregated, squarrose, the lowest with a setaceous or sometimes leafy bract 1′–2$\frac{1}{2}$′ long; perigynia elliptical-lanceolate, winged, nerved, tapering from the middle to a rough-edged bidentate beak, recurved or spreading at maturity; scale lanceolate, obtusish, brown, one-third shorter than the perigynium; achenium oval, short-stalked.

Fields and open woods, mostly in wet places. Common. July.

This fine species is at once known by its squarrose globose spikelets and light green foliage. It is not very variable. It is regarded as a variety of C. tribuloides in the Manual, but it is so constant and so peculiar in its appearance, being easily recognizable at sight, that it seems worthy of specific distinction.

23. Carex tribuloides *Wahl.*

Stems 2°–3° high, firm, rough on the acute angles above; leaves 1$\frac{1}{2}$″–2$\frac{1}{2}$″ wide, their sheaths loose and wide above, rough beneath or mostly on the margins, usually shorter than the culm; spikes 1′–1$\frac{1}{2}$′ long or more, erect, green; spikelets 8–15, aggregated or a little interrupted below, subglobose, the lowest with a setaceous or leafy bract 1′–2$\frac{1}{2}$′ in length; perigynia narrowly lanceolate, nerved, winged, 2″–2$\frac{1}{2}$″ long, tapering from the middle to a long, rough-edged, bidentate beak, erect or spreading at maturity; scale lanceolate, obtuse, one-half as long as the perigynium; achenium oval, stalked.

Low moist ground and swales in fields or thin woods. Common. July.

Var. reducta *Bailey*. More slender than the type; spike 1′–2′ long, straight or flexuous, often nodding or recurved, somewhat evenly interrupted or moniliform; spikelets 3–10, 2″–2½″ long, subglobose or obovate; bracts, when present, bristle-form; perigynia lanceolate, spreading, a little longer than the scale; achenium short-stalked or sessile.

Swamps or wet places in fields or the borders of woods. Common. July.

The spikelets are smaller than in the typical form of the species, and in general appearance the plant is quite distinct and probably worthy of specific distinction.

Var. Bebbii *Bailey*. Slender, erect; leaves 1½″–2″ wide, much shorter than the culm, their sheaths not enlarged above; spikelets 4–6, ovoid, 2″–2½″ long, aggregated into an ovoid head 5″–6″ long, greenish-brown or tawny; bracts usually present, bristle-form; perigynia lanceolate, narrowly winged, erect-spreading, a little longer than the acute brown scale; achenium oval, sessile.

Wet places. Rensselaer and Cortland counties and in the northern part of the State. July.

This also might easily be regarded as a valid species.

24. Carex scoparia *Schk.*

Stems 1½°–2½° high, slender, erect, rough at the top; leaves shorter than the culm, 1″–1½″ wide, rough-margined; spike ¾′–1½′ in length, straight or a little flexuous, greenish brown or tawny; spikelets 4–8, oblong ovate or elliptical, acute, the upper contiguous, the others distinct, or often aggregated into an ovoid head, sub-erect; bracts usually early deciduous, leafy when present; perigynia narrowly lanceolate, nerved, winged, tapering to a pointed bifid beak, slightly spreading at maturity; scale lanceolate, acute, brown, about one-half the length of the perigynium; achenium narrowly oval, long-stalked.

Common in open fields and in ditches by roadsides. July.

This species is very easily distinguished by its ovate acute brownish or tawny spikelets and appressed perigynia.

Var. minor *Boott.* A much reduced form, 6′–10′ high, the spikelets 2″–4″ long and darker than in the type. It often grows in drier places. Apparently an off-shoot of this is *forma elatior Peck, in litt.* which is taller, the spikes darker, and the perigynia more spreading, a not unusual condition in the Adirondack specimens. A noticeable feature is the filiform bract, which subtends the lowest spikelet.

25. Carex albolutescens *Schw.*

Stems 1½°–2° high, erect, or slender and recurved at the summit; leaves 1″–1½″ wide, rough margined, mostly shorter than the culm; spike ¾′–1½′ in length, erect or subflexuous and drooping, light yellowish-green; spikelets 3–8, approximate, ovoid, obtuse or subacute, the terminal one conspicuously staminate and contracted at the base; the scales acute or cuspidate; bracts scale-like or bristle-shaped, that of the lowest spikelet ½′–1½′ long; perigynia broadly ovate, nerved on both sides, thin, erect, with a slightly rough-margined bifid beak, a little longer than the ovate pointed or cuspidate scale; achenium oval, short-stipitate.

The spikelets are sometimes globose and green rather than pale yellowish-green, but the species is well marked by its erect perigynia, sharply pointed scales and bristle-shaped bracts.—(C. straminea var. fœnea *Torr.* Gray's Man., 6th ed.)

Suffolk county. July.

Var. cumulata *Bailey.* Stems taller and leaves shorter; spikelets 5–30, aggregated, abruptly contracted at base, spreading; perigynia obscurely nerved, appressed, otherwise as in the type.

Suffolk county. July.

26. Carex fœnea *Willd.*

Stems 15′–30′ high, slender, erect or recurved-spreading, smooth; leaves light green, 1″–1½″ wide, smooth, shorter than the culm, spike ¾′–1½′ in length, recurved or flexuous, silvery or whitish green; spikelets 5–8, the upper 2 or 3 contiguous, the others more or less separate, globose or obovate, contracted at the base into a short or long slender stipe, the lowest sometimes with a colored bristle-tipped bract ½′ long; perigynia broadly ovate, prominently nerved on both sides, broadly winged above the middle, finely scabrous margined, with a short bidentate beak, somewhat loosely spreading when mature; scale ovate, acute, whitish or tawny, about the length of the perigynium; achenium ovate, apiculate.

A fine species, easily determined by the slender lax stems, and silvery-white, subsquarrose spikelets.

Woods and copses, especially in hilly and mountainous parts of the State. Common. June, July.

Var. perplexa *Bailey.* Larger, stouter, erect; the spikelets larger, the staminate portion less conspicuous, approximate, or aggregated into an erect head, the lowest sometimes prominently bracteate, perigynia of a firmer texture.

A form occurs which has stiff, subflexuous spikes, silvery-green spikelets, ovate above but narrowed below, and somewhat club-shaped; perigynia thin, spreading, about as long as the pointed scale.

Dry ground. Washington and Otsego counties. June, July.

Var. sparsiflora *Olney.* Differs from the type in its more slender culms, the spikes mostly nodding, and in its fewer, smaller and fewer-flowered spikelets.

27. Carex silicea *Olney.*

Stems 1°–2° high, firm, often recurved at the summit, mostly smooth; leaves stiff, erect, flat or involute, rough beneath, as long as the culm; spikes 1½′–3′ long, often flexuous; spikelets 4–8 or more, separate, moniliform, ovate, acute or obtuse, with a club-shaped base, silvery-white or tawny, 3″–5″ long, erect or spreading; bracts scale-like, lanceolate, as long as the stipe-like base; perigynia broadly ovate, nerved on both sides, wrinkled on the broad wing above, tapering into a short, smooth or roughish bifid beak, about equal to or a little surpassing the ovate, pointed scale; the tips of the perigynia mostly appressed.

Sandy soil. Suffolk county. July.

This species is abundant near the sea shore. Forms sometimes occur in which the spikelets are contiguous or the upper ones even aggregated. Occasionally the lowest one is borne on a long peduncle or branch, and rarely it is compound.

28. Carex straminea *Willd.*

Stems 15′–30′ high, erect or the summit drooping, smooth; leaves usually shorter than the culm, 1″–1½″ wide, smooth or rough-margined, yellowish green; spike 1′–1½′ long, flexuous;

spikelets 3–8, contiguous or 3″–4″ apart, ovate or subglobose above the contracted staminate base, 2″–2½″ wide, erect or ascending; bracts scale-like, pointed, or the lowest bristle shaped, rarely leaf-like; perigynia ovate, faintly or conspicuously nerved on one or both sides, moderately winged, with a short or long bifid beak, the tips loosely spreading, a little longer than the ovate acute tawny scale; achenium oval or obovate, apiculate.—(C. tenera *Dew.*, Wood's Cl. B., C. straminea var. tenera *Boott.*, Gray's Man., 5th ed.)

A common species in copses and open fields. June, July.

Var. brevior *Dew.* Every way larger than the type; spike stiff and erect; spikelets approximate or separate, ovate or subglobose above the staminate base, 3″–5″ broad; perigynia orbicular-ovate, broadly winged, nerved, with a conspicuously short bifid beak, the points loosely spreading.

Var. festucacea *Boott.* Spike erect, or slightly flexuous and recurved; spikelets 4–10, club-shaped, the sterile portion usually exceeding the fertile, 4″–6″ long, the upper 3 or 4 contiguous, the others separate, forming an open or interrupted spike 1½′–3′ long, straw-colored or tawny.

Var. Crawei *Boott.* Differs from the last in its more robust habit, its weaker and sometimes drooping spikes, its larger globular spikelets, usually only the highest with a conspicuously contracted base, and in its broader winged, longer beaked perigynia.

Saratoga county.

Var. aperta *Boott.* Resembles the type in its slender habit and nodding spikes, but has larger spikelets all prominently tapering at the base, the perigynia more broadly winged, longer beaked, twice the length of the rusty brown scale.

Var. invisa *W. Boott.* Stems 1°–2° high, lax at the summit; leaves as long as the culm, 1″ wide or less; spike narrow, flexuous; spikelets aggregated or separate, the lowest often distant or remote, 2½″–3″ broad, rusty brown; bracts filiform, 2′–5′ in length.

Sandy soil. Suffolk county.

29. Carex alata *Torr.*

Stems 1½°–3° high, firm, erect, smooth below; leaves stiff, rough-margined, 1″–1½″ wide, shorter than the culm; spike 1′–1½′ long or more; spikelets 4–10, 4″–6″ in length; ovate or obovate, acute, contiguous or separate, greenish or straw-colored, sometimes tawny; perigynia orbicular-ovate or obovate, cuneate or cordate at the base, nerved, broadly winged, with a short abrupt beak, longer and broader than the lanceolate, acute or rough-awned scale — (C. straminea *Willd.* var. alata *Bailey.*)

Swales and wet places. Suffolk and Seneca counties. July.

30. Carex mirabilis *Dew.*

Stems 15′–36′ high, erect, smooth; leaves about equaling the culm, 1½″–2″ wide, rough-edged; spike 1½′–2′ in length, erect, often flexuous; spikelets 4–11, globose, contiguous, or the 2 or 3 lower ones sometimes 2″–3″ apart, ascending or widely spreading, green becoming tawny or rusty when old; bracts scale-like, or the lowest usually short setaceous; perigynia ovate-lanceolate, lightly nerved on both sides, narrowly winged, gradually tapering into a short or long rough-margined bifid beak, widely diverging when mature; scale narrowly ovate, obtuse, much shorter than the perigynium; achenium oval, apiculate and stipitate.

Easily determined by its coarse, rigid aspect and squarrose spikelets. Common in copses and fields. June.

This is added to C. straminea as a variety in the last edition of the Manual.

31. Carex sychnocephala *Carey.*

Stems 8′–16′ high, erect, smooth; leaves 4′–9′ in length, 1″–1½″ wide; spikelets 4–5, densely aggregated in a head, 6″–9″ long, 3″–5″ wide, partly concealed by 3 leaf-like bracts 3′–6′ in length; perigynia linear-lanceolate, 2½″–3″ long, pointed at the base, nerved, the long slender beak sharply toothed, twice the length of the blunt or mucronate scale.

Low wet meadows and moist places. Very rare. June, July.

Collected about fifty years ago in Herkimer and Jefferson counties, but it does not appear to have been found in our State recently.

Staminate flowers situated above or below the pistillate or the middle spikelets sometimes wholly sterile or wholly fertile.

Spikelets oblong-lanceolate, perigynia linear-lanceolate.. bromoides.
Spikelets 4–8, perigynia lanceolate................ .... siccata.
Spikelets 10-15 or more, perigynia ovate-lanceolate..... Sartwellii.

32. Carex Sartwellii *Dew.*

Stems 18′–30′ high, erect, smooth; leaves usually shorter than the culm, 1″–1½″ wide, rough on the slender points; spike 1′–2′ long, erect, brown; spikelets 12–20, contiguous or the lower 2″ or 3″ distant, ovate, widely spreading; bracts scale-like, or the lower ones setaceous, 3″–6″ long; perigynia ovate-lanceolate, nerved, gradually tapering into a short, rough-edged, bifid beak, a little exceeding the ovate acute brown scale, loosely spreading at maturity.

Bogs and swamps. Very rare. Seneca county. July.

The numerous spreading spikelets disposed in a rather compact spike distinguishes this species. It is C. disticha *Huds* in the fifth edition of the Manual.

33. Carex siccata *Dew.*

Stoloniferous; stems 15′–30′ high, slender, erect or spreading, smooth; leaves mostly shorter than the culm, about 1″ wide, smooth; spikes ¾′–1½′ long, brown, dry and chaffy; spikelets 7–16, 4″–6″ long, ovate or elliptical, acute or blunt at the apex, mostly aggregated; bracts scale like, the lower lanceolate acuminate, sometimes rough-awned; perigynia lanceolate, nerved, with a long rough bifid beak scarcely spreading at maturity; scale broadly lanceolate, acute, brown, with broad white margins above the middle.

A special feature of this species is the dry or over-ripe appearance of the spikes.

Rich soil in open woods and copses, also on sandy plains. Rare in the western part of the State, but more common in the eastern and southern part. June, July.

34. Carex bromoides *Schk.*

Stems 1°–2° high, slender, erect or spreading, rough above the middle; leaves as long as the culm, or shorter, ½″–1″ wide, rough-edged; spikes ¾′–1½′ long, of a clear light brown; spikelets 3–8, the upper three usually contiguous, the lower ones more or less separate, the lowest sometimes subdistant, erect, cylindrical, 3″–9″ in length; bracts scale-like, the lowest short-setaceous; perigynia linear-lanceolate, nerved, tapering below to a thick corky base, and above into a long slender rough edged bifid beak, much longer than the oblong-lanceolate or ovate acute brown scale, erect-spreading at maturity.

The conspicuously corky base of the perigynia distinguishes this species.

Wooded swamps, wet meadows, etc. Common. May, June.

Stigmas 3 ; *achenium triangular.*

Spikes staminate above, pistillate below.

Flowers disposed in a single spike 2″–8″ long.

Bracts and scales not leaf-like.

Perigynia oblong, erect .... polytrichoides.
Perigynia awl-shaped, deflexed .... pauciflora.

35. Carex polytrichoides *Muhl.*

Stems 4′–15′ high, capillary, diffuse or erect, rough above; leaves flat or capillary, ½″ wide, smooth and soft, mostly about the length of the culms; spike linear, 2″–5″ long, subloosely flowered, green or brownish at maturity; bracts scale-like, ovate, bristle-tipped; perigynia 1½″ long, subtriquetrous, alternate, erect, slightly recurved at the apex, nerved, about twice longer than the obtuse or acute, whitish scale, the latter usually caducous.

Swamps and wet places. Common. June.

The species is easily distinguished by the small green few-flowered spikes and caducous scales.

36. Carex pauciflora *Lightf.*

Stems 6′–15′ high, stiff, erect or curved, smooth below; leaves flat or involute, ½″ wide, rough-margined, stiff and often curved, mostly shorter than the culm; staminate scales 2, light brown, conspicuously terminating the spike; spike loosely 2–5 flowered; perigynia awl-shaped, 4″ long, slightly inflated, mostly erect in the early stage, becoming widely divergent and strongly deflexed at maturity, twice the length of the lanceolate scale.

Cold sphagnous swamps and bogs. Common in the northern part of the State, rare elsewhere. June, July.

A pretty species, easily distinguished by its single spike and subulate at length deflexed perigynia.

Bracts and scales leaf-like.

Perigynia 2–5, smooth .... Backii.
Perigynia 4–9, rough on the angles and beak .... Willdenovii.
Perigynia 2–5, rough on the beak .... Jamesii.

37. Carex Backii *Boott.*

Stems $\frac{1}{2}'$–$4'$ high, diffuse; leaves 2–4 times the length of the culm, $1\frac{1}{2}''$ wide, slightly rough-margined; perigynia 2–4, globular-ovate, abruptly contracted into a long, smooth beak; scales leafy, mostly concealing the spike; staminate scales inconspicuous.

Woods. Local. June. Found many years ago in Jefferson county. The name has recently been changed to C. durifolia *Bailey.*

38. Carex Willdenovii *Schk.*

Stems $1'$–$10'$ high or more, slender, erect or diffuse; leaves $1''$–$1\frac{1}{2}''$ wide, far surpassing the culm, roughish on the margins; spike $2''$–$4''$ long, 4–9 flowered; perigynia globose-ovoid, rough on the angles and the awl-shaped beak; scales leaf-like below, the upper broadly lanceolate with a green 3-nerved center and scarious margins, usually exceeding the perigynia, staminate portion $2''$–$3''$ long.

Moist, shady places in woods and ravines. Rare. Jefferson and Cayuga counties. June. Sometimes one or two additional spikes are borne on subradical peduncles

39. Carex Jamesii *Schw.*

Stems $3'$–$10'$ high, capillary, spreading or erect; leaves mostly twice the length of the culm, $\frac{1}{2}''$–$1\frac{1}{2}''$ wide, rough on the margins; spike conspicuous, loosely 2–5 flowered; perigynia globular, smooth, abruptly contracted into a long, rough-edged beak; scales leaf like, mostly exceeding the culm; staminate portion $3''$–$5''$ long.

Woods and ravines. Very rare. Cayuga county. June. This is C. Steudelii *Kunth.*

B. Staminate and pistillate flowers disposed in separate spikes on the same culm or plant (monœecious), or on distinct culms or separate plants (diœcious).

Stigmas 2, *rarely* 3; *achenium lenticular.*

Plant commonly diœcious.

40. Carex gynocrates *Wormsk.*

Stems $4'$–$6'$ high, erect, rough at the summit, as long as the capillary leaves; sterile spike linear, $6''$ long or less, fertile spikes $4''$–$5''$ in length; perigynia oblong-ovate, teretish, $1\frac{1}{2}''$ long;

nerved, contracted into a short bifid or notched beak, longer than the ovate acute or pointed scale, horizontally spreading at maturity.

Swamps. Rare. June, July. Genesee, Wayne, Yates and Herkimer counties.

Var. substaminata *Peck.* (C. monosperma *Macoun*). This has a single perigynium at the base of the staminate spike.

Plant Monœcious.

Staminate spikes 1–3, stalked, often with a few fertile flowers at the base or apex; pistillate spikes 1–5, stalked or sessile, cylindrical, densely flowered or sometimes loosely flowered toward the base, often staminate at the apex; bracts leaf-like or filiform, the lowest usually equaling or surpassing the culm, sheathless; perigynia compressed, ovate or obovate (turgid in 47 and 48); scales dark purple or brown (sometimes greenish in 47 and 48), giving a mottled appearance to the spikes, mostly shorter than the perigynia.

Pistillate spikes erect or spreading (the lower ones recurved or drooping in 46), scales awnless	1
Pistillate spikes nodding, scales rough-awned	6
1 Perigynia stalked, their scales blackish-purple or brown,	2
1 Perigynia sessile, their scales brown or purple-margined,	5
2 Perigynia nerved or nerveless, their scales blackish-purple	rigida.
2 Perigynia nerveless, their scales brown.............	3
3 Perigynia obovate, spikes 2″ wide	aquatilis.
3 Perigynia ovate or elliptical, spikes less than 2″ wide ..	4
4 Scales sharp pointed, squarrose....	aperta.
4 Scales obtuse, perigynia tortuous at the apex........	torta.
5 Perigynia nerveless.................................	stricta.
5 Perigynia slightly nerved..........................	lenticularis.
6 Perigynia obovate................................	crinita.
6 Perigynia ovate or oblong-ovate....................	gynandra.

41. Carex rigida *Good.*, var. Bigelovii *Tuckm.*

Stems 10′–15′ high, erect, smooth, sometimes stoloniferous; leaves shorter than, or as long as, the culm, smooth, usually 1″ wide, erect, or the lower ones recurved-spreading, smooth;

staminate spike linear, 3″–9″ long, borne on a stalk 2″–10″ in length, light brown; pistillate spikes 2–3, approximate, the upper two sometimes contiguous and sessile, or the lower two stalked, the lowest sometimes borne on an erect or spreading peduncle 6″–9″ long, subdensely or loosely flowered, often interrupted and tapering at base, $\frac{1}{4}'$–$1\frac{1}{4}'$ in length; bracts short setaceous, or the lowest sometimes exceeding the spike; perigynia elliptical, nerved or nerveless, whitish-green, mostly covered by the blackish-purple elliptical scale.

It may be distinguished from the related species by its small size, blackish fertile spikes and by its alpine habit.

Summits of the higher peaks of the Adirondack mountains, especially Mt. Whiteface and Mt. Marcy.

In the fifth edition of Gray's Manual, Carey describes a very different plant under the above name.

42. Carex lenticularis *Mx.*

Stems 10′–20′ high, slender, erect or somewhat spreading, mostly smooth; leaves usually shorter than the culm, $\frac{1}{2}''$–1″ wide, rough-margined; staminate spike cylindrical, sometimes bearing a few perigynia, 3″–12″ long, its stalk 2″–8″ in length, brown, erect; pistillate spikes 3–4, 6″–12″ long, approximate or contiguous, sometimes the lowest distant, short-peduncled or sessile, erect or ascending, densely flowered above, more or less loosely flowered and tapering at the base; bracts leaf-like, usually surpassing the culm; perigynia ovate, stipitate, lightly nerved, the upper third sometimes conspicuously empty and a little recurved, minutely pointed, one-third longer than the blunt, green and brown scale.

Well marked by its densely flowered, nearly aggregated, grayish green spikes, and by the usually empty points of the perigynia.

Gravelly shores of lakes and streams. Adirondack mountains. July.

Var. merens *Howe, n. var.* Differs from the preceding in its longer, narrower, darker colored fertile spikes, the lowest usually short-pedunculate; in its longer, wider bracts, $1\frac{1}{2}'$–$2\frac{1}{2}'$ longer than the culm; in its elliptical perigynia, and in its longer scale which nearly covers the perigynium.

43. Carex aquatilis *Wahl.*

Stems 2°–3° high, firm, erect, acutely triangular above, smooth; leaves long, sometimes surpassing the culm, 1½″–2″ wide, rough-margined, pale green or glaucous; staminate spikes 1–4, the highest on a short stalk, 1′–1½′ in length, the others shorter and sessile; usually 1 or more with a setaceous or filiform bract; pistillate spikes 3–5, sessile or the lowest short-peduncled, approximate or subdistant, or the lowest remote, cylindrical or subclavate, the upper often staminate at the apex, ½′–2′ long, compactly flowered; bracts leafy, much surpassing the culm; perigynia broadly ovate or elliptical, nerveless, biconvex, minutely pointed or pointless, about the length of the narrow, obtuse, brown scale.

Cold upland swamps and wet places. Not common. June, July.

44. Carex aperta *Boott.*

Stems 20′–30′ high, erect, triangular, rough above the middle; leaves about 1½″ wide, rough-margined, shorter than the culm; staminate spikes 1–2, cylindrical, the highest 1′–1½′ long, short stalked, the other shorter and sessile, usually with a setaceous bract; pistillate spikes 2–4, cylindrical, the upper approximate and sessile, sometimes sterile at the apex, the lowest distant, short-peduncled, often staminate above, 9″–15″ long, densely flowered above, more loosely at the tapering base; upper bract bristle-shaped, longer than the spike, the lowest leafy, mostly shorter than the culm; perigynia ovate, stipitate, nerveless, olive-brown, minutely dotted, with a small notched point, more or less spreading at maturity; scale dark brown, narrowly lanceolate, pointed, horizontally spreading, exceeding the perigynia.

Rare. Essex county. July.

This is Carex stricta var. decora *Bailey* in the 6th edition of the Manual.

45. Carex stricta *Lam.*

Stems 2°–3° high, erect, acutely triangular, rough above the middle; basal sheaths with fibrillose margins, the fibrils either reticulated or parallel; leaves 1″–1½″ wide, rough margined, more or less involute when dry, glaucous-green, mostly shorter than the culm; staminate spikes 1–3, ½′–1½′ long, the highest on a stalk

$\frac{1}{4}'$–1′ in length, the others smaller and sessile, usually with a scale-like or short setaceous bract; pistillate spikes 2–5, $\frac{1}{2}'$–2′ long, the upper approximate, sessile, the lower subdistant or remote, short peduncled, erect or spreading, cylindrical or clavate, densely flowered above the middle, more loosely at the usually tapering base, often barren at the summit; bracts of the upper spikes short setaceous, of the lower ones leafy, and mostly shorter than the culm; perigynia ovate or elliptical, usually with two or three short nerves at the base, minutely pointed, of a creamy white color, often dashed with dark purple or sometimes wholly blackish purple; scale narrowly oblong, obtuse, reddish or dark brown, about the length of the perigynium, or sometimes longer.

A common species in wet places. May, June. It almost always grows in tufts. It is quite variable.

Var. strictior *Carey*. Pistillate spikes 2–3, approximate, or the lowest subdistant, densely flowered; perigynia ovate, bright green, about the length of the acute rusty-brown scale.

Var. xerocarpa *S. H. Wright*. Slender; pistillate spikes 2–3, linear, more narrow than in the type, on filiform erect-spreading or drooping peduncles $\frac{1}{2}'$–1′ long; perigynia lenticular; scales mostly green with rusty brown points. A graceful variety about one-half smaller than the type.

Var. angustata *Bailey*. Pistillate spikes cylindrical, strict, 2′–3′ long, densely flowered; scales more acute, dark-brown or rust-colored, often exceeding the perigynium.

Var. curtissima *Peck n. var*. Stems 18′–24′ high, very slender, erect, rough, exceeding the narrow ($\frac{1}{2}''$ wide) rough leaves; staminate spike with a minute one at its base, linear-clavate, 8″–10″ long, short-stalked; pistillate spikes 2, ovoid or oblong, densely flowered, sterile at the apex, 3″–6″ long, 8″–10″ apart, sessile; the lowest bract leaf-like, 1′–1$\frac{1}{2}$ in length, the uppermost setaceous; perigynia oval with a minute orifice, longer than the blunt brown scale.

46. Carex torta *Boott*.

Stems 15′–30′ high, erect or spreading, acutely angled, mostly smooth; basal sheaths short, brown, fibrillose, leaves 1$\frac{1}{2}'$–6′ or more long, 1$\frac{1}{2}''$–2″ wide; staminate spikes 1–2, cylindrical, $\frac{1}{2}'$–1$\frac{1}{2}'$ long, the terminal one short or long-stalked, the lowest sessile; pistillate spikes 2–5, $\frac{3}{4}'$–2$\frac{1}{2}'$ long, cylindrical, densely flowered, or sometimes loosely flowered toward the base, often sterile at the apex, approximate, or subdistant, or even remote, the uppermost sometimes erect, the others spreading, recurved or drooping, all sessile or the lowest on short, slender peduncles; bracts leafy or filiform, the lowest about equaling the culm, the others shorter or longer than their respective spikes; perigynia lanceolate, thin, deep-green or olive-colored, nerveless, oblique and tortuous or recurved at the empty apex; scale narrowly oblong obtuse or acute, a little shorter than the perigynium.

Wet places, especially along streams. Common. June.

47. Carex crinita *Lam.*

Stems 2°–4° high, stout, acutely angled, rough above; sheaths smooth, fibrillose at the base; leaves mostly shorter than the culm, 2″–4″ wide, hispid beneath and on the margins; staminate spikes 1–3, ½′–3′ in length, the longest on filiform stalks ½′–1′ long, more or less recurved, or even pendulous; pistillate spikes 3–5, 2′–4′ long, cylindrical, curved, densely flowered, or loosely flowered and tapering at the base, sometimes staminate at the apex, approximate, all on filiform stalks ¼′–1½′ long, recurved-spreading or pendulous; lower bracts leafy, surpassing the culm, the upper short, filiform, longer or shorter than the spikes; perigynia round-obovate, stipitate, a little inflated, thin, faintly nerved or nerveless, with a conspicuous entire point; scale brown, oblong, obtuse, with a rough, green awn, twice the length of the perigynium.

Common in swamps, ditches and wet fields. June, July.

A tall, robust, coarse-looking species, distinguished by its long, recurved or pendulous bristly fertile spikes.

Var. minor *Boott.* This is every way smaller; fertile spikes more compactly fruited, usually shorter peduncled, the upper less drooping; scales with less conspicuous awns; plant paler and of finer aspect.

48. Carex gynandra *Schw.*

Stems 2°–4° high, stout or slender, erect, rough on the angles and sheaths, those at the base fibrillose; leaves shorter or longer than the culm, 2″–4″ wide, hispid beneath and on the margins; staminate spikes 1–3, cylindrical, the terminal one on a filiform, curving peduncle 1′ long, the others short-stalked or subsessile, each with a scale-like or bristle-form bract; fertile spikes 3–6, subdensely flowered, 2′–4′ long tapering at the base, usually one or more sterile at the apex, all short-peduncled and recurved or drooping, the lower subtended by foliaceous bracts longer than the culm, the upper bracts filiform or setaceous and shorter than the stem; perigynia oblong-ovate, subinflated, nerveless or obscurely nerved, with a distinct entire point; scale oblong, obtuse or lanceolate with a long rough awn, twice or thrice the length of the perigynium.

Separated from the last, to which it is closely related, by its hispid sheaths, soft fertile spikes, and by its ovate or oblong-ovate perigynia. Both species often grow together and in both the staminate spike often bears a few perigynia.

Stigmas 3; *achenium triangular.*

Staminate spike single (sometimes 2 or 3 in 49); fertile spikes 1–4, on slender drooping stalks; perigynia compressed-triangular with a few indistinct nerves; scales dark purple or brown.

Perigynia oval or oblong-ovate, scale ovate, blunt or acute .... littoralis.
Perigynia ovate, scale ovate-mucronate .... limosa.
Perigynia orbicular-ovate or obovate, scale slender pointed .... Magellanica.

49. Carex littoralis *Schw.*

Stem 15′–24′ high, slender, erect, acutely angled, smooth; leaves much shorter than the culm, 1″–1½″ wide, stiff and erect, smooth; staminate spike (rarely 2 or 3) subclavate, 6″–15″ long, short-stalked, scales brown or blackish-purple; pistillate spikes 2–4, densely flowered, cylindrical, all usually staminate at the apex, subapproximate, the uppermost short-peduncled and suberect, the others on filiform drooping stalks 4″–9″ long; bracts sheathless, the upper setaceous or scale-like, the lower leaf-like, shorter than the culm; perigynia compressed-oval, or oblong-ovate, lightly few-nerved, with a minute entire orifice, about the length of the obtuse or acute dark purple scale.

Wet places Suffolk county. May.

This species has not before been credited to our State. In the Manual, New Jersey is given as its northern limit. It is doubtful if it will be found north of Long Island and Staten Island. Our specimens were collected near Islip.

It is C. Barrattii, *Schw.* and *Torr.*, in the 5th edition of the Manual.

50. Carex limosa *L.*

Stoloniferous; stems 1°–2° high, slender, erect, acutely angled, rough above the middle; leaves ½″–1″ wide, thick, sometimes involute, rough-margined, shorter than the culm; staminate spike solitary, linear, ½′–1¼′ in length, usually equaling its peduncle; pistillate spikes 1–3, approximate or subdistant, oblong or ovoid on recurved or drooping stalks ½′–1′ long, 10–20 subloosely flowered, often barren at the summit, ½′–1′ long, 1½″–3″ wide; bracts slender-setaceous, shorter than the culm; perigynia ovate or elliptical, nerved, light green, with a minute, entire point; scale lustrous brown, ovate, acute or obtuse, sometimes cuspidate, as long and wide as the perigynium.

Cold swamps and bogs. Rare except in the central and northern parts of the State. July.

It bears some resemblance to C. castanea, but that species has pubescent leaves and lanceolate perigynia.

Var. radicalis *Paine.* Staminate spike terminal on the naked, erect stout culm; pistillate spike single, drooping, on a filiform radical peduncle 4′–9′ long. Herkimer county. *Paine*

51. Carex Magellanica *Lam.*

Stems 10′–20′ high, slender, erect, a little rough on the angles above; leaves mostly shorter than the culm, 1″–1½″ wide, erect, rough on the margins; staminate spike single, subclavate, ½′ long, its peduncle filiform and drooping; pistillate spikes 2–4, ½′ in length, 10–24 subloosely flowered, approximate, all on filiform drooping stalks ½′–1′ long; bracts leaf-like, the 2 lower usually surpassing the culm; perigynia ovate or elliptical, lightly nerved, pale green, with a minute entire point, one-half the length of the lanceolate, pointed, dark purple scale, the latter a little divergent at maturity.

Cold sphagnous swamps, often in company with C. limosa. July.

This handsome species may be identified by its short, mostly pendulous mottled spikes with long-pointed, dark-purple scales.

Spikes 2–4, oblong, ovoid or cylindrical, densely flowered, erect, 2″–5″ broad or more, $\frac{1}{4}$′–1′ long, the upper half or more of the terminal one fertile, staminate and stalk-like at the base, the others all fertile or nearly so; bracts leaf-like, the lowest shorter or longer than the culm.

Spikes brown .... fusca.
Spikes green, perigynia pupescent .... virescens.
Spikes green, perigynia smooth .... triceps.

52. Carex fusca *All.*

Stems 15′–30′ high, erect, or sometimes curved at the summit, acutely angled, rough above; leaves subradical, 1″ wide, shorter than the culm, rough-margined; spikes 2–4, the terminal one staminate at the base, all approximate, or somewhat scattered, sessile, erect, the upper ones with filiform or bristle-form bracts, the lowest short-peduncled or sometimes on a spreading stalk 1′ long and subtended by a leafy bract 1′–5′ long, mostly densely flowered, oblong-ovoid, or cylindrical, 3″–12″ in length or more, 2½″–6″ thick, dark-brown or mottled; perigynia elliptical, prominently nerved, light-green, with a minute, entire or slightly notched point, shorter than the lanceolate, cuspidate, dark-brown scale, the latter more or less divergent at maturity. (C. Buxbaumii *Wahl.*)

Bogs and wet places. Albany, Essex, Genesee and Seneca counties. June, July.

The slender, mostly naked culms, and the short thick erect dark-colored or mottled spikes sufficiently distinguish this species.

53. Carex triceps *Mx.*

Stems 12′–20′ high, stiff, scabrous above; leaves about the length of the culm, 1″–1½″ wide, erect, more or less pubescent, the sheaths densely hairy, pale-green; spikes 3–4, the terminal staminate at its base, all contiguous, sessile or nearly so, erect, ovate, ovoid or oblong, 3″–8″ long, 2″–3″ thick, densely flowered; bracts leafy or filiform, the lowest, and sometimes all, exceeding the culm, perigynia ovate, obtuse, nerved, smooth or hairy before maturity, longer than the ovate, acute, short-awned, variable scale.

Dry soil in pastures copses and thin woods. Common. June.

This species is easily distinguished by its three or four short thick erect contiguous spikes, at first pale green but turning brownish when old.

54. Carex virescens *Muhl.*

Stems 12′–30′ high, slender, erect or sometimes spreading, rough near the summit; leaves pubescent, 1″–1½″ wide, mostly tapering to a long filiform point, often equaling the culm; spikes 2–5, the highest staminate at the base, all approximate or contiguous, ovoid or oblong, 4″–12″ in length, about 2″ thick, compactly flowered, all on short stalks, the lowest sometimes spreading; bracts leafy or filiform, the lowest exceeding the culm; perigynia ovate prominently nerved, scabrous-pubescent, longer than, or equaling the ovate, mucronate scale.

Similar to C. triceps in its place of growth and time of maturity. It is separated from it by the narrower and often longer spikes, and by its hairy perigynia.

Var. costata *Dew.* Stems 20′–30′ high, spikes cylindrical, erect or slightly spreading; perigynia strongly nerved or ribbed. Equally common with the type.

Terminal spike pistillate at the summit, staminate below; fertile spikes 3–5, linear or cylindrical, on short, erect or long filiform peduncles, approximate, or the lowest sometimes distant, subdensely or loosely flowered; perigynia oblong with a short, notched point, or obtuse and pointless.

	Spikes narrowly cylindrical, less than 2″ wide	1
	Spikes broadly cylindrical, 2″ wide	2
1	Spikes loosely flowered, perigynia acute	æstivalis.
1	Spikes densely flowered, perigynia obtuse	gracillima.
2	Scale shorter than the perigynium	formosa.
2	Scale as long as the perigynium	Davisii.

55. Carex æstivalis *M. A. Curtis.*

Stems 1°–2° high, slender, erect or spreading, rough above the middle; leaves mostly shorter than the culm, 1″–1½″ wide, sparsely hairy, bright green, sheaths pubescent; staminate spike fertile at the summit, linear or clavate; pistillate spikes 3–4, linear, erect or spreading, the upper 2 or 3 approximate, the uppermost sometimes sessile at the base of the staminate, the others short-stalked, the lowest often distant or remote on a filiform spreading peduncle 1′–2′ long, loosely flowered; bracts leafy or filiform, the lowest surpassing the culm; perigynia small, ½″ wide, ovate, acutish at each end, nerved, entire at the apex, twice longer than the ovate, hyaline scale; achenium obovate, substipitate.

Shaded soil in woods. Rare. July. Otsego county. This delicate carex is distinguished from its near relatives by its slender, loosely-flowered, erect or spreading spikes and its hairy sheaths.

56. Carex gracillima *Schw.*

Stems 18′–30′ high, erect, mostly smooth; basal sheaths prominently fibrillose; leaves shorter than the culm, 1″–2″ wide, radical leaves tufted, 2″–3½″ wide, rough, light green; staminate spike with or without pistillate flowers at the apex, linear; pistillate spikes 3–4, linear, the upper 2 or 3 approximate, the lowest distant, all drooping on filiform peduncles, subdensely flowered, or loosely flowered at the base; bracts leafy or filiform, the lowest as long as the culm; perigynia ovate, nerved, entire at the obtuse apex; scale ovate, obtuse, hyaline, one-half as long as the perigynium; achenium oblong-obovate, apiculate.

Woods and fields in moist or dry soil. Very common. June.

Very rarely the lower spikes have 1 or more additional branches at the base.

This species is well marked by the blackish purple, fibrillose basal sheaths, and the obtuse perigynia of the linear, subdensely-flowered, drooping spikes.

Var. humulis *Bailey.* A much reduced form with 2–12 flowered spikes and smaller perigynia.

C. gracillima × pubescens *Howe.*

Stems 15′–30′ high, stiff, rough; leaves 1½″–2½″ wide, roughish and sometimes hairy, shorter than the culm; spikes approximate or the lowest distant, sessile or stalked, erect; perigynia ovoid, hairy with a short bidentate beak, not unlike an abortive perigynium of C. pubescens. (Botanical Gazette, Feb., 1881, p. 169.) (C. Sullivantii *Boott.*)

In a swampy meadow. Yonkers, Westchester county. 1878.

A similar hybrid, but one more closely resembling C. gracillima, occurs in Albany and Greene counties, where it was detected by Mr. C. L. Shear.

The terminal spike bears perigynia at its apex; the perigynia are smooth and the scale is acute or barely mucronate, not awned. In these respects it approaches C. gracillima more closely than it does C. pubescens. This has been somewhat doubtfully considered by Professor Bailey to be a hybrid between C. gracillima x æstivalis, but it is only necessary to suppose that in this case the prepotency lies with C gracillima and in the other with C. pubescens to make both forms descendants of the same parent plants, as they probably are.

57. Carex formosa *Dew.*

Stems 15′–30′ high, slender, erect, smooth; leaves short, the uppermost sometimes equaling the culm, $1\frac{1}{2}''$–$2\frac{1}{2}''$ wide, slightly hispidly pubescent beneath, yellowish green; spikes 2–5, the terminal with 6–8 perigynia at the apex, staminate below, long peduncled, the others subdistant or approximate, secund, all on filiform recurved or drooping peduncles, subdensely flowered, with 2 or 3 empty scales at the base; bracts leafy or filiform, about equaling the culm; perigynia ovate, turgid, nerved, thin, tapering to a short entire or minutely-notched beak; scale ovate, obtuse, cuspidate, white or brownish, one-half as long as the perigynium.

The spikes are $\frac{1}{4}'$–1′ long, and about 2″ wide; the perigynium 3″ long and 1″ wide, giving to the former a thick and heavy appearance, by which the species may be distinguished.

Woods and wet places. Rare. June. Columbia, Oneida and Yates counties.

58. Carex Davisii *Schw. & Torr.*

Stems $1\frac{1}{2}°$–3° high, erect, rather stout, smooth or with a soft pubescence; leaves mostly equaling or exceeding the culm, $1\frac{1}{2}''$–4″ wide or more, clothed with a soft pubescence beneath, hispid on the veins and margins; spikes 3–5, the terminal, pistillate above, erect, the 2 upper fertile ones contiguous at the base of the staminate portion, subsessile or short-peduncled, the lowest distant or remote on a short, erect, or rarely long, spreading stalk $\frac{1}{2}'$–$1\frac{1}{2}'$ long, densely flowered, 3″–4″ wide, light green, erect or somewhat spreading; bracts leaf-like, equaling or exceeding the culm; perigynia ovate, conspicuously nerved, turgid, tapering into a short bifid beak, about the length of the ovate obtuse awned scale.

Wet meadows Not common. June. Oneida county.

The drooping of the lower spikes depends on the splitting of the long sheaths which, for a time at least, include their short peduncles. This species is conspicuously marked by its short, thick, mostly erect spikes and large turgid perigynia.

Staminate spike club-shaped, long-peduncled; fertile spikes 2–4, subapproximate or mostly remote, erect; bracts shorter than the culm; perigynia oblong, ovate or obovate, beakless except in 60.

Upper spikes appproximate or nearly so	1
Upper spikes not approximate	2
1 Perigynia oblong, lightly nerved or nerveless	livida.
1 Perigynia with impressed nerves	conoidea.
2 Sheaths dilated	vaginata.
2 Sheaths not dilated	2
Leaves and bracts 1″ wide, shorter than the culm	tetanica.
Leaves and bracts 1″–1½″ wide, nearly equaling the culm . . .	Crawei.

59. Carex Crawei *Dew.*

Stoloniferous; stems 6′–12′ high, slender, erect or diffuse, smooth; leaves short, sometimes equaling the culm, 1″–1½″ wide, smooth, rough-margined; staminate spike clavate ½′–1′ in length on a stiff, erect stalk 1′–2′ long, sometimes with 1 or more short additional ones at or near its base, and sometimes with a few fertile flowers at the apex; pistillate spikes 2–4, cylindrical, densely flowered, 6″–9″ long, distant or remote, sometimes the lowest subradical on a short exserted stalk; bracts leafy, sheathing, about equaling the culm; perigynia ovate, lightly nerved, slightly turgid, roughish, tapering to a small entire point, longer than the ovate, cuspidate scale.

Limestone soil. Rare. June, July. Genesee, Herkimer and Jefferson counties.

Distinguished by its low stature, creeping root-stock, and densely flowered distant dull brown nearly sessile spikes.

60. Carex livida *Willd.*

Stems 6′–18′ high, slender, erect, smooth; leaves mostly shorter than the culm, ½″–1″ wide, flat or involute, stiff, rough margined; staminate spike cylindrical, acute, ½′–1′ in length, on a stiff stalk ½′–1′ long; pistillate spikes 1–2, contiguous, rarely a third subradical one, short oblong or cylindrical, $\frac{1}{4}'$–$\frac{3}{4}'$ long, 15–20 loosely flowered, sessile; bracts small, leafy or setaceous, scarcely equaling the culm; perigynia ovoid-oblong, lightly nerved, pale green, tapering to a small, straight, entire point, a little exceeding the ovate, light brown scale.

Cold swamps. Very rare. June, July. Oneida and Herkimer counties.

61. Carex vaginata *Tausch.*

Stoloniferous; stems 10′–24′ high, mostly weak and diffuse, smooth; leaves subradical, half the length of the culm, $1\frac{1}{2}''$–2″ wide, smooth, slightly rough on the margin, radical leaves tufted, nearly as long as the culm, 2″–3″ wide; staminate spike clavate, or ovoid-oblong and acute, erect or oblique, $\frac{1}{2}'$–$\frac{3}{4}'$ long, its stalk $\frac{3}{4}'$–$1\frac{1}{2}'$ in length, or more; pistillate spikes 2 or 3, remote, 4–10 loosely or 12–15 compactly flowered, $\frac{1}{4}'$–$\frac{1}{2}'$ or more long, on exserted, filiform erect or drooping peduncles $\frac{1}{2}'$–$1\frac{1}{2}'$ in length, the latter partly included in the conspicuously dilated sheaths of the short leafy bracts; perigynia oblong-ovate, nerved, tapering to a short round oblique-notched beak, longer than the ovate acute or obtusish thin brown scale.

Swampy places. Very rare or local. June. Genesee county.

This rare species is conspicuously marked by its dilated sheaths and round beaked perigynia. It stands under the name C. Saltuensis *Bailey* in the sixth edition of the Manual.

62. Carex tetanica *Schk.*

Stoloniferous; stems 1°–2° high, slender, erect, rough at the summit; leaves mostly shorter than the culm; $\frac{1}{2}''$–1″ wide, stiff, flat or involute above, roughish on the margins, bright green or glaucous; staminate spike clavate or cylindrical $\frac{1}{2}'$–1′ in length, on a slender, mostly erect peduncle 2′–4′ long, light brown; pistillate spikes 1–3, remote, loosely flowered, cylindrical, usually with a tapering base, $\frac{1}{2}'$–1′ in length; the uppermost short-stalked or nearly sessile, the lower on slender, erect or spreading peduncles $\frac{1}{2}'$–$3\frac{1}{2}'$ long; bracts foliaceous, much shorter than the culm; perigynia triangular-obovoid, prominently nerved, abruptly contracted into a short curved entire point, longer than the ovate obtuse, sometimes mucronate or cuspidate thin white and brown scale; achenium short-obovate, tricostate, with a short, bent style.

Wet swampy places. Rare. June. Cayuga, Seneca and Jefferson counties.

This is distinguished from its congeners by the long-peduncled spikes and obovoid, nerved perigynia.

Var. Woodii *Bailey* is a lax form growing in deep shade and having longer spreading leaves and shorter fewer flowered fertile spikes.

63. Carex conoidea *Schk.*

Stems 12′–20′ high, stiff, rough above; leaves mostly shorter than the culm, 1″ wide, rough-margined; staminate spike ½′–1′ long, clavate, long or short-peduncled, erect, light brown; pistillate spikes 1–3, 6″–9″ long, subdensely flowered, the upper 2 approximate or distant, short-stalked or sessile, the lowest remote on a spreading or erect peduncle ½′–1½′ long; bracts foliaceous, usually shorter than the culm; perigynia oblong-conic with impressed nerves, and a short straight or curved entire point, about the length of the ovate rough-awned scale, the latter more or less divergent at maturity; achenium obovate, apiculate.

Moist meadows and grassy places. Common. June.

This is easily recognized by the shape and nerving of the perigynia.

Fertile spikes 2–6, erect on exserted stalks or the uppermost sessile, approximate or the lower distant; bracts leaf-like, exceeding the culm; perigynia oblong or pyriform, obtuse, nerved (obscurely in 64 and 65).

	Perigynia obscurely nerved	1
	Perigynia distinctly nerved	2
1	Perigynia oblong	pallescens.
1	Perigynia pyriform	aurea.
2	Perigynia oblong-ovate, 1½″ long	glaucodea.
2	Perigynia oblong, 2″ long	grisea.

64. Carex pallescens *L.*

Stems 6′–24′ high, slender, mostly erect, hispid on the angles near the spikes, smooth below; leaves mostly shorter than the culm, 1″–1½″ wide, rough-margined, slightly pubescent on the sheaths; staminate spike often clavate, 4″–8″ long, short-stalked; pistillate spikes 2–4, oblong, densely flowered, 3″–6″ long, contiguous, the uppermost sessile, the others on short peduncles, erect or spreading; bracts leafy, sheathless, often transversely wrinkled at the base, exceeding the culm; perigynia oblong, faintly nerved, pointless, as long as the pointed scale.

Fields and grassy places. Common. June.

The species is well marked by the somewhat clustered, short-peduncled, fertile spikes, and the oblong obscurely-nerved pointless perigynia.

65. Carex aurea *Nutt.*

Stems 3′–18′ high, slender, erect or subprocumbent, smooth below, roughish above; leaves mostly shorter than the culm (or exceeding it in pigmy forms) ½″–1″ wide, smooth, slightly rough on the margins, bright green; staminate spike clavate, 3″–8″ long, sessile and inconspicuous, or stalked and manifest; pistillate spikes 2–4, cylindrical, 3″–9″ long, the upper 2 contiguous, sessile or subsessile, erect or slightly spreading, the lower subdistant, on slender peduncles ½′–1′ in length, suberect or spreading, sometimes a subradical spike is present on a long, suberect peduncle; bracts leaf-like, sheathing, exceeding the culm; perigynia ovoid or pyriform, nerved, thick, yellowish or golden brown at maturity, obtuse at the apex, longer than the ovate, acute or mucronate scale; stigmas 2 or 3, achenium lenticular, apiculate.

Wet springy ground and banks of streams. June, July.

This interesting and infrequent species may be distinguished by its small pyriform yellowish-brown perigynia and lenticular achenia.

66. Carex glaucodea *Tuckm.*

Stems 6′–20′ high, erect or spreading, smooth; leaves mostly subradical, usually shorter than the culm, 1½″–4″ wide, rough at the extremities, smooth on the lower half, glaucous or pale green; staminate spike subclavate, 6″–9″ long, sessile, sometimes inconspicuous; pistillate spikes 2–4, subdensely flowered, perfectly cylindrical, ½′–1′ long, the upper 2 usually approximate, the lower on erect, exserted stalks ½′–1′ in length, or the lowest remote on a filiform spreading or recurved peduncle 2′–5′ long, glaucous, turning to a dull brown; bracts like the leaves, sheathing, all but the lowest exceeding the culm; perigynia oblong-ovate, numerously finely nerved, of a thick or leathery texture, tapering to an acutish, entire or notched apex, about twice longer than the ovate, acute or cuspidate scale; achenium obovate; style even (not tumid), curved or abruptly bent at the base.

Thin woods and moist places. Rare. June, July. Cayuga and Dutchess counties.

This species may be separated from C. grisea, which it resembles, by its shorter stems and leaves, its more cylindrical spikes, and shorter perigynia, and by its curved styles.

67. Carex grisea *Wahl.*

Stems 1°–2½° high, firm, usually somewhat robust, smooth, or sometimes roughish at the summit; leaves slightly hispid on the upper surface, smooth beneath, 1½″–3″ wide, the highest exceeding the culm, pale green; staminate spike 3″–9″ long, sessile; pistillate spikes 2–4, oblong, thick, loosely or subloosely flowered, ¼′–1′ in length, the upper 2 usually contiguous, the uppermost sessile, the others more or less distant on stiff, erect peduncles ¼′–1′ long, light green or fading to tawny; bracts leafy, sheathing, erect-spreading, or the upper divergent, much longer than the culm; perigynia oblong, obtuse, turgid, finely nerved, about the length of the ovate, cuspidate or rough-awned scale; achenium obovate, sometimes apiculate, with a straight, tumid or bulbous-thickened style.

Moist ground and grassy places. Common. June.

This species frequently forms tufts. Its straight, tumid or bulbous-thickened style articulates at or slightly above its base. A slender narrow-leaved form occurs which closely approaches, and which perhaps is referable to Var. angustifolia *Boott.*

Leaves and bracts alike, sheathing, conspicuously thin, the latter exceeding the culm; perigynia obovoid or ovate-triquetrous, finely striate or nerved, distinctly beaked, shorter than the tri-nerved, pointed or rough-awned scale.

Spikes 3–8 flowered, sheaths smooth .... oligocarpa.
Spikes 3–10 flowered, sheaths pubescent .... Hitchcockiana.

68. Carex oligocarpa *Schk.*

Stems 6′–18′ high, slender, erect or somewhat diffuse, rough on the upper portion; leaves short, or sometimes equaling the culm, about 1″ wide, slightly rough on the veins beneath and margins;

staminate spike linear or subclavate, subsessile or on a stalk ½′-1′ in length; pistillate spikes 2-4, the upper 1 or 2 contiguous or distinct, short-pedunculate or sessile, the others distant or remote on stalks ½′-1½′ long, all erect, loosely 3-8 flowered on a flexuous rachis; bracts with smooth sheaths, thin, longer than the culm; perigynia obovoid-triangular, with a distinct straight or slightly oblique beak, shorter than the rough-pointed or awned scale achenium obovate, apiculate; style tumid above the minute persistent base.

Woods and shady places. Rare in the eastern part of the State, occasional elsewhere. June.

This species is distinguished by its thin, narrow foliage, few and loosely flowered spikes, nearly straight-beaked striate perigynia, and tri-nerved awned scale.

69. Carex Hitchcockiana *Dew.*

Stems 1°-2° high or more, erect or spreading, rough, or smooth below; leaves short, or the upper equaling the culm, 1′-1½′ wide, thin, more or less hispidly pubescent; staminate spike linear or subclavate, ½′-1′ in length, on a slender, erect peduncle ¼′-1½′ long; pistillate spikes 2-4, loosely 3-10 flowered on a flexuous rachis, the upper two approximate, mostly on included stalks or the highest sessile, the lower distant or remote on erect, slightly-exserted peduncles; bracts and sheaths roughly pubescent, the former mostly surpassing the culm; perigynia oval or obovate, obtusely triangular, striate-nerved, 2″ long, with an abrupt or tapering oblique recurved truncate beak, a little shorter than the broad tri-nerved rough-awned white scale; achenium and style like the last.

Woods. Rare in the eastern part of the State. June, July.

This may be distinguished from the preceding species by its pubescent sheaths, rougher foliage, shorter-stemmed fertile spikes, and by its perigynia, which have a conspicuously oblique or recurved beak.

Var. triflora *Peck n. var.* More slender, with the fertile spikes 1-3 flowered.

Collected on Mt. Defiance. June.

Pistillate spikes 2-6, more or less flexuous, the upper 2 contiguous or approximate, sessile or nearly so, the rest scattered and stalked, or sometimes all subdistant; bracts mostly exceeding the culm; perigynia obtusely angled, prominently nerved and having an abruptly bent or recurved rarely straight beak.

	Lower or radical leaves 8″ broad or more........ ...	albursina.
	Lower leaves less than 8″ broad	1
1	Pistillate spikes densely flowered, perigynia ovate....	granularis.
1	Pistillate spikes subdensely or loosely flowered.......	2
	2 Upper spikes usually contiguous, the sterile subsessile,	blanda.
	2 Upper spikes rarely contiguous, the sterile stalked..	3
3	Spikes subloosely flowered, bracts shorter than the culm,	styloflexa.
3	Spikes loosely flowered, bracts longer than the culm..	laxiflora.

70. Carex laxiflora *Lam.*

Stems 1°–2° high, erect or spreading, triangular, smooth leaves mostly subradical, short, $1\frac{1}{2}''$-4″ wide, smooth except on the margins, the radical often wider and half as long as the culm; staminate spike linear or clavate, $\frac{1}{2}'$–1′ long, conspicuously stalked or subsessile; pistillate spikes 2–4, linear, loosely flowered on a flexuous rachis $\frac{1}{4}'$–1′ in length, the uppermost (rarely 2) sessile or short-stalked at the base of the sterile, the others subdistant or the lowest remote, all on erect, exserted peduncles $\frac{1}{4}'$–$1\frac{1}{2}'$ long; bracts leafy, short-sheathed, shorter or slightly longer than the culm; perigynia obovate, strongly nerved, with a straight or slightly recurved beak, exceeding the ovate, obtuse, mostly mucronate white scale.

A subradical spike on a slender, flattened peduncle 2′–$2\frac{1}{2}'$ in length is not rare.

Woods, ravines and open places. Common. June.

Var. varians *Bailey* has stouter culms and broader leaves than the type, the fertile spikes a little closer flowered, the upper 2 mostly contiguous to the sterile, the highest sessile, bracts often longer than the culm, the perigynia less strongly nerved.

Var. patulifolia *Carey*, differs from the type chiefly in its broader root leaves, 5″–7″ wide, and in the usually longer bracts, equaling or surpassing the culm.

Very common in damp shades and ravines. May, June.

71. Carex styloflexa *Buckley.*

Stems 12′–18′ high, slender, erect or diffuse, smooth, leaves 2′–4′ long, 1″ wide, the radical longer and 1″–$1\frac{1}{2}''$ wide; staminate spike about $\frac{1}{2}'$ long on a slender, smooth stalk $\frac{1}{2}'$–$\frac{3}{4}'$ in length; scales oblong, blunt, light brown; pistillate spikes 2–4, $\frac{1}{4}'$–$\frac{1}{2}'$ in length, 5–10 subloosely flowered, scattered, all but the highest stalked, the lowest usually on a filiform recurved peduncle; bracts mostly shorter than the culm; perigynia obovate, lightly nerved, with a straight or recurved beak, longer than the ovate acute brown scale.

Grassy places. Rare. June. Albany and Cattaraugus counties.

This has been regarded by some as a variety of the preceding species, but it is easily separated by its short spikes.

72. Carex blanda *Dew.*

Stems 8′–20′ high, erect, triquetrous, rough on the angles; leaves $1\frac{1}{2}''$–3″ wide, rough above the middle, equaling or shorter than the culm; staminate spike clavate, 4″–9″ long, sessile or on a stalk $\frac{1}{4}'$–1′ long; pistillate spikes 3–4, 3″–9″ long, subdensely flowered, the upper 2 usually contiguous to the staminate spike and sessile or nearly so, the lower pedunculate, erect, or the lowest remote on a setaceous peduncle 2′–3′ long, suberect or recurved; bracts leafy, mostly exceeding the culm; perigynia obovate, with a long or short tapering base, prominently nerved, terminating in a short recurved or abruptly bent beak, longer than the ovate, acute or mucronate white scale, more or less diverging at maturity.

Woods and fields. Very common. June.

Rarely among the large forms 1 or 2 of the lower spikes are compressed; occasionally there is but 1 spike, stalked or sessile and contiguous to the staminate, in which case the latter is usually long-peduncled, exceeding the bracts. This species has been considered by some as a variety of C. laxiflora to which it is joined in the Manual, but its short dense pistillate spikes and commonly short sessile staminate spike give it such a distinct aspect that it may be distinguished at a glance.

73. Carex albursina *Sheld.*

Stems 12′–20′ high, erect or spreading, flaccid below, acutely triangular and somewhat winged above, smooth; stem leaves 2′–6′ long, $1\frac{1}{2}''$–3″ wide, the radical longer, 8″–15″ broad, smooth; staminate spike linear, 3″–15″ in length, mostly sessile and often inconspicuous; pistillate spikes cylindrical, loosely flowered on a slightly flexuous rachis ½′–1′ long, the upper 1 or 2 contiguous to the staminate and sessile or nearly so, the lowest on a filiform peduncle 1′–2′ long, all erect or slightly spreading; bracts leafy, 2″–4″ broad, acuminate, the lowest much exceeding the culm; perigynia ovoid-elliptical or obovate, nerved, 1½″–2″ long, half as broad, with a short recurved beak, twice the length of the obtuse mucronate white scale.

Rich moist soil in woods and shaded places. Not common. June. Albany, Cayuga and Jefferson counties.

This species was separated from C. laxiflora, to which it was formerly joined as Var. latifolia *Boott*, because of its broad leaves and bracts and its short sessile staminate spike. Its large perigynia also confirm the validity of its separation.

The fruit of this and the three preceding species shells easily, and the specimens should be collected while it is yet scarcely mature.

74. Carex granularis *Muhl.*

Stems 10′–24′ high, mostly erect, smooth; leaves short, usually much shorter than the culm, 1″–4″ wide, smooth, rough near the apex, sheaths prominently glaucous; staminate spike subclavate, ¼′–1′ long, sessile or short-peduncled, often inconspicuous; pistillate spikes 2–5, cylindrical, compactly flowered, ¼′–1′ in length, the upper 2 mostly contiguous to the staminate spike, sessile or slightly stalked, the others more or less distant on exserted peduncles ¼′–2′ long, erect or the lowest spreading, or rarely on a filiform drooping stalk 3′ long; bracts leafy, rough, the lower sheathing, exceeding the culm; perigynia round-ovate or oblong-conical, prominently nerved, slightly turgid with a short bent entire or notched apex, nearly twice longer than the ovate pointed thin white scale; achenium obovate, minutely dotted, tipped with the abruptly bent style.

Wet or moist ground in meadows and grassy places. Common. June.

It is distinguished by the dense, cylindrical fertile spikes, and the strongly-nerved perigynia.

Var. recta *Dew.* is usually smaller, the spikes less densely flowered, the perigynia with a straight acute or acuminate point.

Staminate spike clavate, pedunculate; pistillate spikes 2–4, short-cylindrical, 3–9 loosely or subloosely flowered, all on exserted erect or spreading filiform stalks, the lowest often subradical or even radical; bracts leafy, sheathed, shorter or longer than the culm; perigynia acutely triangular, finely and closely nerved, with a short recurved or sometimes obsolete point; scale thin, white or brown.

Pistillate spikes pendulous; leaves 2″–5″ broad ...... laxiculmis.
Pistillate spikes erect-spreading, leaves 1″–1½″ broad.... digitalis.

75. Carex digitalis *Willd.*

Stems 6′–18′ high, slender, almost capillary, erect or at length spreading, smooth; leaves about the length of the culm 1″–1½″ wide, rough-margined, bright green; staminate spike 6″–9″ long, its stalk ½′–2½′ in length; pistillate spikes 2–4, loosely 6–9 flowered, the highest subsessile or long-peduncled, the lower subdistant or remote on filiform spreading peduncles 1′–2½′ in length or more, the lowest sometimes pendulous; bracts leafy, sheathing, equaling or exceeding the culm; perigynia triangular-elliptical, finely nerved, with a short, obliquely bent point, nearly twice longer than the acute white scale.

Woods and ravines. Not very common. June.

The species is known by its narrow, 3-veined leaves and the small triangular perigynia. It usually grows in tufts.

76. Carex laxiculmis *Schw.*

Stems 10′–20′ high, slender, suberect or prostrate, smooth; leaves mostly shorter than the culm, 1½″–5″ wide, conspicuously 3-veined, glaucous, rough on the margins; staminate spike clavate, 6″–10″ long, sometimes subtended by a slender green bract 2″–5″ in length, mostly long-peduncled, exceeding the leaf-like sheathing bracts; pistillate spikes 3″–6″ long, densely 3–8-flowered, all except the subsessile highest one on drooping filiform peduncles 1½′–2½′ long; perigynia triquetrous, elliptical, densely nerved, with a short oblique or curved point, exceeding the ovate, obtuse or pointed brown or white scale. (C. retrocurva *Dew.*)

Thin woods and copses. Common. June.

The broad glaucous leaves and drooping spikes on long filiform peduncles characterize this species.

There is a late form (Forma *serotina*) in which the new growth develops fruit soon after the old fruit has matured. In it the staminate spike is inconspicuous or abortive, and the pistillate spikes are erect and on peduncles much shorter than usual.

Staminate spikes clavate; pistillate 2–5, erect, mostly on included stalks; bracts about the length of their long sheaths or obsolete; perigynia acutely angled, finely nerved (obscurely in 80) with a short recurved or straight beak; leaves radical, prominently 3-ribbed (narrow and 1-veined in 80).

	Leaves narrow, 1-veined	pedunculata.
	Leaves 3-ribbed, bracts conspicuous	1
	Bracts obsolete, sheaths purple	plantaginea.
1	Leaves 2″–5″ broad, dark green	Careyana.
1	Leaves 3″–12″ broad, whitish-green	platyphylla.

77. Carex Careyana *Torr.*

Stems 1°–2° high, erect-spreading, smooth; leaves rough beneath or smooth throughout, 2″–5″ wide, shorter than the culm, dark green; staminate spike clavate, 5″–10″ in length, its stalk ½′–1′ long, usually with a scale-like or slender green bract, scales purplish or brown; pistillate spikes 2–3, loosely 2–8 flowered, the uppermost sessile at the base of the sterile, the others scattered, sometimes the lowest remote on a partly included stalk 1′–1½′ long; bracts leafy, as long as their sheaths; perigynia acutely triangular-ovate, 2″–2½″ long, closely nerved, with an oblique or recurved beak, twice the length of the ovate, acute or mucronate purple-brown scale.

Woods and ravines. Rare. May. Cayuga, Genesee and Jefferson counties.

78. Carex platyphylla *Carey.*

Stems 8′–15′ high, slender, erect, at length widely spreading, smooth; leaves shorter than the culm or rarely exceeding it, ¼′–1′ broad, smooth, glaucous or whitish green; staminate spike 4″–10″ long, its peduncle ¼′–1′ in length or rarely subsessile, usually with a scale-like or bristle-shaped bract; pistillate spikes 2–3, 2–10 loosely flowered, scattered, all erect on included stalks;

bracts leafy, about twice the length of the spikes; perigynia ovoid, acutely angled, closely nerved, with a recurved, entire or notched beak, $1\frac{1}{2}''$ long, a little longer than the pointed brown scale.

Woods, hillsides and ravines. Common. June.

This species is easily recognized by its broad pale or glaucous leaves, conspicuous leaf-like bracts and short, loose, few-flowered spikes.

79. Carex plantaginea *Lam.*

Stems 1°–2° high, slender, erect, at length spreading or prostrate, smooth; basal bracts 4–7, acute, dark purple; leaves shorter than the culm, $\frac{1}{2}'$–$1'$ broad or more, smooth, prominently 3-ribbed; staminate spike subclavate, acute at each end, $\frac{1}{2}'$ in length, its stalk $5''$–$15''$ long, with dark purple scales; pistillate spikes 3-4, 3–10 loosely flowered, $\frac{1}{4}'$–$\frac{3}{4}'$ long, distant, erect on included peduncles, or the lowest subradical on an exserted stalk $1'$–$2'$ in length; bracts $2''$–$4''$ long, acuminate or bristle-tipped, purple, with dark purple sheaths $\frac{1}{4}'$–$1'$ long or more; perigynia triangular ovate, finely nerved, with a short recurved beak, $2''$–$2\frac{1}{2}''$ long, a little exceeding the ovate, acute, purple-pointed scale.

Shaded banks, hillsides, copses and open woods. Infrequent. May, June.

This is a very distinct species, recognizable at a glance by its broad radical leaves and its purplish sheaths, bracts and scales.

80. Carex pedunculata *Muhl.*

Stems $3'$–$12'$ long, slender, diffuse, smooth; basal bracts purple with acute green points; leaves flat, $1''$–$1\frac{1}{2}''$ wide, rough beneath, stiff, longer than the culm; staminate spike cylindrical or ovoid, sessile, obtuse or acute, $2''$–$3''$ long, with dark purple scales; fertile spikes 2-4, 3–8 subdensely flowered, slightly staminate at the apex, $2''$–$4''$ in length, the uppermost sessile at the base of the sterile spike, the others subdistant on stalks $\frac{1}{4}'$–$1'$ long, suberect or spreading, radical spikes numerous, prostrate on filiform peduncles $2'$–$6'$ long; bracts inconspicuous, green, about the length of the sheaths; perigynia triangular-obovate, minutely downy or smooth, with a long tapering base and a short recurved minutely notched beak, smaller than the broadly obovate awned or cuspidate purplish scale.

Woods and banks. Common. May, June.

This species is characterized by its commonly prostrate growth, inconspicuous bracts and concealed fruit.

It inhabits chiefly dry shaded situations, but is found in meadows, on banks, and amongst shrubbery in rocky places.

Pistillate spikes 3–4, few flowered, on erect or drooping partly included stalks; bracts obsolete or as long as their respective sheaths; perigynia minute, oblong, obscurely nerved, with a bent or straight beak; olive-brown at maturity; leaves short, setaceous or about 1″ wide.

Leaves subradical, not setaceous........................ capillaris.
Leaves radical, setaceous........................ ..... eburnea.

81. Carex capillaris *L.*

Stems capillary, 4′–12′ high, erect, smooth; leaves shorter than the culm, 1″ wide or less, rough on the margins, the radical ones numerous, flat, soft, often involute when old; staminate spike clavate, 2″–3″ long, its stalk 3″–9″ in length; pistillate spikes 2–3, scattered, the uppermost usually erect and equaling the staminate spike, the lower on drooping peduncles 3″–12″ long; bracts leaf-like, as long as their respective sheaths or more, the lowest usually exceeding its spike; perigynia oblong, 1″–1½″ in length, nerveless, 2-ribbed, slightly turgid, somewhat thin in texture, olive brown, with a slender, entire roughish beak about twice the length of the ovate obtuse brown scale; achenium narrowly obovoid.

Wet places. Local. Cortland county.

82. Carex eburnea *Boott.*

Stoloniferous; stems 5′–12′ high, capillary, but firm and erect, smooth; leaves bristle-shaped, recurved-spreading, rough above the middle, shorter than the culm; staminate spike linear, 3″–5″ long, sessile or slightly peduncled between the more elevated and conspicuous pistillate spikes, acute at each end, the brown scales often partly concealed by the scarious sheaths; pistillate spikes 2–4, 2–6 densely flowered, 1″–2″ long, approximate on slender stalks 4″–8″ in length, sometimes the lowest distant; sheaths scarious, white with a tinge of brown at the base; perigynia triangular obovate, obscurely nerved, smooth, olive-brown, shining, with a minute round beak, longer than the ovate obtuse or acutish light-brown scale.

Thin soil on or about limestone ledges. June.

A very small species, but one easily known by its setaceous leaves and its very small erect pistillate spikes surpassing the staminate one.

Plant diœcious; staminate and pistillate spikes of the same size and color; bracts, when present, scale-like or setaceous, sheathless; perigynia dark purple, densely hairy, with a short, entire beak; scales blackish purple.

83. Carex scirpoidea *Mx.*

Stoloniferous; stems 6′–15′ high, slender, erect, smooth; basal bracts dark purple, acute or obtuse; leaves subradical, stiff, mostly much shorter than the culm, 1″ wide, smooth; staminate spike subclavate, ½′–1′ in length with a small greenish tri-nerved cuspidate bract and dark purple scales; pistillate spikes ¼′–1′ long, densely flowered; bracts setaceous, sheathless; perigynia ovate, very hairy, gradually tapering to a short entire or notched beak, mostly covered by the acutish blackish-purple ciliate scale.

Thin soil covering rocks. Adirondack mountains July.

Plant monœcious; staminate spike clavate, sessile or short-stalked; pistillate spikes 1–5, globular-ovoid, oblong or cylindrical, sessile or short-stalked, the upper 2 contiguous or approximate, or all distinct and the lowest subdistant, each subtended by a scale-like or green bract, the lowest often by a leafy one ½′–2½′ long; perigynia subrotund, oval or elliptical, obtusely or acutely angled, mostly densely pubescent, abruptly contracted into a slender bifid beak; scale ovate, commonly brown or purplish, equaling or shorter than the perigynia.

	Plant pubescent	pubescens.
	Plant glabrous	1
1	Pistillate spikes on short stems, umbellately clustered,	umbellata.
1	Pistillate spikes not umbellately clustered..........	2
	2 Bracts sheathing, purplish	Richardsonii.
	2 Bracts not sheathing............................	3
3	Staminate spike 3″ long or less	4
3	Staminate spike more than 3″ long	6

4 Culms weak, recurved or reclining	5
4 Culms erect or spreading	Peckii.
5 Radical spikes present	deflexa.
5 Radical spikes wanting.........	Emmonsii.
6 Staminate spike about $\frac{1}{2}''$ wide, the lowest pistillate spike with a long slender green bract............	Novæ-Angliæ.
6 Staminate spike more than $\frac{1}{2}''$ wide..............	7
7 Plant stoloniferous, scales of pistillate spikes commonly brown or purplish	Pennsylvanica.
7 Plant not stoloniferous, scales of pistillate spikes commonly greenish or tawny..................	varia.

84. Carex umbellata *Schk.*

Stems 2′–4′ high, erect, growing in dense tufts from strong fibrous roots, somewhat stoloniferous; leaves 2′–10′ long, about 1″ wide, flat, or sometimes involute, rough, stiff, erect or spreading; staminate spike clavate, $\frac{1}{4}'$–$\frac{1}{2}'$ in length, rarely with a pistillate spike at its base; pistillate spikes in clusters of 2 or 3 on stems $\frac{1}{2}'$–2′ long; usually level topped, 3-8 flowered; perigynia ovoid or triangular-obovate, nerveless, lightly pubescent, green or turning to brownish with age, with an abrupt flattish bidentate beak, usually covered by the ovate pointed scale.

Dry or sandy soil and rocky places. Common. May, June.

The umbel-like clusters of pistillate spikes suggest the name of this species. They are often half concealed by the leaves.

Var. vicina *Dew.* A form with 1 or 2 fertile spikes at the base of the sterile spike.

It is found with the typical form.

85. Carex Pennsylvanica *Lam.*

Stoloniferous; stems 6′–18′ high, slender, erect or spreading, rough or smooth, basal sheaths purplish or dull brown, fibrillose; leaves mostly about the length of the culm but sometimes exceeding it, $\frac{1}{2}''$–$1\frac{1}{2}''$ wide, rough-margined, bright or dull green, erect or diffuse; staminate spike club-shaped, 5″–9″ long, usually sessile, scales oblong obtuse or pointed, brown, or blackish brown; pistillate spikes 1–4, usually 3, globular or oblong, densely or loosely flowered, the upper 2 contiguous, sessile, the lowest 2″–6″ distant, sessile or slightly stalked, bracts scale-like acute or bristle-tipped, or sometimes the lowest leaf-like and 9″-18″ in length; perigynia subrotund or obovate, obtusely angled, densely or lightly pubescent, indistinctly nerved, abruptly contracted at the base, and narrowed above into a short bifid beak, covered by the ovate acute or acuminate, dark purplish or light brown scale.

Dryish soil in woods, copses or open places. Very common. May, June.

Var. separans *Peck.* Pistillate spikes 1–3, usually 2, the uppermost approximate to the short-stalked dark-brown sterile spike, the lowest 5″–10″ distant; perigynia with a longer and more slender beak; otherwise like the type (Var. distans, Report 46, p. 51).

Along or within the borders of woods. Jefferson and Otsego counties. June.

Var. gracilifolia *Peck, n. nom.* Leaves long and slender, $\frac{1}{2}''$–$\frac{2}{3}''$ wide, sometimes slightly involute and almost capillary, about equaling or sometimes considerably surpassing the slender culm. (Var. angustifolia l. c.)

Light or sandy soil in woods or open places. It often grows in tufts. This variety is common on Long Island. May.

Because of the frequent previous use of the varietal name under which this plant was published it is thought best to give it a new name.

Var. glumabunda *Peck, n. var.* Stems 8′–18′ high, rather weak and often somewhat drooping, frequently growing in definite tufts; pistillate spikes mostly short and sessile as in the type, but sometimes the lowest 3″–8″ long, conspicuously stalked or on a capillary peduncle 2′–8′ long which issues from the axil of the uppermost leaf, the others near the staminate spike and contiguous to each other or the lower sometimes 4″–6″ distant, these occasionally sterile and acute at the apex; scales conspicuously brown or blackish brown, oblong-ovate or lanceolate, sharp-pointed or cuspidate, longer than the perigynia and widely spreading at maturity. (Forma paleacea in part, l. c.)

Sandy soil. Albany and Suffolk counties.

Very rarely a second long-peduncled spike issues from the axil of one of the lower leaves. In all these varieties the bract of the lowest sessile spike is sometimes longer than its spike and green or foliaceous.

86. Carex varia *Muhl.*

Stems 6′–18′ high, rather stout, erect or spreading, roughish above the middle; basal bracts bright purple, fibrillose; leaves mostly shorter than the culm, 1″–2″ wide, rough; staminate spike clavate, 4″–12″ long, sessile or short-stalked, tawny or brown; pistillate spikes 2–5, usually 3, globular or oblong, sessile or sometimes the lowest short-peduncled, all separate or the upper 2 occasionally contiguous, each with a scale-like bract or the lower 2 subtended by leaf-like bracts ½′–2′ long; perigynia subrotund or obovate, pubescent, abruptly contracted into a short bifid beak, covered by the ovate, pointed, pale-greenish, whitish or tawny-brown scale. (C. communis Bailey, Gray's Man., 6th ed.)

It is noteworthy that the smallest plants often have the long staminate spikes, and commonly the tall plants the short spikes which are 4″–6″ long. In his description of this species Muhlenberg remarks, "variat spica mascula abbreviata et elongata." No other species in this group is known to have such a variable staminate spike.

In some of its forms C. Pennsylvanica approaches this species, but the absence of creeping rootstocks, the paler scales of the pistillate spikes and the more constant green foliaceous bract of the lowest spike will distinguish this plant. The scale of the pistillate spike is often entirely whitish or scarious except the green midrib. The species is found chiefly in hilly or rocky places in loose or gravelly soil. It seems to avoid sandy soil. It matures its fruit in May and June.

The name C. varia *Muhl.* formerly applied to this species was referred by Prof. Bailey to C. Emmonsii *Dew.*, and in its place he substituted C. communis *Bailey.* This name was discarded in the List of Plants of Northeastern North America, and C. pedicellata *Britton* adopted in its stead.

87. Carex Emmonsii *Dew.*

Stems capillary, 3′–15′ high, suberect or procumbent, smooth; basal sheaths dull purplish-brown, mostly green at the extremities, slightly fibrillose; leaves lax, about ½″ wide or more, flat, rough-margined, shorter than the culm or sometimes surpassing it; staminate spike slender, subclavate, sessile about 3″ long, acute or obtuse, commonly pale, but dark brown in the variety; pistillate spikes 2–4, ovoid, sessile, the upper 2 contiguous, the other distinct, densely 3–8 flowered, each with a scale-like bract, the lowest often bristle-tipped, or rarely leaf-like; perigynia triangular-oval, pubescent, with a long slender base, contracted above into a narrow, oblique, bifid beak, usually about the length of the body; scale ovate-oblong, pointed, whitish, barely tinged with brown, as long as the perigynium.

Commonly in dry places but sometimes in low wet soil. Common. May, June.

The species is easily recognized by its weak reclining or prostrate stems, contiguous or approximate pistillate spikes and short, narrow, sessile, staminate spike.

Var. distincta *Howe n. var.* Light or glaucous green; staminate spike linear ½″ wide, 2″–5″ long; pistillate spikes distinct, 2″–5″ apart, the lowest with a green bract 2–4 times the length of the spike, 3–5 flowered; perigynia obovoid, minutely pubescent, with a rather short, straight or oblique bifid beak, about the length of the acute white scale.

This variety seems to be intermediate between the type and C. Novæ-Angliæ.

Var. colorata. Differs from the type only in its dark purple scales, which give a much darker color to the spikes than in the type. Common in Westchester county. It is C. varia *Muhl.* var. colorata *Bailey* in the Manual.

89. Carex Novæ-Angliæ *Schw.*

Stoloniferous; stems 4′–12′ high, slender, diffuse or erect, slightly rough above the middle, usually purple and a little fibrillose at the base; leaves mostly shorter than the culm, ½″–1″ wide, flat, erect or spreading, rough-margined, bright green; staminate spike linear, 3″–6″ long, ½″ wide, short-peduncled or subsessile, light brown; pistillate spikes 1–3, ovoid, densely flowered, the upper 2 contiguous, or sometimes 3″–6″ apart, sessile or the lower one on a short pedicel, each with a scale-like awned bract longer than the spike, the lowest distant, conspicuously stalked, subtended by a green filiform bract nearly or fully equaling the culm; perigynia triangular obovoid, slightly pubescent, tapering to a short base and abruptly contracted above into a short, slender, bidentate beak, mostly covered by the ovate acute or pointed whitish scale.

Damp soil in shaded hilly places. Rare. Rensselaer county. June.

The distant lowest pistillate spike with its long slender green bract and the very narrow short-peduncled staminate spike are noticeable features of this species.

90. Carex Peckii *Howe.*

Strongly stoloniferous; stems 3′–18′ high, slender, erect or spreading, smooth, purplish and lightly fibrillose at base; leaves mostly much shorter than the culm, 1″–$1\frac{1}{2}$″ wide, open and flat, soft, erect or spreading, rough-margined, bright green; staminate spike linear, $1\frac{1}{2}$″–3″ long, sessile, often invisible, scales brown, white-margined; pistillate spikes 2–3, ovoid, sessile, 2–8 closely flowered, the upper two crowded, usually concealing the staminate spike, each with a green setaceous or short-awned, divergent bract mostly not longer than the spike, the lowest $1\frac{1}{2}$″–2″ distant, subtended by a green divergent bract about twice the length of the spike; perigynia triangular-elliptical, $1\frac{3}{4}$″–2″ long, $\frac{3}{4}$″ broad, hairy, with an evenly tapering base and a short bidentate beak, longer than the ovate acute or cuspidate whitish or brownish scale; achenium exactly elliptical, $\frac{1}{2}$″ wide, substipitate, the style deciduous at its base.

Dry soil in woods and open places. May, June. Albany, Essex, Jefferson, Cayuga and Yates counties.

This is C. Emmonsii *Dew.* var. elliptica *Boott.*

91. Carex deflexa *Hornem.*

Densely tufted; stems 2′–6′ high, capillary, curved, diffuse, smooth; basal bracts acute or cuspidate fibrillose, dull brown or purple; leaves shorter or longer than the culm, $\frac{1}{2}$″–1″ wide, smooth, open and flat; staminate spike small and inconspicuous; pistillate spikes 1–3, usually 2, contiguous, 2–6 flowered, 1″–$1\frac{1}{2}$″ in length and thickness, green or brownish, the lowest slightly peduncled with a green filiform bract 2″–4″ long; radical spikes occasional; perigynia pyriform, tri-costate, thinly pubescent, contracted above into a short, flat, slightly curved or oblique beak, a little exceeding the ovate acute or acutish, green and purple glume.

Adirondack mountains. July.

It forms small dense tufts, the short capillary stems often being prostrate at maturity, the longer leaves partly concealing the fruit; or, they are suberect, and the spikes drooping; by which, and the apparent absence of the sterile spikes, this delicate species may be readily known.

Var. Deanei *Bailey*. Stems 6′--12′ high, mostly longer than the leaves; staminate spike 2″--3″ long, less than ½″ wide, often oblique; pistillate spikes 4--8 flowered, 2″--3″ apart, the lowest conspicuously stalked, its bract leaf-like and longer than the culm; radical spikes few or numerous.

Adirondack mountains.

92 Carex Richardsonii *R. Br.*

Stoloniferous; stems 4′--9′ high, stiff, erect or recurved-spreading, rough; basal bracts dull purple or tawny; leaves shorter than or as long as the culm, 1″--1½″ wide, smooth, rough-margined, their extremities often involute, stiff, erect or recurved-spreading; staminate spike clavate, about 1′ long, on a short stalk or subsessile, conspicuously mottled; pistillate spikes 1--2, 3″--9″ long, densely flowered, approximate, erect, the lowest on an included stalk, its sheath (or bract) 6″--9″ long, acute or acuminate, usually covering the lowest scale, dark purple or brown; perigynia subglobose or obovoid, thickly pubescent, obscurely nerved, with a long tapering base, contracted above into a short point with an entire or erose orifice; scale ovate-oblong, obtuse, purplish-brown with scarious margins.

Dry ground. Rare. Monroe county.

This species seems to be quite local. It is, however, well marked by its purplish bracts and by its spikes appearing as if spotted with purple or brownish-purple.

93. Carex pubescens *Muhl.*

Stems 1°–2° high, erect, hairy; leaves shorter than the culm 1½″–2½″ wide, pubescent, dull green; staminate spike subclavate, on a peduncle 3″–6″ long, erect, tawny; pistillate spikes 2–4, oblong or short-cylindrical, subdensely flowered, 5″–9″ long, approximate, the upper 2 sessile or nearly so, the lowest on stalks 3″–6″ in length, all erect; bracts conspicuous, the upper setaceous, the lowest leaf-like, 1′–2′ long; perigynia acutely triangular-obovate, densely hairy, 2″ long, $\frac{3}{4}$″ wide, obscurely nerved, with a prominent bifid beak, a little longer than the oblong-ovate, cuspidate white scale.

Wet, grassy places. Common. June.

It is distinguished from the other species of this group by its larger size and general pubescence.

Staminate spike single, stalked, often fertile at the apex; pistillate spikes 3–5, cylindrical, densely or loosely flowered on a straight or flexuous rachis, all on filiform more or less drooping peduncles; bracts sheathing, longer or shorter than the culm; perigynia obtusely or sharply triangular ovate or fusiform with a long tapering beak, slightly inflated.

Pistillate spikes densely flowered	1
Pistillate spikes loosely flowered	2
1 Spikes clavate or cylindrical, green, perigynia sharply angled	prasina.
1 Spikes cylindrical, fulvous, perigynia obtusely angled ...	castanea.
2 Perigynia short-stalked	arctata.
2 Perigynia sessile	3
3 Perigynia tapering into a long beak	debilis.
3 Perigynia contracted into a rather short beak	glabra.

94. Carex prasina *Wahl.*

Stems 15′–30′ high, slender, often diffuse, slightly scabrous on the acute angles; leaves shorter than the culm, rough at the summit and on the margins, $1\frac{1}{2}$″ wide or less; staminate spike cylindrical or club-shaped, 1′–$1\frac{1}{4}$′ long, on a filiform peduncle $\frac{1}{4}$′–1′ in length, mostly drooping, often with a few pistillate flowers at the apex; pistillate spikes 3–4, cylindrical, $\frac{1}{2}$′–$1\frac{1}{2}$′ long, densely flowered or loosely flowered at the base, on filiform nodding stalks, the upper 2 or 3 approximate, the lowest remote on a peduncle $1\frac{1}{2}$′–$2\frac{1}{2}$′ in length; bracts leafy, the lower ones usually surpassing the culm, the upper 1 or 2 often slender, scarcely exceeding the spike; perigynia acutely triangular, few-nerved, tapering each way from below the middle, terminating above in a short, smooth, minutely-notched or entire beak, exceeding the oblong-ovate, acute or cuspidate white scale; achenium triangular-elliptical, apiculate.

Moist or wet fields and woods. Common. May, June.

The pistillate spikes, when fresh, are pale green and more densely flowered than in any of the other members of this group.

This is C. miliacea *Muhl.* of the older botanies.

95. Carex arctata *Boott.*

Stems 1°–2° high, slender, erect-spreading or diffuse, smooth, somewhat stoloniferous, basal bracts dark purple; leaves mostly shorter than the culm, radical leaves numerous, $1\frac{1}{2}''$–$5''$ wide, smooth, rough-margined; staminate spike linear, $6''$–$9''$ long, its filiform stalk $5''$–$8''$ in length, often inconspicuous; pistillate spikes 3–5, $\frac{1}{2}'$–$1\frac{1}{4}'$ long, loosely flowered on a flexuous rachis, all on drooping peduncles $\frac{1}{2}'$–$3'$ long, scattered, or the upper 2 approximate, the highest usually extending above the staminate spike, the lowest remote; bracts leafy, sheathing, or the upper mostly filiform equaling or extending above the culm; perigynia ovate, stipitate, nerved, obtusely angled, tapering to a short bidentate beak, longer than the white, acute or cuspidate scale; achenium obovoid, apiculate.

Woods and shaded banks. Common. May, June.

The stipitate perigynia constitute a distinguishing feature of this species.

C. arctata × castanea *Bailey.* Pubescent; spikes $1''$ wide, loosely flowered, green or yellowish, somewhat approximate, erect-spreading or drooping; perigynia ovate, nerved, hairy, with a short bifid beak a little exceeding the acute whitish scale. (C. Knieskernii *Dew.*) In the List of the Plants of Northeastern North America this stands as C. arctata × formosa *Bailey.*

96. Carex debilis *Mx.*

Stems 1°–$2\frac{1}{2}$° high, slender, erect or spreading, smooth, sometimes stoloniferous; leaves shorter or longer than the culm, $1\frac{1}{2}''$–$2''$ wide, spreading, rough; staminate spike linear, pistillate at the summit, short-stalked or subsessile; pistillate spikes 3–5, linear or narrowly cylindrical, loosely flowered on a flexuous rachis $1'$–$3'$ long, the 2 or 3 upper approximate on drooping stalks $\frac{1}{2}'$–$2'$ in length, or the highest nearly erect, the lowest remote, pendulous on a penducle $2'$–$3'$ long, rarely branched at the base; bracts leafy, sheathing, exceeding or equaling the culm; perigynia fusiform, nerved, $3''$ long, tapering into a long slender hyaline bifid beak, twice the length of the obtuse or acutish white scale; achenium exactly elliptical, stipitate, apiculate.

Fields and woods. Very common. June, July.

The species is distinguished by its long flexuous fertile spikes and its spindle-shaped perigynia.

Var. strictior *Bailey*. Stems taller and mostly erect; leaves firmer, 2″ wide, spikes stiff and erect or erect-spreading; perigynia deep green, a little longer than the scale.

Var. interjecta *Bailey*. Stems tall, erect; pistillate spikes nearly erect, often compound at base, alternately flowered; perigynia shorter than in the type. Differs from the last in its narrower leaves and more loosely flowered spikes.

97. Carex glabra *Boott.*

Stems 1°–2° high, slender, erect or somewhat spreading, smooth; basal bracts dark purple; leaves about the length of the culm or less, 1″–1½″ wide, rough, bright green; staminate spike linear, 1′ long or more, short-peduncled, often fertile at the apex; pistillate spikes 3–4, cylindrical, flexuous, subloosely flowered, 1′–1½′ long, the upper 2 approximate, the lowest remote, all on filiform drooping peduncles 1′–6′ long, or the uppermost short-stalked and suberect; bracts leafy or the upper ones filiform, sheathing, usually exceeding the culm; perigynia narrowly oblong-elliptical or lanceolate, nerved, 2½″–3″ or more in length, gradually tapering into an empty sharply bidentate beak, twice the length of the obtuse brown-margined scale.

Wet places. Rare. June, July. Oneida and Otsego counties.

The few flowered slightly flexuous fertile spikes and the large perigynia are characteristic of this species, which approaches C. debilis in appearance.

98. Carex castanea *Wahl.*

Stoloniferous; stems 1°–2° high, erect, acutely angled, lightly pubescent, basal bracts dull brown, pubescent; stem leaves 1′–3′ in length, the radical half as long as the culm or more, 1½″–2″ broad, soft-hairy, conspicuously veined, glaucous or fulvous-green; staminate spike clavate, usually acutish at each end, 6″–9″ long, on a stiff stalk ½′–1′ in length, bright brown; pistillate spikes 2–4, oblong, or cylindrical, densely flowered, sometimes sterile at the apex or base, ½′–1′ long, 2″ wide, the upper 2 or 3 aggregated on drooping stalks $\frac{1}{2}'$–$1'$ in length, the lowest distant and pendulous; bracts variable, the lowest leafy, $2'$–$3'$ long, sheathing, the upper setaceous; perigynia ovate-lanceolate, $2\frac{1}{2}''$ long, turgid, 2-ribbed, obscurely nerved, spreading, tapering into a long smooth or roughish, mostly entire beak, about one-third longer than the acute, fringed, brown scale.

Very rare. May, June. Oneida and Herkimer counties.

Well marked by its glaucous leaves, and its short, yellowish or brown spikes, the upper subtended by setaceous bracts. This is C. flexilis *Rudge* in the older botanies.

Perigynia moderately inflated.

Staminate spikes 1–4, the terminal stalked; pistillate spikes 2–5, sessile or short-stalked (the lower ones long-stalked in 99), approximate or distant, ovoid, oblong or cylindrical; bracts leafy, longer or shorter than the culm; perigynia ovoid or oblong-conic, nerved, smooth or pubescent, somewhat coriaceous in texture, with a short bifid beak.

	Perigynia scabro-pubescent........................	scabrata.
	Perigynia smooth or granular, pistillate spikes distant, purple..	polymorpha.
	Perigynia pubescent	1
	Perigynia smooth or slightly rough, spikes not purple..	2
1	Pistillate spikes cylindrical, leaves involute	filiformis.
1	Pistillate spikes cylindrical, leaves not involute.......	3
3	Leaves and bracts exceeding the culm..............	lanuginosa.
3	Leaves and bracts shorter than the culm............	4
4	Spikes ovoid or oblong, approximate.................	vestita.
4	Spikes oblong-cylindrical, distant....................	Houghtonii
2	Pistillate spikes $6''$–$12''$ long, $2''$–$4''$ wide, leaves involute,	striata.
2	Pistillate spikes $2'$–$3'$ long, $4''$–$5''$ wide, leaves flat....	riparia.

99. Carex scabrata *Schw.*

Stems $1°$–$2°$ high, rather stout, rough on the angles; leaves numerous, the upper ones surpassing the culm, $2''$–$3''$ wide, rough, light-green; staminate spike clavate, $6''$–$9''$ long, its peduncle $2''$–$6''$ in length; pistillate spikes 3–5, cylindrical, densely flowered above, thinly at the base, approximate or scattered, the upper 2 sessile and erect, the others on erect or spreading stalks $\frac{1}{2}'$–$2\frac{1}{2}'$ in length; bracts leafy, sheathless or sometimes the upper ones short-filiform, the lowest surpassing the culm; perigynia ovoid, nerved, slightly turgid, scabro-pubescent, contracted into a short obliquely toothed beak, exceeding the ovate acute or cuspidate brown scale; achenium obovate, acutely triangular.

Scattered or in patches along streams and in wet places. Common. June.

A rather coarse but bright-green species with the fertile spikes of a bristly or squarrose appearance when mature. It is somewhat stoloniferous.

100. Carex filiformis *L.*

Stems 1°–3° high, slender, erect, obtusely angled, mostly smooth; basal bracts 1′–2½′ in length, pointed, purplish-brown, more or less fibrillose; leaves 1″–1½″ wide, carinate, prominently grooved, smooth, rough margined, becoming doubled or involute when dry, shorter than the culm, the radical ones numerous and longer; staminate spikes 1–3, rarely 4, clavate or cylindrical, 1′–2′ in length, on a slender peduncle 1′–2½′ long, subtended by a scale-like, bristle-tipped, or short setaceous bract; pistillate spikes 1–4, usually 2, cylindrical, densely flowered, or sometimes loosely at the base, subdistant or remote, sessile, or the lowest short-stalked, often staminate at the apex, ½′–1½′ in length; perigynia obtusely triangular, ovoid, nerved, of a thick coriaceous texture, densely pubescent or tomentose, slightly inflated, contracted into a short, sharply toothed beak, mostly covered by the ovate lanceolate, pointed or rough cuspidate brown scale, the latter usually widely spreading at maturity.

Swamps and wet meadows. Common. June, July.

This species may be recognized by the long sterile, and grayish fertile spikes, and by the usually erect, narrow, carinate leaves. It seems to prefer cold elevated swamps and bogs, though by no means limited to them.

101. Carex lanuginosa *Mx.*

Stems 1°–2° high, stout, erect, acutely angled, roughish above the middle; root stock somewhat creeping; leaves open and flat, smooth, 1″–1½″ wide, shorter than the culm; staminate spikes 1–3, ½′–1½′ long, on stiff peduncles ½′–1½′ in length; pistillate spikes 2–4, ½′–1′ in length, 2½″–3″ thick, densely flowered, cylindrical, the uppermost usually sessile, the lower distant on short stalks, or the lowest remote on a slender peduncle 1′–1½′ long, spreading or suberect, the others mostly ascending; bracts leafy, the lowest sheathing, longer or shorter than the culm; perigynia ovate, nerved, densely hairy, abruptly contracted into a short bidentate beak, about the length of the ovate cuspidate brown spreading scale.

Wet meadows, marshes and swales. Not rare. June.

This differs from the preceding in its open flat leaves, shorter bracts and stalked fertile spikes. The carinate or involute leaves of the former cause them to appear to be much more narrow than those of this species, which is considered by some to be a mere variety of C. filiformis.

102. Carex vestita *Willd.*

Stoloniferous; stems 1°--3° high, rigid, acutely angled, rough at the summit; basal bracts fibrillose; leaves 1″–1½″ broad, rough, shorter than the culm; staminate spikes 1--2, clavate, mostly sessile, ¾′--1¼′ long; pistillate spikes 2-4, ovoid or short-oblong, 5″--9″ in length, compactly flowered, approximate or distant, rarely remote, sessile, erect, frequently with a few staminate flowers at the apex; bracts leafy, as long as the spikes, or the lowest 1½′ long; perigynia ovate, nerved, densely hispid-pubescent, contracted into a short beak, the white orifice erose or slightly notched; scale ovate, cuspidate, brown with a white margin.

Wet or dry sandy places. Rather rare. Albany, Richmond and Suffolk counties.

It is credited by Dr. Torrey to the western counties of the State, but if there, it must be very scarce.

103. Carex polymorpha *Muhl.*

Stems 1°--2° high, stout, strict, acutely angled, smooth; leaves 1′--6′ long or more, 1″--3″ broad, smooth; staminate spikes 1--4, the terminal short or long-peduncled, clavate, ½′--1′ long, frequently with a few pistillate flowers at the base; pistillate spikes 1–2, usually cylindrical, densely flowered, occasionally sterile at the apex, ½′--1½′ long, on exserted erect stalks ½′--1′ in length; bracts leafy, sheathing, mostly as long as the spike; perigynia oblong-ovate, nerved, conspicuously turgid, minutely papillose or smooth, abruptly contracted into a slender purplish beak with an oblique, entire or slightly notched orifice, longer than the ovate, obtuse, dark purple scale.

"Western counties." Dr. Torrey in the N. Y. State Flora. It does not appear to have been collected in the State recently.

104. Carex striata *Mx.*

Stoloniferous; stems 15′–30′ high, stiff and erect, acutely angled, rough near the summit; basal bracts purple, fibrillose; leaves shorter or longer than the culm, 1″–2″ wide, the upper surface rough, involute when dry; staminate spikes 2–3, the terminal one 1′–2′ long, short stalked or subsessile, the lowest with a setaceous bract ½′–1′ in length; pistillate spikes 1–2, distant or remote, the highest sessile, the lowest short-peduncled, densely or subdensely flowered, 9″–18″ long, erect; bracts leafy, shorter or longer than the culm, or the highest about equaling it; perigynia oblong-ovate or subglobose, prominently nerved, smooth or roughish with a scattered pubescence, somewhat divergent, abruptly contracted into a short bifid beak with whitish teeth, about twice the length of the ovate, obtuse or acute, thin scale.

Wet places and boggy shores of ponds. Suffolk county. June.

Var. brevis *Bailey.* More slender, the leaves and bracts shorter and narrower (1″ wide), the fertile spikes narrower, the highest sometimes sterile at the apex and the perigynia pubescent; otherwise like the type.

105. Carex Houghtonii *Torrey.*

Stoloniferous; stems 1°–2° high, stiff, erect, acutely angled, rough at the summit; leaves shorter than the culm, 1″–2″ wide, rough-margined; staminate spikes 1–2, clavate, the terminal one on a stiff peduncle ½′–1′ long, the lowest often with a setaceous or bristleform bract as long as the spike or longer; pistillate spikes 1–3, cylindrical or short oblong, subdensely flowered, ½′–1′ long, subdistant, the upper two sessile, the lowest on an exserted stalk 3″–9″ in length, all erect; bracts leafy, sheathless, or the lowest short-sheathed, equaling or exceeding the culm; perigynia broadly ovate, prominently nerved, rough-pubescent, abruptly contracted into a short, slender, sharply toothed beak, a little exceeding the ovate pointed or rough-awned brown scale; achenium broadly obovate, minutely dotted.

Sandy soil. Rare. Essex and Saratoga counties. June, July. Sometimes the mature perigynia become reddish-brown or almost chestnut color.

106. Carex riparia *Curtis.*

Stoloniferous; stems 2°–3½° high, stout, acutely angled, rough above the middle, flaccid at the base; leaves longer than the culm, 2″–5″ wide, mostly smooth on the upper surface, rough beneath, erect or spreading, glaucous; staminate spikes 2–5, cylindrical, the highest 1½′ in length on a stalk 1′ long or less, the lowest with a setaceous bract 1′–1½′ long; pistillate spikes 2–4, densely flowered, or loosely at the base, cylindrical or clavate, 1½′–3′ long, 4″–5″ thick, distant, the uppermost subsessile, the others short-peduncled, all erect, or the lowest sometimes spreading; bracts leafy, equaling or exceeding the culm; perigynia oblong-conical, finely nerved, smooth, gradually tapering into a short conical bidentate beak, a little longer than the ovate-lanceolate, awned scale; achenium narrowly obovate, apiculate.

Bogs, swamps and wet places. Common. June.

This is readily determined by the large erect spikes and oblong-conical, finely-nerved, olive brown perigynia. It is C. lacustris *Willd.*

Staminate spikes 1–5, stalked or the lower ones sessile, rarely fertile at the apex; pistillate spikes 1–4, cylindrical or short-oblong, densely or subdensely flowered, subapproximate, distant or remote, sessile or nearly so, erect; bracts leafy, the lower short-sheathing or sheathless, mostly surpassing the culm; perigynia turgid, ovate-lanceolate, nerved, pubescent or smooth, with a long bifurcate beak, the teeth mostly recurved-spreading.

	Perigynia smooth	aristata.
	Perigynia hairy.....................................	1
1	Staminate spikes 1–2	hirta.
1	Staminate spikes 2–5..............................	trichocarpa.

107. Carex hirta *L.*

Stoloniferous; stems 8′–24′ high, slender, erect or spreading, smooth below the summit, obtusely angled; leaves shorter than the culm, or, in low forms, the radical surpassing it, 1″–1½″ wide, scabro-pubescent, densely hairy on the sheaths, light green; staminate spikes 1–2, cylindrical, ½′–1¼′ long, on a slender peduncle 1′–2′ in length, the lowest ½′ long and sessile; pistillate spikes 1–3, distant or remote, the highest sessile, the lowest on an included stalk ½′–1′ in length, erect, subdensely flowered, ¾′–1½′ long; bracts leafy, the lowest sheathing, surpassing the culm; perigynia ovate-oblong or lanceolate, prominently nerved, turgid, downy-pubescent, 3″ long, tapering into a long slender bifurcate beak, longer than the ovate rough-awned scale.

Introduced. Rare or local. Cayuga county. June, July.

It is separated from the next by its light green foliage and downy sheaths, and by its fewer, softer fertile spikes.

108. Carex trichocarpa *Muhl.*

Stems 2°–3° high, rigidly erect, acutely angled, smooth or hispid on the angles above; leaves stiff, rough, 2″–3″ wide, longer than the culm; staminate spikes 2–5, linear or subclavate, ½′–1½′ long, the terminal short-stalked, rarely with a few fertile flowers at the base or apex, the lowest, which is frequently the longest, with a bristleform bract, each tapering to an acute apex; pistillate spikes 2–4, distant, short-peduncled, or the highest subsessile, erect, cylindrical, closely flowered above, somewhat loosely at the base, 1′–2½′ long or more; bracts leafy, sheathless, longer than the culm; perigynia oblong-ovate, prominently nerved, hispidly pubescent, gradually tapering into a long bifurcate beak, the teeth sharp and spreading; scale ovate-lanceolate, thin, brown with scarious margins, shorter than the perigynium; achenium obovate, apiculate, smooth.

Marshes and wet places. Common. June, July.

Prominently marked by its 2–5 narrow acute sessile sterile spikes, and its rough-hairy, deeply cleft perigynia.

Var. imberbis *Gray.* A reduced form with rough sheaths, smooth perigynia and mostly longer scales.

109. Carex aristata *R. Br.*

Stems 1°–2½° high, erect, stout, acutely angled, smooth below the spikes; leaves longer than the culm, 1½″–3″ wide, smooth, rough on the margins, stiff, yellowish green; staminate spikes 1–4, club-shaped, the uppermost on a stalk ½′–1′ long; pistillate spikes 2–4, distant, the upper two sessile, the lowest on a short included stalk, densely flowered, 9″–24″ in length; bracts leafy, the lowest sheathing, mostly longer than the culm; perigynia oblong-ovate, smooth, prominently nerved, 3″–3½″ in length, gradually tapering into a long and slender bifurcate beak, the awn-like teeth recurved, a little longer than the ovate-lanceolate, hispidly-awned scale; achenium elliptical, apiculate, very minutely papillose.

Very rare. June. Jefferson county.

Staminate spike solitary; pistillate spikes cylindrical, pendulous; perigynia stipitate, lanceolate, finely and densely nerved, with a slender deeply cleft beak, strongly reflexed at maturity.

Perigynia with long, very strongly recurved teeth .. comosa.
Perigynia with long straightish or divergent teeth .. Pseudo-Cyperus.

110. Carex comosa *Boott.*

Stems 2°–3° high, robust, erect, acutely angled, flaccid at the base, rough above the middle smooth below; leaves surpassing the culm, 4″–5″ broad or more, rough toward the extremities; staminate spike cylindrical, 1½′–1¾′ in length, subsessile or short-stalked, with a filiform bract mostly exceeding the culm; pistillate spikes 3–5, 1′–2½′ long, 5″–7″ wide, compactly flowered, the upper two, or sometimes three, approximate, the lowest distant or remote, all on slender pendulous peduncles, frequently sterile at the apex; bracts leafy, sheathless, surpassing the culm; perigynia stipitate, lanceolate, densely nerved, gradually tapering into a long, slender bifurcate beak, the awn-like teeth strongly recurved; perigynia reflexed at maturity; scale lanceolate, bristle-tipped, a little shorter than the perigynium.

Shores and wet places. Common. July, August.

The strongly recurved teeth of the reflexed perigynia, the former as conspicuous at the time of flowering as at maturity, are characteristic of this species, which is closely allied to the next following one, of which, by some, it is considered a variety.

111. Carex Pseudo-Cyperus *L.*

Stems 2°–3° high, stout, sharply angled, smooth below the spikes, slightly flaccid at the base; leaves rough, 2″–4″ wide, much surpassing the culm; staminate spike cylindrical, 1½′–2½′ in length, short-peduncled, with a filiform bract one-half the length of the spike or more; pistillate spikes 2–5, compactly flowered, exactly cylindrical, 2′–3′ in length, usually one or more compound at the base and sometimes sterile at the apex, the upper ones mostly approximate and the lowest distant, all pendulous on filiform peduncles $\frac{1}{2}$′–2′ long; bracts leaf-like, sheathless, rough on both surfaces, much surpassing the culm; perigynia triangular-lanceolate, prominently nerved, smooth, stalked, gradually tapering into a short forked beak, the sharp teeth straight or spreading; scale lanceolate, rough-awned, about the length of the perigynia which are strongly reflexed at maturity.

Shores and wet places. Common. July, August.

Closely like the preceding when mature, but the spikes are more evenly cylindrical, and the teeth of the perigynia less spreading, and not so strongly recurved. Also, in its early stage it has been confounded with the next following species, which it resembles, but its longer spikes and peduncles should distinguish it.

Perigynia much inflated.

Staminate spike single (rarely 2), stalked, sometimes fertile at the summit or base; pistillate spikes 1–4, approximate, or the lowest distant and spreading, the upper subsessile and suberect or all on short stalks, spreading or drooping, densely flowered, squarrose.

Pistillate spikes erect, 3″ wide, perigynia 8-nerved ... Baileyi.
Pistillate spikes 6″ wide, perigynia 10-nerved .... tentaculata.
Pistillate spikes 5″–6″ wide, the lower drooping ...... hystricina.

112 Carex hystricina *Muhl.*

Stems 15′–24′ high, erect, acutely angled, rough above the middle or near the summit, smooth and flaccid at the base; leaves mostly surpassing the culm, $1\frac{1}{2}$″–3″ wide, rough above the middle and on the margins; staminate spike single (rarely 2), cylindrical, 1′–2′ long, mostly short-peduncled, light brown; pistillate spikes 2–3, oblong or cylindrical, densely flowered, $\frac{3}{4}$′–$1\frac{1}{2}$′ long, the lowest often with 1 or 2 short branches at the base, approximate, the uppermost subsessile and spreading, the others on short nodding peduncles; bracts leaf-like, with obsolete sheaths, much surpassing the culm; or the highest often filiform and about equaling it; perigynia ovoid or ovate-lanceolate, smooth, many-nerved, gradually tapering into a long, sharply toothed beak; scale, ovate-lanceolate, rough-awned, shorter than the widely divergent or horizontally spreading perigynia.

Wet places. Very common. June, July.

This species may be distinguished from the next by its longer-stalked drooping spikes and by its smaller, many-nerved perigynia. In cold, springy, sterile soil a small form occurs with only one or two fertile spikes which are erect and nearly sessile. The scales of the sterile spikes of this species and C. Pseudo-Cyperus are strikingly alike.

113. Carex tentaculata, *Muhl.*

Stems 18′–30′ high, erect or spreading, acutely angled above the middle, rough at the summit, mostly smooth below; leaves $1\frac{1}{2}''$–$3''$ wide, rough, longer than the culm; staminate spike linear, very rarely with an additional short spike at its base, $1\frac{1}{2}'$–$2\frac{1}{2}'$ long, short-peduncled; pistillate spikes 2–4, compactly flowered, ovoid-cylindrical, $1'$–$1\frac{1}{2}'$ long, the upper two contiguous, sessile or nearly so, erect or divergent, the others approximate or the lowest sometimes remote on a short stalk, horizontally spreading; bracts leaf-like, far surpassing the culm; perigynia turgid-ovoid, thin, about 10-nerved, widely divergent when mature, tapering into a long, slender, roughly-toothed beak, about twice the length of the linear-lanceolate, rough-awned scale; achenium ovoid, minutely papillose, with a long curved persistent style.

Wet places. Very common. June, July.

This species may be identified by the short-stalked, horizontally-spreading lowest spike, and by the spreading, slender beaks of the perigynia, which give to the spikes a coarse, comose appearance. The name C. lurida, *Wahl.*, is applied to this plant in the last edition of the Manual. Rarely the staminate spike is fertile at the apex.

Var. flaccida (*Bailey*). Smaller, with 2–4 loosely flowered, approximate, sessile spikes 1′ long or less; the fruit longer than in the type and less abruptly contracted into the beak; the spikes of a dull or reddish-brown color.

Var. parvula *Paine.* A diminutive form 5′–10′ high with one or two globose or ovoid sessile densely flowered reddish-brown spikes.

C. tentaculata x lupulina (*Bailey*.). Resembles C. lupulina, but is every way smaller; staminate spike stalked, pistillate spikes approximate, sessile, erect-spreading, dull yellowish or greenish; perigynia turgid-ovate, about 15-nerved, the long slender beaks widely divergent; scales with long rough awns shorter than the perigynia.

In a meadow bog in Poestenkill with the above-named species and C. hystricina, the latter being the most abundant.

114. Carex Baileyi *Britton*.

Stems 19′–20′ high, slender, erect, acutely angled, smooth or rough near the spikes; leaves 1″–1½″ wide, rough, longer than the culm; staminate spike linear, ½′–1′ long, short-stalked or sessile; pistillate spikes 1–3, compactly flowered, ovoid or exactly cylindrical, ½′–1¼′ in length, 2″–3″ thick, rigidly erect, sessile, or the lowest subsessile; bracts leaf-like, sheathless, far surpassing the culm; perigynia turgid-globular, about eight-nerved, evenly divergent, very abruptly contracted with a long, slender bidentate beak, a little exceeding the long, rough-awned scale; achenium triangular-elliptical, tapering to each end, minutely papillose, with a strongly curved style. (C. tentaculata var. gracilis *Boott*. C. lurida var. gracilis *Bailey*.)

Swamps and wet places. Adirondack mountains. July.

This slender handsome species bears but a slight resemblance to the preceding, of which it was long ago made a variety by Dr. Boott; nor have intermediate forms been found which might possibly connect it with that species. On the other hand, it has, since it was first discovered, maintained its perfect identity as a mountain-loving species. It does not appear to descend into the lower regions, where the other species is so common. Even dwarf forms of the allied species have their fertile spikes thicker than those of the most luxuriant forms of this, and the two maintain their distinctive characters when growing side by side and under similar conditions. The name C. montamans was given to this species in the manuscript of this Report, but owing to the delay in its publication it becomes necessary to substitute for it the earlier published name of Prof. Britton.

Pistillate spikes 9″–12″ broad, erect on stiff peduncles or the upper sessile; bracts prominently sheathing; perigynia 6″ long and 2″ broad, ascending. Spikes hop-like in appearance.

Pistillate spikes 1′–2′ long, achenia without prominent mammillate angles............................ lupulina.
Pistillate spikes 2′–3′ long, achenia distinctly mammillate on the angles................................ lupuliformis.

115. Carex lupulina *Muhl.*

Stoloniferous; stems 2°–3° high, erect, robust, acutely angled, smooth; leaves 3″–6″ broad or more, smooth, rough-margined, conspicuously nodose, reticulated on the upper surface, much surpassing the culm; staminate spike single (rarely two), cylindrical, 1′–3′ in length on a peduncle ½′–1½′ long; pistillate spikes 2–6, closely flowered, 1′–2′ long, 8″–10″ broad, the upper ones approximate, short-stalked or sessile, the others somewhat scattered and longer peduncled, or sometimes all sessile or nearly so, the lowest usually on a stalk ½′–1½′ long; bracts leaf like, prominently sheathing, much surpassing the culm; perigynia ovate-lanceolate, conspicuously stipitate, prominently nerved, thin, 6″–9″ long, erect-spreading, gradually tapering into a long bidentate beak, nearly twice the length of the lanceolate, awn-pointed scale; achenium triquetrous, sharply angled, stipitate, about 1½″ long, scarcely 1″ broad, tapering each way from the middle, the apex continuous with the persistent tortuous base of the style.

Swamps and water holes. Common. July.

Var. pedunculata *Dew.* Differs in its more scattered prominently peduncled spikes, its usually long-stalked sterile spike and the more divergent perigynia.

C. lupulina × retrorsa *Dudley.* Perigynia straw-colored, horizontally spreading; scale acute or short-awned.

116. Carex lupuliformis *Sartwell.*

Stems 2°–3° high, stout, smooth, usually stoloniferous; leaves longer than the culm, 3″–6″ wide, smooth, rough-margined; staminate spike clavate, 1½′–3′ long, often long-stalked; pistillate spikes 2–5, mostly 4, cylindrical, closely flowered, the upper 3 contiguous, sessile, the others short-peduncled, the lowest distant or remote on an exserted stalk ½′–1′ in length, all erect and stiff, 2′–3′ long, 9″–12″ broad or more; bracts foliaceous, sheathing, far surpassing the culm; perigynia ovate-acuminate, 5″–9″ long, much inflated, strongly nerved, thin, more or less spreading, tapering from a stalked base into a long cylindrical, bidentate beak, about twice the length of the ovate lanceolate, pointed or rough-awned scale; achenium nearly as broad as long, with a mammillate protuberance on each angle, and a long curved style. (C. lupulina var. polystachya *Schw.* and *Torr.*)

Marshes. Rare. Yates and Putnam counties. July.

The long spikes and peculiar achenia characterize this species.

Perigynia moderately or much inflated, ascending, divergent or deflexed.

Staminate spike single (rarely 2), clavate, stalked or sessile, rarely androgynous; pistillate spikes 1–5, globose, oblong or short cylindrical, sometimes sterile at the apex, compactly subdensely or alternately flowered, sessile or peduncled, erect or spreading, the upper contiguous or approximate, the others distinct or scattered or all scattered, green or yellowish-green at maturity; bracts leaf-like, with conspicuous or obsolete sheaths, erect or divaricate, longer than the culm; perigynia ovoid, lanceolate or awl-shaped, nerved, mostly smooth with a short notched or long bifurcate beak.

Spikes short-cylindrical, leaves involute	extensa.
Spikes globose or ovoid, distant, bracts sheathing	1
Spikes globose or oblong, contiguous above, bracts obsolete	2
1 Spikes 4–8, distant, perigynia awl-shaped	Collinsii.
1 Spikes subdensely or densely flowered, perigynia not awl-shaped	3
3 Leaves 2″–6″ wide	folliculata.
3 Leaves about 1″ wide	Michauxiana.
2 Spikes 3–8-flowered, leaves involute	oligosperma.
2 Spikes more than 8-flowered, leaves not involute	4
4 Perigynia deflexed when mature, its beak bent	flava.
4 Perigynia with a straight beak	5
5 Perigynia small, with a short, minutely notched beak	Œderi.
5 Perigynia much inflated, 6″–8″ long	6
6 Spikes 15–30 flowered, perigynia 25–30 nerved	Grayii.
6 Spikes 3–12 flowered, perigynia 15–20 nerved	intumescens.

117 Carex Grayii *Carey.*

Stems 12′–30′ high, stout, acutely angled above, smooth; leaves surpassing the culm, 2″–3″ wide, rough, light green; staminate spike linear or sub-clavate, 1′ long, often inconspicuous, sessile or short-peduncled; pistillate spikes 1–3, usually 2, densely flowered, globular, contiguous or subdistant the uppermost sessile, the lower short-peduncled, erect, 6″–9″ thick; bracts leafy, longer than the culm; perigynia turgid-ovate or ovoid, 25–30 nerved, 6″–9″ long, smooth, widely spreading and deflexed, tapering into a long bidentate beak, about twice the length of the broadly ovate, acute scale.

Wet places in the central and western part of the State, rare in the eastern part. July.

The large yellowish-green spikes, mostly contiguous and of a bur-like aspect, sufficiently mark this fine species. It is related to the next following species to which it has sometimes been subjoined as a variety. It is C. Asa-Grayi *Bailey.*

Var. hispidula *Gray.* Perigynia hispidly-pubescent. Greene county.

118 Carex intumescens *Rudge.*

Stems 15′–30′ high, slender, erect, acutely angled, smooth below the middle, sometimes with a few short stolons; leaves 1½″–3″ broad, rough, longer than the culm, dark green; staminate spike cylindrical, ¾′–2′ in length, subsessile or on a stalk ½′–1½′ long; pistillate spikes 1–3, 5–10 loosely or subdensely flowered (rarely 1–3 flowered), globular, contiguous or approximate, sessile or the lowest on a short stalk 3″–6″ in length, dark green, often becoming blackish in drying; bracts leafy, sheathless, much surpassing the culm; perigynia turgid-ovoid, 15–20 nerved, widely spreading, tapering into a long, smooth or roughish bidentate beak, about twice longer than the oblong-ovate cuspidate scale.

Wet places in fields or woods. Very common. June, July.

This species has more slender culms, darker foliage, fewer flowered spikes and fewer nerved perigynia than C. Grayii, to which it is closely related. It is quite variable. In shaded places there is a very slender form with one to three perigynia in a spike; also in open places there is a very slender form with two to three scattered spikes having one to five rather small perigynia in each. These sometimes assume a reddish-brown color even before maturity.

119. Carex folliculata *L.*

Stems 15′–30′ high, slender, erect, smooth; leaves 2″–6″ wide, rough beneath, the lowest short and long-sheathing, the upper surpassing the culm; staminate spike small and often inconspicuous, ½′ long or more, sessile or short-peduncled; pistillate spikes 3–4, 10–20 subloosely flowered, globose-ovoid, 5″–8″ broad, approximate, distant or remote, the uppermost sessile, the lower on exserted peduncles ¼′–1′ long, all erect, green or tawny; bracts leafy, sheathing, longer than the culm; perigynia ovate-lanceolate, many-nerved, inflated, smooth, widely spreading, gradually tapering into a short bidentate beak, longer than the ovate rough-awned, white scale.

Swamps and wet places. Common. June, July.

The species is easily recognized by its short, lower stem leaves, and by its usually distant green or yellowish, subglobose spikes. On the sand plains west of Rome and in sphagnous marshes of the Adirondack region a short form occurs, having the pistillate spikes approximate, four of them being included in a space of 2½′–3′.

120. Carex Michauxiana *Bœckl.*

Stems 10′–20′ high, stiff, smooth; leaves exceeding the culm, 1″–1½″ wide, rough or sometimes smooth below the middle, yellowish-green; staminate spikes 3″–6″ long, sessile, mostly inconspicuous; pistillate spikes 1–3, densely flowered, globose-ovoid, the upper contiguous and sessile, the lowest distant or remote on an exserted peduncle ½′–1′ long, yellowish-green; bracts leafy, sheathing, longer than the culm; perigynia lanceolate, numerously nerved, inflated, smooth, erect, spreading or widely divergent, tapering into a short, slender bidentate beak, twice longer than the oblong, obtuse, light-brown scale. (C. rostrata *Mx.*, C. Michauxii *Schw.*)

Swamps and bogs. Adirondack region. July.

More slender than the last; spikes fewer, more densely flowered, with the perigynia shorter and more slender, and the scale much smaller and awnless. An occasional form has the lowest spike on a peduncle five or six inches long.

121. Carex Collinsii *Nutt.*

Stems 6′–20′ high or more, slender, erect, rough above the middle; basal bracts purple; leaves exceeding the culm, 1″–1½″

wide, rough, bright green; staminate spike linear, 3″ long ½″ wide, sessile; pistillate spikes 2–4, distant, sessile or the lowest on a short exserted peduncle, all erect, 4–8 loosely flowered, green; bracts leafy sheathing, longer than the culm; perigynia awl-shaped, finely nerved, smooth, slightly inflated, 6″ long, reflexed, with a long, slender, deeply cleft beak, the awn-like teeth deflexed at maturity; scale lanceolate, cuspidate, less than half the length of the perigynium. (C. subulata *Mx.*)

Swamps and wet places. Very rare. Long Island and Richmond county. June, July.

122. Carex oligosperma *Mx.*

Stems 15′–30′ high, slender, erect or somewhat spreading, slightly rough on the acute angles above; leaves as long as the culm, 1″ wide, becoming involute, smooth or rough-margined; staminate spikes 1 or 2, clavate, ½′–1½′ long, on stalks ¼′–1′ in length; pistillate spikes 1–2, globular or ovoid, 3–8 flowered, subdistant, the uppermost sessile, the lowest usually short-stalked, sometimes half staminate; bracts leaf-like, sheathless, shorter or longer than the culm; perigynia turgid ovate, 2″–2½″ long, 1½″ wide, prominently nerved, ascending, contracted into a short slender bidentate beak, longer than the ovate obtuse brown scale.

Bogs and marshes. Northern part of the State. July, August.

Conspicuously marked by its tall slender stems, involute leaves and few flowered, ovoid spikes.

123. Carex flava *L.*

Stems 1°–2° high, erect, smooth; leaves shorter than the culm, 1″–1½″ wide, mostly smooth, yellowish-green; staminate spike subclavate, about ½′ long, sessile or short-stalked, erect or oblique, sometimes small and inconspicuous; pistillate spikes 1–4, ovoid or globular, compactly flowered, aggregated and sessile or the lowest subdistant and short-peduncled, yellowish-green or fulvous; bracts leaf-like, sheathless, divaricate, longer than the culm; perigynia turgid-ovate, prominently nerved, smooth, tapering into a long, slender bent or recurved bidentate beak, strongly reflexed at maturity; scale oblong-ovate acute or obtusish, brown, much shorter than the perigynium; achenium short, triangular, obovate, apiculate, blackish-brown.

Bogs shores and wet places. Very common and variable. June to August.

A form sometimes occurs in which the staminate spike is fertile at the apex.

Var. graminis *Bailey*. Differs from the type in its much smaller size, longer leaves which exceed the culm, its mostly erect bracts, and in its smaller, usually straight perigynia. The beaks are deeply cleft as in the type and occasionally slightly rough.

This variety is not rare in the Adirondack region.

Var. fertilis *Peck n. var.* Stems 15′--20′ high, firm and erect, smooth; leaves 1½″–2″ wide; staminate spike invisible; pistillate spikes 4--5, ovoid or short-oblong, 5″--6″ long, 3″ wide, compactly flowered, the upper 3 aggregated, sessile, the lowest subdistant on a partly included stalk 3″--5″ in length; bracts short-sheathed, divaricate and recurved, 3′--8′ long, or the upper sometimes setaceous; perigynia yellowish-green with long rough beaks, a little longer than the oblong, acute deep brown scale.

Low moist ground. Dutchess county. June.

The staminate spike is apparently almost or wholly fertile.

124. Carex Œderi *Ehrh.*

Stems 5′–20′ high, slender, smooth; leaves mostly exceeding the culm, 1″ wide or more, smooth, yellowish-green, fading to fulvous when old; staminate spike 3″–9″ long, often androgynous, sessile; pistillate spikes 2–4, ovoid or short cylindrical, 3″–8″ long, densely flowered, aggregated, or the lowest subdistant, all sessile and erect, sometimes 1 or 2 proliferously branched at the base, yellowish-green; bracts leaf-like, erect, longer than the culm, or the upper sometimes setaceous; perigynia obovoid, straight, prominently nerved, divergent or ascending, contracted into a short bifid or slightly notched smooth beak, longer than the ovate acute thin brown scale; achenium triangular, obovate, apiculate, sharply angled, blackish-brown.

Wet places. Common, especially in the western part of the State. July, August.

This is easily separated from C. flava, to which it is closely allied, by its much smaller spikes and smaller perigynia with a shorter, straight, smooth, slightly notched beak. In the last edition of the Manual it is referred to C. flava as Var. viridula *Bailey*.

125. Carex extensa *Good.*

Stems 1°–2° high, slender but strict, smooth; leaves shorter than the culm or sometimes surpassing it, involute, smooth; staminate spike clavate, 8″–10″ long, subsessile; pistillate spikes densely flowered, ovoid or short cylindrical, 4″–9″ long, 2½″–3″ wide; the upper ones approximate, sessile, the lowest remote on a short partly included stalk; bracts like the leaves or the uppermost often setaceous, the lowest sheathing, surpassing the culm; perigynia ovate, prominently nerved, ascending or widely divergent, gradually tapering into a short bifid beak, longer than the ovate acute or obtuse mucronate deep-brown scale; achenium elliptical, substipitate.

Introduced and local. Coney Island and Long Island.

Distinguished from the last by its stiff involute leaves, less approximate spikes and larger, firmer perigynia.

Spikes 1–4, the upper half or more of the terminal one fertile, sterile below, the others fertile, densely flowered; perigynia long-beaked, squarrose at maturity.

126. Carex squarrosa *L.*

Stems 1½°–3° high, stiff and erect, acutely angled, smooth; leaves surpassing the culm, 1½″–4″ wide, lax and spreading, smooth, or rough above the middle; spikes 1–4, ovoid or cylindrical, densely flowered, 6″–12″ long, 4″–6″ wide, usually approximate, short-peduncled, or the lowest on a stiff stalk ½′–1′ long, all erect, the terminal one pistillate above, staminate below; bracts leafy, longer than the culm, or the uppermost sometimes not exceeding its spike; perigynia turgid, obovoid, lightly few nerved, thin and papery, abruptly contracted into a long slender bifid beak as long as the body, the teeth short and thin, horizontally spreading at maturity; scale lanceolate, mostly concealed by the crowded perigynia; achenium elliptical.

Moist meadows and swales. Common. June, July.

This is a very distinct and peculiar species not closely related to any other in our limits.

Forma robusta *Peck.* Stouter, leaves firmer, mostly erect; spikes 8″–12″ long, 6″–7″ wide, 2′ apart, the lowest on a slender drooping pedundcle 2′ long.

Staminate spikes 1–4, short or long-stalked, often pistillate at the base or apex; pistillate spikes 1–5, cylindrical, usually densely flowered, the upper approximate (clustered in 127), sessile or short-stalked, erect or spreading, the lower sometimes drooping, or all distant, short-stalked or sessile, erect or ascending, sometimes sterile at the apex, straw-colored or tawny; bracts like the leaves, the lower sometimes sheathing, equaling or surpassing the culm; perigynia ovate or globular-ovoid, much inflated, nerved or nerveless, ascending or spreading (reflexed in 127) shining, with a prominent bidentate beak. (Spikes pendulous, loosely flowered and perigynia globular with a needle-shaped beak in 133.)

Perigynia large, 1½″–3″ wide	1
Perigynia small, less than 1½″ wide	2
1 Pistillate spikes 2 or more, ascending	Tuckermani.
1 Pistillate spikes 1 or 2, perigynia widely spreading	bullata.
2 Pistillate spikes less than 4″ wide	3
2 Pistillate spikes 4″ wide or more	4
3 Spikes erect or spreading	monile.
3 Spikes drooping	longirostris.
4 Spikes contiguous, perigynia reflexed	retrorsa.
4 Spikes approximate or distant, perigynia not reflexed,	5
5 Spikes distant	utriculata.
5 Spikes approximate or the lowest only distant	Schweinitzii.

127. Carex retrorsa *Schw.*

Stems densely clustered, 2°–3° high, firm and erect, smooth with obtuse angles; leaves much longer than the culm, 1½″–4″ wide, rough, bright green; staminate spikes 1–3, often slightly pistillate above or at the base, cylindrical, 1′–2′ long; pistillate spikes 3–5, densely flowered, cylindrical, 1′–2′ long or more, 4″–5″ thick, the upper contiguous and erect on short included stalks, the lowest sometimes distant or remote on a short or long partly drooping peduncle, one or more often compound at the base; bracts leaf-like, short-sheathing, or sometimes the uppermost filiform, all much surpassing the culm; perigynia ovoid, prominently few-nerved, thin, strongly reflexed, tapering into a long bidentate beak; scale short-lanceolate, usually invisible.

Wet places and water holes. Common. June, July.

Readily identified by the clustered spikes and reflexed perigynia.

Var. Hartii *Gray*. Slender; fertile spikes more or less distant, stalked, loosely flowered; perigynia slightly reflexed. (C. Hartii *Dew.*) This is regarded by Prof. Britton as a distinct species.

128. Carex Tuckermani *Dew.*

Stems 1½°–3° high, stout, the acute angles rough; leaves rough, 1½″–2″ wide, exceeding the culm; staminate spikes 1–3, cylindrical, 1′–1½′ long, on a stalk ½′–1′ in length, the lowest sometimes with a few pistillate flowers at its base; pistillate spikes 2–4, densely flowered, oblong or cylindrical, ¾′–2′ in length, 4″–6″ thick, rather distant, the uppermost sessile, erect-spreading, the remainder peduncled, the lowest sometimes remote and drooping; bracts leaf-like, sheathless, longer than the culm; perigynia large, ovate, prominently nerved, thin, 4½″–5″ long, 2½″–3″ thick, contracted into a slender bidentate beak, twice the length of the lanceolate acute or pointed scale.

Wet places in shaded stations or open fields. Common. June, July.

The rather short thick spikes and the large ovate shining perigynia are characteristic of this species. When very young the perigynia of this species and of C. intumescens, C. Grayii and some others with inflated perigynia are very pale or almost white.

129. Carex bullata *Schk.*

Stems 1°–2° high, slender, erect, acutely angled, rough above, smooth below the middle, dark purple and fibrillose at the base; leaves smooth or roughish, stiff, mostly erect, 1″–1½″ wide, about the length of the culm; staminate spikes 2–3, cylindrical or subclavate, ½′–1½′ in length on stalks 6″–9″ long; pistillate spikes 1–2, densely flowered, 6″–9″ (rarely 1′) long, 3″–5″ thick, sessile and erect, or, when 2, approximate or remote, the uppermost short-stalked or sessile, the lowest on a slender peduncle 1′ long or less, erect or slightly spreading; bracts leafy with obsolete sheaths, usually exceeding the culm; perigynia ovate, much inflated, nerved, thick, shining, widely divergent, tapering into a long, smooth or minutely roughened, bidentate beak, longer than the lanceolate acute or obtuse scale.

A very rare species but one well marked by its 1–2 short thick spikes, and its large shining widely divergent perigynia. No specimens of it are in the State Herbarium, but it is said to occur in Westchester county and in the valley of the Mohawk.

130. Carex monile *Tuckm.*

Stems 2°–3° high, slender, erect, rough on the acute angles above the middle; leaves longer than the culm, $1\frac{1}{2}''$–$2\frac{1}{2}''$ wide, rough at the top and on the margins, lax and somewhat spreading; staminate spikes 2–4, cylindrical or clavate, $1'$–$1\frac{1}{2}'$ in length, usually on a stalk 1′ long; pistillate spikes 1–3, densely flowered, cylindrical, $1'$–$2\frac{1}{2}'$ long, 3″–4″ thick, scattered, the upper ones sessile and erect or erect-spreading, the lowest on a slender spreading stalk $\frac{1}{2}'$–$1'$ in length, or sometimes sessile and erect; bracts leaf-like, with obsolete sheaths, far surpassing the culm; perigynia globose-ovate, much inflated, thin and papery, nerved, somewhat divergent, gradually tapering into a long bidentate beak, about twice the length of the acute or pointed scale.

Wet places, margins of streams, etc. Common. July.

It may be known by the slender stems and lax leaves, and by the 2–3 distant or remote, mostly erect, narrow, densely flowered spikes, and the globose thin shining perigynia. Forms sometimes occur with a single pistillate spike, and such forms having the spike unusually thick might easily be mistaken for C. bullata. The species is very common in the Adirondack region.

131. Carex utriculata *Boott.*

Stems 2°–4° high, stout, acutely angled above the leaves, smooth, flaccid, conspicuously reticulated below the middle; leaves surpassing the culm, 3″–5″ broad, nodulose-roughened, dark green; staminate spikes 3–4, the terminal one short stalked, the others sessile, $\frac{1}{2}'$–$3'$ in length, the lowest with a slender bract exceeding its spike; pistillate spikes 2–5, densely flowered, sometimes one or more staminate at the apex, cylindrical, $1\frac{1}{2}'$–$4'$ long, 4″–6″ thick, scattered, the upper sessile, the lower short-stalked, all erect or nearly so; bracts leafy, the lowest short-sheathing, far surpassing the culm; perigynia small, turgid-ovate, of a thick texture, few-nerved, divergent, abruptly contracted into a cylindrical, sharply-toothed beak, longer than the lanceolate acute or awned scale.

Swamps, bogs and margins of streams. Common. June, July.

The spikes are longer than in the last species, the perigynia are smaller and firmer. The species may be recognized by the nodose-netted stems and leaves. It is common in the Adirondack region where there are small forms, Var. minor *Boott*, with spikes scarcely more than 1′–1½′ long.

132. Carex Schweinitzii *Dew.*

Stoloniferous; stems 1°–2° high, erect, rough on the acute angles; leaves longer than the culm, 1½″–3″ broad or more rough, yellowish-green; staminate spikes 1–2, clavate, 9″–12, long on peduncles ½′–1′ in length; pistillate spikes 3–4, densely flowered, often loosely at the base, and sometimes compound, occasionally staminate at the apex, cylindrical, 1′–2′ long or more, 3″–4″ thick, approximate, mostly on short spreading stalks, or sometimes the lowest remote on a filiform nodding peduncle 2′–2½′ long; bracts leaf-like, short sheathing or not sheathing, longer than the culm; perigynia small, turgid-ovoid, few-nerved, thin, divergent, gradually tapering into a slender bidentate beak, nearly twice the length of the rough-awned scale.

Swamps and borders of streams. Oneida and Herkimer counties. Apparently rare or wanting elsewhere. June.

133. Carex longirostris *Torr.*

Stems 20′–30′ high, slender, erect, smooth; leaves shorter than the culm, 1½″–2″ wide, rough, light or glaucous green; staminate spikes 2–3, clavate, ½′–1′ long, short-peduncled, yellowish-white; pistillate spikes 2–5, loosely flowered, cylindrical, 1′–2′ long, distant, the uppermost short-stalked and mostly erect, sometimes half staminate above, the others on filiform, drooping peduncles 1½′–6′ in length; bracts leafy or the uppermost setaceous, the lowest barely sheathing, shorter than the culm; perigynia turgid-globular or globose-ovoid, 2-ribbed, nerveless, divergent, smooth, very abruptly contracted into a slender bifid beak longer than the body; scale lanceolate, whitish, often with a long awn-like point, equal to or a little shorter than the perigynia.

Dry rocky places in woods or clearings. Not common. June.

A form with spikes less than one inch long is Var. minor *Boott.*

(F.)

EDIBLE AND POISONOUS FUNGI OF NEW YORK.

The figures and descriptions of the "Edible and Poisonous Fungi of New York" here given have been prepared with a view to meet a growing and popular demand for information concerning a much-neglected department of economic botany, and to facilitate and encourage a more general acquisition of a knowledge of the natural food products of our State. Many who would gladly avail themselves of the agreeable and highly nutritious food afforded by our edible fungi are debarred from doing so by a lack of the knowledge necessary for a proper discrimination between the edible and the poisonous or worthless species. With this knowledge, the fear of the bad would no longer prevent the use of the good. With it many whose circumstances are such as to make it difficult or impossible to procure an adequate supply of animal food might often obtain a very good substitute for it by the slight labor of gathering it in the fields and woods.

European works on this subject are less satisfactory, because the species in this country are not wholly the same as in that. Some of them are not readily procurable because of their high price, others and cheaper ones are less desirable because of deficiency in the number or the character of their illustrations. It has been the purpose of the writer in his attempt to elucidate this subject to be satisfactorily profuse in illustrations. The plates are of such dimensions as to admit of figures of natural size in all except a single species. Whenever it was necessary a whole plate has been devoted to a single species. In nearly all cases the appearance of the young as well as of the mature plant has been shown, and in several instances well-marked varieties have also been illustrated. For the benefit of the botanical student the spores of each species have been figured, magnified to a uniform scale of four hundred diameters. A compound microscope and a micrometer are necessary to ascertain the shape and size of the spore.

Of each species a brief diagnosis or botanical description is first given for the use of botanists. This is followed by a more full description in plain and simple language which may readily be comprehended by the general reader. This description has been made as concise as was compatible with completeness and with the avoidance of technical terms. It is supplemented by a statement of the usual dimensions of the plant, its habitat or usual place of growth, its time of appearance, its qualities as an esculent and its relations or resemblances to other species.

Sixty-three edible species have been figured on thirty-nine plates, three poisonous ones on three plates and one unwholesome one on one plate. Of the sixty-three edible species, about forty have been tested as to their edible qualities by the writer. Of the remainder, all save four have been eaten without harm by some of his acquaintances or correspondents. The four unproved species have been recorded as edible by various writers and no word of suspicion has ever been raised against them, so that it may be asserted most confidently that no species here represented as edible is at all dangerous or deleterious if used with moderation and after proper selection and preparation. All the species are not equally sapid, tender or desirable, but any of them may be eaten with perfect safety, if collected in good condition and eaten in reasonable quantity. Nine of these species were first published as edible in the State Museum reports, seven having been proved by the writer, two by his friends.

Other species belonging to our flora have been classed as edible by various writers, but they are not included in the present work, because opportunity has not yet been found for a personal trial of their edible qualities or for making accurate figures of them. It is to be hoped that in due time it may be possible to include them in a supplementary publication which shall complete this work.

That there are dangerous species whose use as food should be most carefully avoided is an acknowledged fact, but the number of such species is far less than many suppose. According to the authority of those who have especially investigated this subject, the dangerously poisonous species found in this country all belong to a single genus, *Amanita*. About a dozen species of this genus have been found in our State, and of these, two are known to be harmless and edible, three or four only are commonly classed as poisonous, and probably a single one of these is responsible for a vast majority of the fatal accidents resulting from "mushroom poisoning." There are, however, some species in other genera that are capable of causing nausea, vomiting and derangement of the digestive organs. They are unwholesome because of their persistently bitter, acrid or otherwise disagreeable flavor, or because of toughness of texture or the possession of some quality repugnant to the stomach. They may indeed cause sickness and vomiting, but the irritation they induce is soon apparent and quickly causes the rejection from the system of the offending substance and then the normal condition of the system is soon restored. Sometimes recovery in such cases may be hastened by the administration of some simple emetic which will assist the stomach in its efforts to expel the unwholesome material.

The dangerous species do not appear to possess such irritating qualities. The symptoms of sickness do not appear till several hours after eating, generally eight to fifteen. Then the face exhibits an ashy paleness, there is distress in the region of the stomach, resulting in nausea, vomiting and relaxation of the bowels, the extremities become cold, the pulse feeble, the sight affected, and finally stupor and death follow if relief is not obtained. To this kind of poisoning, *atropine*, the active principle of *Atropa belladonna*, has been found to be an antidote. It has been administered in doses of $\frac{1}{180}$ to $\frac{1}{90}$ of a grain according to the severity of the case, and the dose may be repeated if necessary. It should be administered in subcutaneous injections.

For two thousand years or more people have made use of mushrooms for food and from time to time death has resulted from their use, either through ignorance or carelessness. Still men persist in their use, and those who would use them if they dared frequently ask how they may distinguish mushrooms from toadstools, the word "toadstools" indicating to them poisonous or harmful species. Many attempts have been made to answer this question and many rules have been formulated by the observance of which, it has been claimed, all difficulty and danger would be avoided. Some of these rules are entirely unreliable and to others there are so many exceptions that they are misleading and practically worthless. The rules vary according to the standpoint of the one proposing them. One who considers the Common mushroom the only edible species seeks to separate it from all others, and says "avoid all which have white gills and a hollow stem." This rule precludes the use of many mushrooms which are just as good as the one it sustains, and at the same time it is not definite enough to limit the selection to the one intended. Another, thinking of the Delicious lactarius which has an orange-colored juice, says "reject all such as have a white milky juice." This rule forbids the use of several species of lactarius that are no more harmful and scarcely less sapid than the Delicious lactarius. Again we are told by some one who has in mind the poisonous amanitas, to "discard all mushrooms that have a warty cap or a membranous sheath at the bottom of the stem." This would be a very good rule if we might add to it the sentence, unless you know the species to be edible and safe. The Orange mushroom, which is deemed an edible species of first quality, has a membranous sheath at the base of the stem, and the Reddish amanita has a warty cap and yet is not only harmless but very good, so that the rule which would forbid the use of these species excludes more than is necessary. The same may be said of those directions which require the rejection of all mushrooms having a viscid cap or an acrid taste or whose flesh on being broken quickly changes to a blue color. And as to the old-fashioned silver spoon test, by which it was thought that a silver spoon thrust among cooking mushrooms would be quickly tarnished if they were poisonous and remain bright if they were edible, that was long ago proved to be most unreliable by a fatal experiment in which several persons lost their lives because the cook put confidence it. We are, therefore, forced to conclude that no abstract rule is at present known by which the good can in every case be separated from the bad. The only safe and reasonable way to do this is *to learn to recognize each species by its own peculiar specific characters.* It is in this way that we recognize the useful and esculent species among flowering plants, and it must be in this way that we select our edible mushrooms. A little more care may be necessary in one case than in the other, because of a closer resemblance in some cases between good and bad mushrooms than between good and bad flowering plants. The principle that is to govern in this matter is the same in both cases. The greater the number of edible species clearly recognizable by any one the greater the field from which he may draw his supplies. If he is acquainted with but one species he should limit his use of mushrooms to that one species, unless he can avail himself of the more extensive knowledge of some one else or unless he is willing to take the risk of eating some poisonous or unwholesome species. In a few instances it is possible to affirm of certain groups of species or of certain genera, that no deleterious species are known in them. Thus we have in this State six species of morels and no morel is known to be poisonous. It is, therefore, possible for any one who is able to separate a morel from all other fungi, to eat morels with considerable confidence though he may not be able to distinguish one species of morel from another. The same may be said of puff balls. No harmful species is known among them, and he who can discriminate between puff balls and all other fungi does not incur very much risk in eating any puff ball of good flavor, though he may not be able to distinguish the species from each other. The probability is that he will suffer no harm by so doing, but there is not absolute safety. It is possible that some rare species exists having deleterious qualities which have not yet been ascertained by experiment, hence the lack of absolute certainty; for we know by experience among the amanitas that excellent edible species may exist in the same genus with and be closely related botanically to dangerously poisonous species. Therefore, those rules which say all morels, all puff balls, and all fairy clubs may safely be eaten are too sweeping, and would be better if modified by the words, "so far as known."

Many mushrooms have a farinaceous taste or odor, or both taste and odor are of this character. Some have thought that all species having this meal-like flavor are edible, and indeed many of them are, and no dangerously poisonous species is known to have it. But occasionally a species has this flavor combined with or followed by a bitter or otherwise disagreeable flavor which would at least render the mushroom undesirable if not unwholesome. So that rules designed to aid in the selection of edible species have their exceptions and their weak points as well as the rules designed to protect us against the poisonous species. There is, therefore, no escape from the necessity of acquiring a knowledge of each species we would utilize, sufficiently clear and exact to enable us to distinguish it from all others. Whatever value investigators and experimenters, who are willing to take some risks for the good of others, may find in such rules or general principles, it is evident that they are not sufficiently definite, exact and reliable for general use. To any one willing to avail himself of the experience of others and to apply himself sufficiently to learn to recognize the species they have found to be edible, nature opens a field productive of much palatable and nutritious food, which is too often left to decay where it grew.

But some care is necessary in the selection of specimens of species known to be edible. The plants selected should be in good condition. Well grown, sound, fresh specimens only should be chosen. Old, partly-decayed, water-soaked, worm-eaten or withered plants should be discarded. Even young and sound ones should not be kept too long before they are cooked. They are in some cases very perishable and deteriorate rapidly. If more have been collected at one time than are needed for a single meal it will generally be better to cook them all at once and keep them in a refrigerator in the cooked rather than in the raw state. As a rule it is better to cook them the same day they are collected. In the case of the inky fungi this will be absolutely necessary, for they will not keep in good condition from one day till the next. Some of the species literally grow up in a night and perish in a day. These also should be cooked with great promptness, for they are only desirable while young and before the gills have begun to change to a black inky liquid. Puff balls should only be used while the inner flesh is pure and white. When the yellowish stains of maturity begin to appear they are no longer fit for food. No one would think of eating them after the flesh has changed to the cottony dusty mass of maturity.

Many insects are fond of mushrooms. Both they and their larvæ feed on them and the latter often live in them. A mushroom may appear fair externally, but if it is cut or broken its flesh may be seen to be full of holes or galleries excavated by larvæ, and perhaps a colony of the larvæ themselves may be found within. It is needless to say that such specimens are unfit for food. Strange as it may seem, a colony of larvæ in the lower part of the stem of a mushroom will sometimes affect disastrously the flavor of the cap or upper part which they have not yet invaded. This fact may explain in part the varying opinions of different writers concerning the flavor and edible qualities of certain mushrooms. Slight differences in flavor may also be attributed to differences in the character of the soil in which they grow, the amount of moisture in the atmosphere, degree of temperature, age and rapidity of growth and to exposure to the sun and wind. Old and slowly-developed individuals are likely to be less tender than young and rapidly growing ones. Differences in individual tastes will also account in part for differences of opinion on this point. There are also peculiarities of constitution which have given origin to the saying, "What is one man's meat is another man's poison." One person can eat no egg, nor anything into which egg enters as an ingredient, without suffering or sickness. Another is made sick by eating strawberries, nevertheless egg and strawberries are not classed as poisonous. Still it is possible that some fungi as harmless as egg and strawberries may have been charged with poisonous qualities from some such accidental circumstance or individual peculiarity.

In collecting mushrooms for the table it is well, in all cases in which the stems are too tough for food, to cut the caps from the stems. In this way much dirt and useless material will be left where it belongs, and it will be possible in many cases to ascertain if the caps have been attacked by insects. Most often the larvæ mine their way up from the ground through the central part of the stem to the cap, and by cutting the cap from the stem their holes or galleries are exposed to view. In but few species are the stems sufficiently tender to be used. Some have recommended that the caps be placed in the collecting basket in an inverted position, for if placed in their natural position with gills downward they will drop their spores and their flavor will be impaired. It is very doubtful if this partial loss of spores affects the flavor in any appreciable degree. If more than one species should be taken during the same excursion it would be well to keep them separate from each other by wrapping each species in a piece of paper by itself. This precaution is not necessary if the species are so distinct in color, shape or size that they can readily be separated from each other at home, or if they are so similar in flavor and texture that they may be treated alike in cooking without any detriment to their esculent qualities.

Should a doubt arise at any time, concerning the identity of a supposed edible species, do not use such a mushroom until all doubt on this point has been banished. If it is thought desirable to compare the plant with the published figures and descriptions for the purpose of identifying the species, select for this purpose sound specimens which represent both the young and the mature forms, that all the specific characters may be shown. Take the specimens up carefully from their place of growth, removing all the loose dirt from the base of the stem. Wrap the specimens carefully in soft paper or large green leaves that they may be kept as fresh as possible till the time of examination. On reaching home, lose no time in making the examination for in some species there are evanescent characters which will not be available after a few hours' delay. In one family of fungi the color of the spores is an important character and a great aid in the identification of species. The color of the spores in many species is the same as or similar to the color of the mature gills, but there are so many exceptions that explicit directions for ascertaining their color will be given in another place.

In the preparation of mushrooms for cooking, the utmost cleanliness should be observed. Some have the upper surface of the cap covered with a sticky, viscid or glutinous substance when fresh. This often causes bits of dirt, leaves or sticks to adhere to the cap tenaciously. In such cases it is generally best to remove this rubbish by peeling the caps. In other cases the dirt may be wiped away with a damp cloth or towel, or washed off and then the surface dried with a towel. It is also well to peel those having a thick tough skin. In boleti, the stratum of pores on the lower surface of the cap is apt to form a mucilaginous or slimy disagreeable mass in cooking. It is, therefore, well to remove it before cooking. It is easily separable from the cap and can readily be removed by pressing it outwardly from the stem with a knife blade. In very large thick-fleshed specimens it is best to cut in slices or chop in small pieces.

The proper method of cooking will depend somewhat on the kind of mushroom, the tastes of those that are to eat them and the conveniences at hand. Many of them can be cooked in the same manner as a beefsteak. It is customary to cook them in a very simple manner, either by frying in butter or broiling gently with a little butter added and seasoning to taste. They may also be stewed or baked. The skillful cook will devise many ways of cooking them and various recipes will be found in cook books and in works on edible fungi. Too much cooking may spoil a mushroom as well as an oyster or a tender beefsteak. My efforts to make a tough mushroom tender by steaming have not been successful, but the experiments have not been numerous nor long continued. Species too tough to be eaten with pleasure or digested with comfort have sometimes been utilized by making of them a kind of soup or broth which could be eaten with relish and comfort. Sometimes mushrooms are used in small quantity to give flavor to meats or other dishes. Those of inferior flavor are sometimes made more agreeable by cooking with them a few specimens of some more highly flavored species. The same species may vary in flavor according to the method of cooking and the kind of seasoning used as well as by reason of the circumstances previously mentioned.

Mushrooms may be dried and kept for future use. The best method of drying them is to place them in a current of warm air. Dry them as quickly as possible without burning them, and keep the drying process in operation till completed. A common fruit evaporator would doubtless be a good instrument for drying them. The drying of thick and moist ones would be facilitated by cutting them in slices.

The general opinion is that mushrooms constitute a very nutritious and sustaining diet. Chemical analysis and personal experience indicate this. The former has shown that in their dry matter they contain from twenty to fifty per cent. of protein or nitrogenous material. They may, therefore, well be called a kind of vegetable meat and be used as a substitute for animal food. Like other vegetables, they are largely composed of water, which is from eighty to ninety per cent. of the whole. In consequence of this they shrink greatly in drying and lose much weight. The presence of so much nitrogenous material induces rapid decay and loathsome decomposition in them. It should also teach moderation in their use as food. A hearty meal on mushrooms alone would be about as reasonable as a dinner on nothing but beefsteak, and might be expected to be followed by similar ill consequences. Gormandizing is not commendable under any circumstances nor with any kind of food. But especially should it be avoided in mushroom eating, for the human system demands but small quantities of the nitrogenous elements which enter into its composition. An excessive amount is sure to be hurtful, but eaten in moderate quantity it is easily digestible, acceptable and beneficial. The digestive organs of the writer are not strong by nature and are easily affected by unfavorable treatment or indigestible substances, yet he has never experienced any discomfort from eating mushrooms. He has eaten them frequently, partaken of many different species, and experimented with a considerable number of species not classified as edible. The explanation is simple. They have always been eaten in moderate quantity. In my opinion, cases of sickness and digestive derangement that have been attributed to poisonous properties of mushrooms are sometimes really due to the excessive use of species that otherwise are perfectly harmless.

In some countries where edible fungi are commonly and extensively employed as food, even species which we regard as unwholesome are utilized. They are soaked in vinegar or in salt water for the purpose of destroying or rendering inert their noxious properties. They are then carefully washed and thrown into hot water for a short time, after which they are treated in the usual way. This practice is not recommended. Aside from the danger arising from the inefficiency of the treatment in some cases, it is very improbable that any mushrooms so treated would still retain a very agreeable flavor. There is, besides, no need of running any risks with doubtful or suspected species, for the number of those known to be good and safe is sufficiently great to satisfy all reasonable demands. Possibly the time may yet come when the noxious properties of poisonous mushrooms may be utilized with advantage in medicine, but such species should not be used as food. He who is too ignorant to recognize with confidence the species known to be good, would better abstain rom such food entirely unless he can avail himself of the knowl-dge of some one who can recognize them.

A few edible fungi appear early in the season, but with us uly, August and September are the months when the greatest ariety is to be found. The morels occur in May and June. The airy-ring mushroom and the Glistening coprinus sometimes ppear in June, and successive crops follow from time to time vhenever the weather is favorable. During warm, showery veather in July and August most of our edible boleti are to be ound.

A few of the species continue in September. The latter part f August and the first half of September will bring the Common nushroom and the Horse mushroom, the weather conditions eing right. Excessively dry weather and prevailing cold veather are unfavorable to mushroom growth. Heat and moist-re combined are favorable. It sometimes happens when the ields and open country are too dry for mushroom growth, a canty supply may be found in deep woods and shady swamps. t would be useless to look in such places for the Common mush-oom and the Fairy-ring mushroom, for they do not grow in voods; but the Delicious lactarius, the Involute paxillus, the Rough-stemmed boletus and the Chantarelle may be found there. he Oyster pleurotus and the Sapid pleurotus may be found in voods or clearings at any time between June and October, pro-ided there is sufficient rain to induce growth, but the Honey-olored armillaria, the Imbricated tricholoma, the Masked tricho-oma and the Elm pleurotus will rarely be found before the last veek in August or the first of September. Let no one expect to nd the Granulated boletus, the Yellowish-brown boletus or the mall Yellowish boletus except in the immediate vicinity of pine rees or in places where pine trees have grown. These hints nay be something of a guide to the inexperienced mushroom unter. The dates and habitat given under the description of ach species will furnish more full and definite information on his subject.

Before proceeding to the description of species it may be well o explain certain technical terms it may be convenient or ecessary to use. For illustration of some of the following terms ee Plate A and its explanation.

The substance of a mushroom takes the name *flesh* though it is quite unlike animal flesh in texture and appearance. Most mushrooms have an expanded part called the *cap* botanically known as the *pileus.* This is generally supported on a stem, but in the absence of a stem the cap is *sessile.* It varies much in shape in different species and even in the same species in different stages of development. In some mushrooms thin vertical plates or membranes radiate from the stem to the margin of the cap, or in the absence of a stem, from the point of attachment of the cap to its free margin. These are called *lamellæ* or *gills.* Shorter ones intervene toward the margin of the cap to fill the spaces that would otherwise be left vacant. The gills are attached by their upper edge to the lower surface of the cap and often by their inner extremity to the stem. They are *adnate* when attached to the stem by the whole width of their inner extremity *adnexed*, when attached by a part of their width only, *decurrent*, when they run down on the stem, gradually tapering to a point, and *free* when not attached to the stem. Sometimes their lower edge is notched or excavated at or near the stem, which fact is designated by the words *emarginate* or *sinuate.*

In some, the lower surface of the cap is full of small holes or cells, called *pores.* These are so small in some species that they are scarcely noticeable but generally they are easily visible They stand like tubes in a vertical position, side by side, with the openings or mouths downward. Theoretically they may be supposed to be formed by numerous gills connected by frequent partitions or transverse membranes.

In still another group of mushrooms the lower surface of the cap has neither gills nor pores, but instead there are numerous spine-like or awl-shaped projecting points called *teeth.* It is very much as if closely placed gills had been deeply, regularly and finely notched or gashed, but the teeth are not arranged in regular radiating rows, as they would be if actually formed in this way.

The upper surface of the cap is *glabrous* when it is smooth or free from hairs, fibrils or scales; *even* when it has no pits, ridges or other inequalities; *silky* when adorned with soft, close-pressed fibrils; *fibrillose* if these fibrils are harsher and looser; *floccose* when they are soft, short and collected in little flocs or tufts; *tomentose* when crisped and interwoven so as to form a woolly surface; *squamose* or *scaly* when coarse and collected in tufts, also when the cuticle breaks or cracks into small flakes or spot-like patches. These same terms are also applicable under the same conditions to the surface of the stem. The cap is also said to be *umbonate* when it has a small projection or boss on its center; *umbilicate* if it has a small central cavity or umbilicus, and *hygrophanous* when it has a soaked or watery appearance, the loss of which by drying is accompanied by some change in color. The margin of the cap is *striate* when marked by nearly parallel radiating lines. If these lines are very slight or are visible only in the moist or hygrophanous state the fact is indicated by the term *striatulate*.

The stem is *equal* or *cylindrical* when it is of uniform diameter in all its length; *bulbous*, when more or less abruptly enlarged at its base; *stuffed*, when its interior or central part is of a softer or looser texture than the exterior. In some mushrooms a thin membrane, in others a mass of webby filaments, stretches from the stem to the margin of the cap and conceals the gills in the young plant, but as the cap expands, this membrane, called the *veil*, usually separates from the margin of the cap and adheres to the stem, forming around it a ring or *collar*, botanically known as an *annulus*.

In a few species the young plant is wholly enveloped in a membranous or somewhat tomentose *volva* or wrapper, but this is soon ruptured by the growing plant and its remains are in some cases entirely left at the base of the stem, in others they partly adhere to the upper surface of the cap in the form of *warts*, or more rarely and exceptionally in a few small irregular patches. The dangerously poisonous species occur in a genus in which the volva is a prominent character.

The *spores* are the seeds or reproductive bodies of mushrooms. They are as fine as dust and are invisible to the naked eye except when collected together in great numbers or in masses. The *hymenium* is the surface or part of the plant immediately concerned in the production of the spores, and the *hymenophore* or *hymenophorum* is the part that supports the hymenium. In the Common mushroom and many others as well, the spores develop on certain specialized cells called *basidia* (basidium in the singular) on each of which four spores usually develop. In the morels, these specialized cells are elongated into cylindrical membranous sacks called *asci* (ascus in the singular), in each of which eight spores usually develop. In germination the spores send out slender threads or filaments called *mycelium* by botanists, but commonly known as *spawn*. The mycelium permeates the soil or other substance on which the mushroom grows and under favorable circumstances develops a crop of mushrooms of its own species.

The method and place of spore development furnishes the basis for the primary classification of fungi. The best way to acquire a knowledge of our edible mushrooms is to study them in the light of the primary characters employed in botanical classification and, therefore, in their natural relations to each other. It is my plan to arrange and describe them in their respective classes, families and genera. It will be seen that the species here described are all included in three great groups or classes, whose names and distinguishing characters may be expressed in the following general manner:

Gasteromyceteæ. Fungi whose spores are produced in the interior of the plant. Example. *Puff balls.*

Discomyceteæ. Fungi whose spores are produced on the upper or exterior surface of the cap and are contained in delicate membranous sacks. Example. *Morels.*

Hymenomyceteæ. Fungi whose spores are produced on the lower surface of the cap. Example. *Common mushroom.*

In the last class there are a few species in which no cap is developed. In these the spores are produced on the exterior of upright simple stem-like plants, or of the branches of upright bush-like plants, or on the upper surface of jelly-like irregularly expanded plants. None of the gelatinous plants will be described and only a few species of the other exceptional cases. These species all belong to the single genus Clavaria.

The spore-bearing surface, or hymenium, is generally recognizable, even to the naked eye, by its smooth, delicate, waxy appearance, which is quite unlike that of the sterile surfaces.

In most of the cap bearing mushrooms the lower surface of the cap is furnished with special organs on whose surfaces the spores are produced. These are in the forms known as gills, pores and teeth, and these organs furnish the characters on which the three principal families of the Hymenomyceteæ are founded. These characters will be more fully discussed in their proper place.

Gasteromyceteæ.

Puff Balls.

Puff balls belong to the class of fungi to which botanists have given the name Gasteromyceteæ. This name may be translated *stomach fungi.* It has reference to the fact that those plants which belong to this class have their stomach, that is, their whole interior, filled with spores when mature. The spores are developed on basidia as in the Hymenomyceteæ.

These are among the most easily recognized of fungi and the larger species in their early state are among the best of our edible species. Almost every country lad is familiar with the globular plants with papery rind stuffed full of a mass of brown dust-like material intermingled with cottony filaments. Time and again these have been seen lying on the ground or adhering to old stumps or the dead trunks of trees, and often have they afforded amusement by being subjected to sudden pressure between thumb and fingers that there might be seen the little cloud of dust-like spores belched forth like a miniature puff of smoke, and like smoke quickly vanishing in the air. But no one would think these good to eat, nor indeed are they while in this condition. But most puff balls are white within when young and their substance is then of a soft fleshy texture very unlike the dusty mass that fills them in mature age. *And it is only while they are white within that they are fit for food.* When they reach maturity the flesh at first assumes greenish-yellow or brownish-yellow hues and is apt to become moist or watery. They are then spoiled for edible purposes.

Lycoperdon *Tourn.*

Most of our puff balls and both the edible species here noticed belong to the genus *Lycoperdon.* There are about twenty species of this genus found in our State, but most of them are quite small, being less than two inches in diameter. They are naturally and botanically divided into two groups characterized by the manner in which they open for the dispersion of the spores. In one group the rind of the mature plant breaks into irregular fragments in the upper part of the plant, and gradually falls away exposing the mass of spores and permitting them to be disseminated by the wind. In the other group the rind opens by a small nearly circular but somewhat ragged apical aperture. This group includes nearly all of the smaller species, and the rind is generally thinner and more papery than in the others. Both the edible species here described belong to the first group. Some botanists have considered this group as worthy of generic distinction and have applied the name *Calvatia* to it, but for our present purpose the original names of the species are deemed preferable.

No deleterious species of puff ball is known, but so far as my experiments have gone the small species are inferior in flavor to the large ones, and these only are at present recommended for food. Possibly some of the untried small species may be as agreeably flavored as the large ones, and perhaps improved methods of cooking may give a more agreeable dish from those already tried. We have two species of *Bovista*, a kind of puff ball differing slightly from lycoperdons in the more perfectly globular shape and in the more tough and smooth rind of the mature plant. These are the Lead-colored bovista, *Bovista plumbea*, and the Ball-shape bovista, *Bovista pila*, both of which are pronounced edible by Professor W. Trelease, but as I have not tried them they are dismissed from further consideration at present.

The genus *Scleroderma* is allied to our common puff balls and would naturally be classed with them in the popular mind. The species differ from puff balls in their thicker rind and in having a colored flesh even in the immature state. I suspect that their disagreeable flavor has kept them out of the list of edible species, but one correspondent affirms that he has eaten these fungi and considers them good.

The two species of puff ball now to be described may be contrasted as follows:

Plant 8 to 15 inches in diameter, spore mass olivaceous, L. giganteum.
Plant 3 to 6 inches in diameter, spores mass purplish . . . L. cyathiforme.

Lycoperdon giganteum *Batsch.*

GIANT PUFF BALL.

Plate 1.

Peridium very large, globose or depressed-globose, sessile or nearly so, glabrous or slightly flocculose, white, whitish or slightly yellowish, becoming dingy with age; capillitium and spores greenish-yellow, then dingy-olivaceous; spores globose, about .00016 in. broad.

The Giant puff ball is our largest species. Its diameter is commonly eight to fifteen inches, but sometimes it attains even larger dimensions. Its horizontal diameter is often greater than its altitude. Its rind is smooth and white or whitish, but as it grows old it becomes yellowish and dusky. The flesh is at first white but with maturity it assumes greenish-yellow hues and when it becomes dusty it is brownish or brownish-olivaceous.

It grows in grassy places and appears in August and September. It is not common, but owing to its large size a single one is sufficient for a meal for a large family. Indeed one writer advises that, when one is found growing near the house, it should not all be taken at once, but that a sufficient quantity of it should be taken for a meal and another portion be cut from it the next day for another meal, and so on until it is all utilized or until it is too old for use. The largest specimens are apt to be depressed so as to resemble in shape a round loaf of bread.

Lycoperdon cyathiforme *Bosc.*

CUP-SHAPED PUFF BALL.

Plate 2.

Peridium three to six inches in diameter, globose or depressed-globose, smooth or minutely floccose or scaly, whitish cinereous brown or pinkish-brown, often cracking into areas in the upper part, commonly with a short thick stem-like base; capillitium and spores purple-brown, these and the upper part of the peridium falling away and disappearing when old, leaving a cup-shaped base with a ragged margin; spores globose, rough, purple-brown, .0002 to .00025 in. broad.

The Cup-shaped puff ball is smaller than the Giant puff ball and more common. Ordinarily it is from three to six inches in diameter. It is at first white, whitish or brownish, but it is apt to become darker with age, assuming brown or pinkish-brown hues. The upper part often cracks into angular areas or patches, the chinks being paler than the surface. When fully mature the upper part of the rind breaks up into fragments which fall away revealing the dull purplish-brown mass of spores and filaments within. After these have disappeared there still remains a cup-shaped base which is suggestive of the name of this puff ball and which sometimes persists all winter. From such an effete specimen the species was first named and described.

This species grows in pastures, sometimes in cultivated ground. It appears in August and September. In preparing it and the preceding species for the table select immature specimens whose flesh is yet pure white. Peel them and cut the flesh into slices one-fourth to one-half an inch thick. These slices may be fried in butter and seasoned according to taste or they may first be dipped in beaten egg and then fried and seasoned. In this way they make a kind of mushroom fritters or omelet that is liked by almost every one. If preferred, the beaten egg may be thickened with bread crumbs or crushed cracker. Some who are very fond of the Common mushroom fry the plain slices in butter, adding a mushroom or two to increase the true mushroom flavor, or they stew them in milk or cream, adding mushrooms if convenient, as before.

Discomyceteæ.

Morels, Helvellas and Mitrula.

The Discomyceteæ or *disk fungi* are evidently so named because in many of the species the fertile or spore-bearing surface is flat like a disk. It includes also many cup-shaped fungi in which the fertile surface is concave like the inside of a saucer or cup. But in the group which contains the edible species here to be noticed the fertile surface is neither flat nor concave, but decidedly convex, conical, oval or even cylindrical or club shaped. In some species also it is very irregular or uneven. In all the species, however unlike they may be in other respects, there is this agreement, the upper or exterior surface is the spore-bearing surface and the spores are developed in thin membranous sacks, not on basidia within the plant as in the case of puff balls. In the morels and allied species the plant consists of a stem and cap as in an ordinary mushroom, but these are very unlike the stem and cap of a mushroom in general appearance. Our edible species are placed in four genera, whose prominent distinctive characters, so far as our species are concerned, may be ascertained from the following table:

Cap coarsely pitted over its whole surface .... Morchella.
Cap convolutely lobed .... Gyromitra.
Cap irregular or reflexed .... Helvella.
Cap club shaped, often irregularly so................. Mitrula.

Morchella *Dill.*

In the genus *Morchella*, to which the morels belong, the cap is supported on a hollow stem and its whole surface is very uneven by reason of a net-work of anastomosing or reticulated ridges and their intervening cavities. This gives the surface a pitted or honeycombed appearance. The ridges are blunt on the edge. The spore sacks are imbedded in the whole surface, both of pits and ridges, each sack usually containing eight spores, a fact which can only be ascertained for one's self by the aid of a microscope. In the mass, the spores are yellowish.

Six species have been found in our State. All are similar in color, and the specific distinctions are not very sharp. They are found chiefly in the size and shape of the cap. All are deemed edible and similar in texture and flavor, and therefore the separation of the species from each other is not of much practical importance if they are sought for food only. The prevailing color of the cap in young and growing plants is buff-yellow or ochraceous, but as the plants become old or begin to dry, darker hues are assumed. The stems are rather stout, white or whitish, or barely tinged with yellow, and scurfy or at least not perfectly smooth and polished. They are hollow and in plants in which the margin of the cap is attached to the stem the cap also is hollow, the cavity being continuous between cap and stem.

The species may be arranged in two groups, in one of which the margin of the cap is wholly attached to the stem, in the other it is free.

All the species occur early in the season. They may be sought in wet weather, in May and June. I have never found any of them later than June. Most of them seem to prefer to grow under or near pine and ash trees, though they are sometimes found under other trees.

There are two or three species of stink horn fungi, species of *Phallus*, which, when old, bear some resemblance to morels. They have a pitted cap supported on a stem, but the cap has an opening in the top and the stem is porous, and besides, these plants have such an intolerable odor that no one would think of eating them. It is not likely that any one would mistake them for morels.

In the annexed table the distinctive features of the species are indicated. All the species are so much alike that the usual botanical diagnosis will be omitted.

	Margin of the cap united to the stem	1
	Margin of the cap free from the stem...........	3
1	Cap rounded or oval	M. esculenta.
1	Cap oblong or cylindrical	M. deliciosa.
1	Cap conical or oblong-conical	2
	2 Cap distinctly broader than the stem...........	M. conica.
	2 Cap scarcely broader than the stem............	M. angusticeps.
3	Cap free from the stem to the middle............	M. semilibera.
3	Cap free from the stem to the top...............	M. bispora.

Morchella esculenta *Pers.*

Common Morel.

Plate 3. Figs. 1 to 3.

In the Common morel the cap is generally a little longer than broad. It is sometimes nearly globose and sometimes slightly narrowed toward the top. The pits or depressions in its surface are rather broader than in other species and more rounded, thereby giving the surface an appearance more like that of a honeycomb.

The plant is commonly two to four inches high, with a stem a half inch or more thick.

It has long been known as an edible species, as its specific name implies.

Morchella conica *Pers.*

Conical Morel.

Plate 4. Figs. 1 to 4.

The Conical morel has the cap conical or oblong-conical, as its name indicates. The longitudinal ridges on its surface run more regularly from top to base than in the Common morel. They are connected by short transverse ridges which are so distant from each other or so incomplete that the resulting pits or depressions are generally longer than broad, and sometimes rather irregular. The color in the young plant is a beautiful buff-yellow or very pale ochraceous, but it becomes darker with age.

The plants are generally three to five inches high, with the cap one and a half to two inches thick in its broadest part, and distinctly broader than the stem.

This is similar to the Common morel in its esculent qualities and is generally admitted by writers to be an excellent food and of delicate flavor. It has been regarded by some as a mere variety of the preceding species. Both may be found growing on either sandy, gravelly or clayey soils.

Morchella angusticeps *Peck.*

NARROW CAP MOREL.

Plate 4. Figs. 5 to 9.

The Narrow cap morel differs from the Conical morel in its generally smaller size, more pointed cap and comparatively thicker stem. Generally the cap is scarcely thicker than the stem, even at its base, which is its broadest part. It is long and narrow and sometimes curved. In some specimens the stem is widest at the top and gradually tapers toward the base as shown in figure 5.

The plants are commonly two to three inches high, with the cap generally less than an inch broad in its widest part, but sometimes much larger specimens occur.

Morchella deliciosa *Fr.*

DELICIOUS MOREL.

Plate 3. Figs. 4 to 7.

The Delicious morel is easily known by the shape of its cap, which is cylindrical or nearly so. Sometimes it is slightly narrowed toward the top and occasionally curved, as in the preceding species, but its long narrow shape and blunt apex is quite strongly contrasted with that species. It is usually two or three times as long as it is broad, and generally it is longer than the stem. Specimens also occur in which the cap is slightly more narrow in the middle than it is above and below, and rarely it is slightly pointed at the apex. The pits on its surface are rather narrow and mostly longer than broad. The stem is often rather short.

The plant varies from one and a half to three inches high. It is a rare species in our State.

The name indicates that the illustrious Fries, who originally described the species, considered it an especially agreeable morel, and indeed he says it is more sapid than the Common morel. Roques sustains him in this opinion and Quelet speaks of it as very fine and fragrant.

In the four species already described the margin of the cap is united to or continuous with the top of the stem. In the two remaining species the margin of the cap is free from the stem, and consequently an open space intervenes between it and the stem.

Morchella semilibera *D C.*

Half free Morel.

Plate 3. Figs. 11 to 13.

The Half free morel has a conical cap, the lower half of which is free from the stem. It rarely exceeds an inch or an inch and a half in length, and is usually much shorter than its stem. The pits on its surface are longer than broad. Deformed specimens occur in which the cap is hemispherical and very blunt or obtuse at the apex; in others it is abruptly narrowed above and pointed.

The plants are two to four inches high. The species is rare with us.

Some writers claim that its flavor is less agreeable than that of the Common morel. The plants are so scarce that I have had no opportunity to test its edible qualities.

The species was described by Persoon under the name *Morchella hybrida*, a name having reference doubtless to the character of the cap, which, by being half free, partakes of the nature of the cap of an ordinary mushroom, while in other respects it retains the features of the true morels. This name is adopted in Sylloge Fungorum, but most English writers have employed the other.

Morchella bispora *Sor.*

Two-spored Morel.

Plate 3. Figs. 8 to 10.

The Two-spored morel is very similar to the Half free morel in external appearance. It is distinguishable by its cap which is free from the stem almost or quite to the top. The stem of the European plant has been described as stuffed, but in our plants it is hollow, though possibly in very young plants it may be stuffed. The remarkable and very distinctive character which gives name to the species, can only be seen by the aid of a microscope. In this species there are only two spores in each ascus or sack and these are much larger than the spores of the other species. They are two or three times longer and sometimes slightly curved. The spores of the other species are eight in an ascus and are very much alike in size and shape, and do not furnish decided specific characters; but in this species their importance can not be overlooked. Their length is about .0024 inch, while in the others it is .0008 to .001 inch.

This is probably our rarest species. I am not aware that it has been found in but one locality in our State. A few years ago Mr. H. A. Warne detected it growing among fallen leaves in a ravine near Oneida. I have not tested its edible qualities, but would have no hesitation in eating it if opportunity should be afforded.

Some writers speak highly of the edible quality of the morels, others are less enthusiastic over them. My own limited experience leads to the conclusion that, as a rule, they are not very highly flavored, though much better than some species classed as edible. One correspondent says, "I do not think much of morels. If cooked like mushrooms they become tough." And here, perhaps, is one cause of dissatisfaction with them. They may be spoiled by bad cooking. Some mushrooms are made more tough by too severe cooking. It is better to let such kinds simmer slowly over a gentle fire. One receipt for cooking morels says, cut clean morels in halves, place in a stew pan with butter and set over a fire. When the butter is melted add a little lemon juice, salt and pepper. Then cook slowly for an hour, adding from time to time small quantities of beef gravy.

Cooke speaks of morels in general as about the safest and most delicious of edible fungi, and Cordier represents the Common morel as a delicate food and one that is in general demand in France. There is one thing in favor of morels. They are generally free from insects, and on this account their natural flavor is unimpaired, and there is no loss from infested specimens. Their flesh is rather brittle or fragile and more dry than that of some mushrooms, in consequence of which they are easily dried for future use.

Gyromitra *Fr.*

The genus *Gyromitra* differs from *Morchella* in the character of its cap. The surface of this is not pitted as in the morels, but it is nevertheless very uneven, some parts being prominent as if inflated, others depressed. These convexities and depressions are so irregular and lobed that they suggest a faint resemblance to the convolutions of the brain. In other respects, and especially in the spore characters, the relationship to the morels is clear. Three species, *Gyromitra esculenta*, *G. curtipes* and *G. sphærospora* belong to our State, but the first one only is common and known to be edible.

Gyromitra esculenta *Fr.*

EDIBLE HELVELLA. ESCULENT GYROMITRA.

Plate 5. Figs. 1 to 3.

Pileus rounded, lobed, irregular, gyrose-convolute, glabrous, bay red; stem stout, stuffed or hollow, whitish, often irregular; spores elliptical, binucleate, yellowish, .0008 to .0009 inch long.

The Edible helvella, formerly known as *Helvella esculenta*, is easily recognized by its chestnut red irregularly rounded and lobed cap with its brain-like convolutions. The margin of the cap is attached to the stem in two or three places. When cut through it is found to be hollow, whitish within and uneven, with a few prominent irregular ribs or ridges. The stem is whitish, slightly scurfy, and, when mature, hollow. In large specimens it sometimes appears as if formed by the union of two or more smaller ones.

The plant is two to four inches high and the cap commonly two to three inches broad. Specimens sometimes occur weighing a pound each. It is fond of sandy soil and is found in May and June. It grows chiefly in wet weather or in wet ravines or springy places in the vicinity of pine groves or pine trees.

Cordier says that this species has an agreeable taste and is highly esteemed. Also that it is sold in the German markets as a true morel. I have repeatedly eaten it without experiencing any evil consequences, but its flavor to me is not that of a first-class mushroom. But it was simply fried in butter and seasoned with salt. Perhaps with more elaborate preparation or with the addition of a little lemon juice or vinegar its flavor might be improved.

Care should be taken by those eating it to use it with moderation and not to cook very old or long-kept specimens. Sickness has been known to result from eating freely of specimens that had been kept twenty-four hours before being cooked. When old and beginning to dry, the cap is apt to assume a darker or brown color. Often the lower or unexposed surface of the cap is paler than that which is more exposed to wind and sun.

Helvella *L.*

In the genus *Helvella* the cap is neither pitted nor convolutely lobed, but it is, nevertheless, quite irregular and variously reflexed, revolute or contorted so that in no two individuals, even of the same species, does it appear exactly alike. The stem in some species is stout and conspicuously marked by longitudinal grooves or furrows and their intervening ribs or ridges. In some species these furrows are continuous, in others, some of them are interrupted or short. In one or two species the stems are slender and even. All the species are rather small and scarce. They grow chiefly in woods and do not appear as early in the season as the morels and the Edible helvella. Though all are deemed edible I have not found them in sufficient quantity to verify their edible qualities and will describe only one of them.

Helvella crispa *Fr.*

WHITE HELVELLA.

Plate 5. Figs. 4 to 7.

Pileus deflexed, lobed or variously contorted, white or whitish; stem equal or slightly swollen at the base, deeply and interruptedly grooved, white or whitish; spores elliptical, .0007 to .0009 inch long.

The White helvella is distinguished from all other helvellas by its white or whitish color and by its peculiar stem, which is strongly ribbed and deeply grooved, the grooves or furrows being interrupted and varying much in length. A transverse section of the stem shows that it contains several longitudinal cavities or hollows. The cap is scarcely alike in any two individuals. Often it is lobed or contorted in such a way as to form two or more projecting points.

The plant is two to four inches high and the stem from one-fourth to one-half an inch thick. It grows in woods in August and September, but is not often plentiful.

Most French authors say that it is excellent when young, and Cooke says that when fresh it has a pleasant nutty flavor and is an excellent substitute for morels. Badham also affirms that all helvellas are esculent and have a general resemblance, in flavor, to morels. I do not know of any deleterious fungus that could reasonably be mistaken for this or any other helvella.

Mitrula *Fr.*

The genus *Mitrula* has been made by Saccardo in Sylloge Fungorum to include species having a club-shaped cap. In consequence of this enlargement of the generic character we find *Geoglossum vitellinum* Bres. and a variety of it, or a closely allied species, *Geoglossum irregulare* Peck, placed with the mitrulas. This pretty little fungus might easily be referred to the genus *Clavaria*, but for the fact that its spores are contained in asci or sacks. Nor is it sharply separated from the genus *Geoglossum* except by its spore characters. The New York plant differs from the European in its more compressed and irregular cap, and in consequence it has been kept distinct as a variety, in Sylloge, and stands as

Mitrula vitellina *Sacc.* var. **irregularis** *Peck.*

IRREGULAR MITRULA.

Plate 5. Figs. 8 to 14.

Pileus clavate, often irregular or compressed and somewhat lobed, obtuse, glabrous, yellow, tapering below into the short, rather distinct, yellowish or whitish stem; spores narrowly elliptical, .0003 to .0004 inch long.

When the Irregular mitrula is well grown and symmetrical it closely resembles the typical European plant, but usually the clubs or caps are curved, twisted, compressed or lobed in such a way that it is difficult to find two plants just alike. The plants are usually only one or two inches high, so that they would scarcely be thought of any importance as an edible species. But sometimes it grows in considerable profusion in wet mossy places in woods, so that it would not be difficult to gather a pint of them in a short time. Its beautiful bright yellow color makes it a very attractive object. It is our largest species of *Mitrula* and occurs in autumn.

It was first reported as an edible species in the Forty-second Report. Its flesh is tender and its flavor delicate and agreeable.

This plant was first described in 1879 in the Thirty-second Report, under the name *Geoglossum irregulare.* In 1882 Bresadola published his *Geoglossum vitellinum*, from which our plant differs so slightly that it has been considered a mere variety; and in consequence of the irregularity in the publication of the Thirty-second Report, no extra copies having been ordered, the later name has been given precedence.

Hymenomyceteæ.

Mushrooms, Boleti and Fairy Clubs.

The mushrooms hereafter to be described belong to the very large class of fungi known to botanists by the name Hymenomyceteæ, a word composed of two parts, signifying *membrane fungi*, and in its present use indicating that in these fungi the spores are produced on thin or membranous parts or surfaces. In the Common mushroom and in all others of similar structure, these spore-bearing membranes or surfaces are found on the lower or under side of the cap. They are commonly called gills, and have already been described. The spores are produced on both surfaces of the gills, and when mature they drop through the interspaces between the gills and fall to the earth below or are wafted away by currents of air. All fungi having a cap with gills beneath belong to the family Agaricineæ.

In the Edible boletus and other fungi of similar structure the lower surface of the cap is full of small holes or pores, previously described. The spores are developed on the inner surface of these pores, and when mature they are dropped or ejected into the open air below. All fungi having a cap with pores beneath constitute a family called Polyporeæ.

In the Spreading hydnum or Hedgehog mushroom the lower surface of the cap is furnished with closely-placed depending spine-like teeth. All fungi of similar structure are included in a family named Hydneæ, from the genus Hydnum, the principal genus in it. In one species the cap is replaced by spreading branches with teeth on their lower surface. Spreading or thinly-expanded plants with no stems which belong to this and the preceding family are not noticed, since there are no edible species among them.

In the Cornucopia mushroom the cap has neither gills, pores nor teeth on its lower surface, which is even or slightly and obscurely wrinkled. It, therefore, belongs to a fourth family which takes the name Thelephoreæ.

There is still another family with a few edible species in it. It is named Clavarieæ, from its principal genus Clavaria. In this genus the edible species occur. It is composed of two kinds of plants. In one kind there is a simple upright club-shaped stem-like growth with no well-marked cap or expanded part. In the other there is a branching bush-like growth. In both these the spores are produced on the exterior surface of the plants or of their branches. A synoptical view of the five families is given in the annexed table.

	Cap present..	1
	Cap wanting	Clavarieæ.
1	Cap with radiating gills beneath....................	Agaricineæ.
1	Cap with pores beneath	Polyporeæ.
1	Cap with spine-like or awl-shaped teeth beneath......	Hydneæ.
1	Cap with neither gills, pores nor teeth beneath.......	Thelephoreæ.

Agaricineæ.

Agarics.

The family Agaricineæ probably includes more edible species than any other. Its members are sometimes called "agarics." More than 500 species of this family have been credited to our State flora. For the sake of convenience in the identification of such a great abundance of material, botanists have divided the family into smaller groups or sections depending on the color of the spores. We can do no better than to follow this arrangement in the study of the species. It is not a difficult matter to ascertain the color of the spores of an agaric. Generally they have nearly or quite the same color as the mature gills, but to this there are so many exceptions that to be exact we must see the spores themselves. Singly they are invisible to the naked eye, but when collected in a mass their color is plainly to be seen. If the cap of a mushroom is cut from its stem and placed in its natural position, gills downward, on any flat surface, say a piece of white paper as broad as itself, it will in a few hours drop enough spores on the paper to show their color, on removing the cap. If the spores are white, and we may infer that they are if the mature gills are white, white paper will not be so good for disclosing their color, as paper of some dark color. Black paper is sometimes used when it is suspected that the spores are white. Or the cap may be placed on a piece of glass and then the glass may be placed over a white or a colored background, according to circumstances.

Fresh, sound, fully-developed specimens should be selected to furnish the spores. If the cap is thin it is well to invert a goblet or similar vessel over it to prevent it from drying and to exclude currents of air.

Having ascertained the color of the spores the subjoined table will show in which section the species belongs.

Spores brown, purplish-brown or black	Melanosporæ.
Spores ochraceous, brownish-ochraceous or rusty-ochraceous	Ochrosporæ.
Spores rosy or pinkish	Rhodosporæ.
Spores white, whitish or pale yellow	Leucosporæ.

Melanosporæ.

By some botanists the brown and purplish-brown-spored species are grouped in one section, and the black-spored species in another; but both are united in one section in Sylloge Fungorum and this is sufficiently simple for our purpose. Our edible species of this section are included in two genera, *Agaricus* and *Coprinus*.

Agaricus *L.*

The genus *Agaricus* originally included nearly all the species that now compose the family Agaricineæ, but it has been divided and subdivided until now it includes only such brown-spored species as have free gills and a stem with a collar.

There are several edible species in the genus, and, so far as I know, it contains no dangerous species. The edible species are closely related to each other, and in all here noticed the gills have a pink color in young or middle age, but become dark-brown or blackish-brown in mature age. There is no simpler way of expressing the distinctive specific features than by an analytical table. The species may be arranged in two groups, depending on their place of growth. This arrangement is not as exact and satisfactory as is desirable, but it brings together those species that are most closely related to each other.

	Plants growing in pastures, grassy or open places..........	1
	Plants growing in woods or groves..........	4
1	Stem stuffed or solid..........	2
1	Stem hollow..........	3
2	Gills at first pink, about as broad as the thickness of the cap..........	A. campester.
2	Gills at first white, breadth less than the thickness of the cap..........	A. Rodmani.
3	Collar radiately divided on its lower surface..	A. arvensis.
3	Collar floccose on its lower surface..........	A. subrufescens.
4	Flesh quickly changing to dull red where wounded..........	A. hemorrhoidarius.
4	Flesh not changing to dull-red where wounded..........	5
5	Cap with numerous persistent brown scales...	A. placomyces.
5	Cap without scales or with few evanescent ones.	A. silvaticus.

Agaricus campester *L.**

Common Mushroom. Edible Mushroom.

Plate 6.

Pileus silky or squamulose; lamellæ at first a delicate pink, becoming brown or blackish-brown with age; stem stuffed, glabrous, white or whitish; spores elliptical, .00025 to .0003 inch long.

The Common mushroom, sometimes called the Edible mushroom, as if it was the only edible species known, and also Meadow mushroom in common with A. arvensis, is perhaps more generally used and better known than any other. It is the one commonly cultivated and the one most often seen on the tables of the rich and of fashionable restaurants and public houses. It is so eagerly sought in some of our cities that it is difficult to find the wild ones near these towns, for they are gathered almost as soon as they appear, and the cultivated ones usually bring prices beyond the reach of the poor.

* This name is usually written *Agaricus campestris*, but in Sylloge Fungorum the more classical and grammatical term here adopted is used.

In very young plants the cap is hemispherical or almost globose and the gills are concealed. Such plants of this and of the closely related Horse mushroom have received the name "button mushrooms," and are preserved in brine or other liquid and sold in the leading grocery stores. As the cap expands the veil separates from the margin revealing the delicate-tinted pinkish gills. When mature the cap is very broadly convex or nearly flat. It is generally a little silky with close-pressed fibrils, but these often vanish with age and the cap appears quite smooth. Its margin, especially in the younger plants, extends a little beyond the exterior extremity of the gills. The color of the cap is commonly white, but with age it may become a little tinged with dingy hues. The flesh is white, but sometimes exhibits a tendency to become slightly tinged with red when cut and exposed to the air. Its taste is mild and pleasant. The epidermis is separable from the cap.

The gills are closely placed, rounded at the inner extremity and not attached to the stem. The beautiful pink hue of their early state gradually becomes darker and finally changes to a smoky brown, which, in dried specimens, becomes almost or quite black. This peculiarity in the coloration of the gills is so unlike anything known in the dangerous species that it seems surprising that any such should ever be mistaken for this mushroom. A whole group of pink-spored species, some of which are suspected of being hurtful, have pinkish-colored gills, but they never assume dark-brown or blackish hues.

The stem is generally shorter than the horizontal diameter of the cap and about equal in thickness from top to base. The central portion is a little softer in texture than the external part. A collar encircles it in the upper part. Sometimes this is so thin and slight that scarcely any vestige of it remains in old plants.

The spores are sometimes described as purplish-brown but I have never been able to see any decided purple tint in them. They are not as dark as seal-brown but approach it.

This mushroom, like many other plants that have been long and extensively cultivated, has developed into several forms which exhibit quite well-marked distinctive features. One of these, called the Garden mushroom, Variety *hortensis*, is represented by figures 8 and 9. It is often found in cultivation and sold in the markets, but is rarely found growing in the fields. Its cap is of a brownish color and frequently adorned with darker spots or scales.

Variety *griseus* has a grayish shining silky cap. I have not yet found it in New York, but it grows in Virginia. It occurs in France and is figured by Richon and Rosé.

Variety *alba* has the cap and stem white. It is our most common form.

Cap two to four inches broad, stem one and a half to three inches long, one-third to two-thirds of an inch thick.

The Common mushroom grows in grassy places, in pastures, manured ground and mushroom beds, never in thick woods. It occurs mostly in August and September. In cultivation in a suitable place it may be had in midwinter. Owing to the attacks of insects it is better to raise mushrooms in winter than in summer, unless the insects can be effectually excluded from the beds and the apartments and the temperature properly regulated. The wild ones are thought by some to have a better flavor than the cultivated ones, but the latter are good enough for any one and sometimes command surprisingly high prices. Mushrooms of all kinds are more eagerly sought and more extensively used in Europe than in this country, but with the great influx of Europeans into this country, bringing with them a taste for this kind of food, and with the rapid increase in population making an increased demand for all kinds of food, it is probable that the demand for and the use of mushrooms will soon be as great here as in Europe. The chief difficulty in the matter is the lack of a sufficient general knowledge of the species or of the means of acquiring the knowledge necessary to make it safe to use them.

In the wild state the Common mushroom usually grows in groups or a single one in a place, but when cultivated they often form large tufts. A kind of out-door cultivation is sometimes employed in order to increase the abundance of mushrooms. Neglected places in fence corners, pastures or roadsides are dug up and manure incorporated in the soil if it is not already very rich. Mushroom spawn, after having been soaked in warm water or kept moist in a warm place for several hours to start it into growth, is then planted in the prepared places and a coat of fine manure spread over the surface.

It is well to mulch the surface with some coarse material like leaves, straw or hay, to keep the soil moist. If the planting is done in spring and the season is favorable a crop of mushrooms should appear in autumn.

Almost every cook claims to know how to prepare this mushroom for the table, and recipes for cooking it will be found in cook books. No extended directions therefore are necessary here. One of the simplest methods and one which is applicable to all tender species is to fry gently in butter, seasoning according to taste. They may be stewed in milk or cream, broiled on a gridiron or in a steak broiler, or baked in an oven. To some they are very acceptable when eaten raw. Doctor Cooke says that when abroad on a day's excursion, one or two of these raw specimens are an excellent substitute for sandwiches, as they satisfy hunger, are nutritive and digestible, and very pleasant and grateful to the palate.

Agaricus Rodmani *Peck.*

Rodman's Mushroom.

Plate 9. Figs. 1 to 6.

Pileus rather thick, firm, glabrous, white or whitish, dingy-yellow or reddish-yellow in the center, flesh white, unchangeable; lamellæ crowded, narrow, at first whitish, then pink, finally blackish-brown; stem short, solid, whitish; spores broadly elliptical, .0002 to .00025 inch long.

Rodman's mushroom may easily be mistaken for the common mushroom to which it is closely related. It has been separated from it because of its comparatively thicker firmer flesh, its more narrow gills, which are almost white when very young, and its peculiar collar. This seems to be double, and in the mature plant the two parts separate in such a way as to leave a deep groove or channel between them. In very short-stemmed specimens the collar is situated so near the base of the stem that it appears much like the remains of the volva or wrapper in some species of Amanita. The spores are a little shorter and broader in proportion to their length than those of the Common mushroom, so that at first sight they seem to be nearly globose.

The cap is two to four inches broad, the stem one to two inches long and one-half an inch or less in thickness.

This mushroom was first described and recorded as edible in the Thirty-sixth Report. Subsequently Richon and Rosé published a species found in France to which they gave the name *Psalliota duriuscula*, the Firm champignon. They speak of their plant as a suspected species with nothing to recommend it, with an unpleasant flavor and with a flesh so hard as to render it indigestible. The figure and description of their species indicate that it is not distinct from Rodman's mushroom. But Mr. Rodman ate of his plant and found it perfectly harmless. It is, therefore, classed as edible. I have had no opportunity to test its edible qualities, but would have no hesitation in eating it if I could find it in good condition.

It grows in grassy ground and even in crevices of unused pavements and paved gutters in cities. It appears from May to July. I have not found it in autumn. It is rare.

Agaricus subrufescens *Peck.*

Slightly reddish Mushroom.

Plate 7.

Pileus at first deeply hemispherical, becoming convex or broadly expanded, silky fibrillose and minutely or obscurely squamulose, whitish, grayish or dull reddish-brown, usually smooth and darker on the disk, flesh white, unchangeable; lamellæ at first white or whitish, then pinkish, finally blackish-brown; stem rather long, often somewhat thickened or bulbous at the base, at first stuffed, then hollow, white; the annulus flocculose or floccose-squamose on the lower surface; mycelium whitish, forming slender branching root like strings; spores elliptical, .00024 to .0002[illegible] inch long.

The Slightly reddish mushroom differs especially from th[illegible] Common mushroom in the peculiar deeply hemispherical shap[illegible] of the cap of the young plant, in the white or whitish color o[illegible] the very young gills, in the at length hollow stem, often some[illegible]what thickened or bulbous at the base, and in the collar which has the exterior or lower surface covered with littl[illegible] downy flakes or scales. Beside these characters it has other[illegible] which may aid in supporting its claim to specific distinction. It[illegible] mycelium seems strongly disposed to form strings which adher[illegible] to the base of the stem like white branching thread-like root[illegible] and the flesh has a flavor like that of almonds. This flavo[illegible] appears to me to be more pronounced in the older plants than in those that are very young. When raised in large quantities in greenhouses it sometimes gives out a perceptible odor of bruised almonds.

The reddish-brown color is due to the coating of fibrils that cover the cap. These are often collected in minute tufts, which give a slight floccose or scaly appearance to the cap. In the center the epidermis does not separate into fibrils and scales, and in consequence the disk or center of the cap is smoother and more distinctly reddish-brown than the rest. The flesh is white and unchangeable when cut or broken. In this respect it differs decidedly from the Reddish variety of the Common mushroom, Variety *rufescens*, though it resembles it in having the very young gills white.

The stem is generally rather long and more or less thickened at the base. It is white and usually slightly flocculose below the collar, very smooth above it. In the mature plant it is hollow, but the cavity is very small. One of the distinguishing features of the species is the flocculent or scaly lower surface of the veil or collar. It is apparently a double membrane, as in the Field mushroom, but instead of the lower membrane breaking in a radiate manner as in that species, it breaks into small floccose flakes or scales. By this character and by the color of the very young gills it may be separated from the Garden variety of the Common mushroom, Variety *hortensis*, which it approaches in the color of the cap.

The plant often grows in large clusters of many individuals, one correspondent affirming that as many as forty individuals sometimes occur in one cluster. In size it is similar to the Common mushroom, but under favorable circumstances it seems sometimes to excel it, the cap attaining a diameter of six inches.

It has been found but once in a wild state within our limits. Mr. Wm. Falconer, of Glen Cove, Long Island, discovered it growing on his compost heap composed chiefly of decaying leaves. From some of these specimens kindly sent me by the discoverer the original description was derived, but the specimens were not in satisfactory condition to figure. The present illustrations have been made from specimens kindly furnished by Colonel Wright Rives of Washington, in whose greenhouse an enormous volunteer crop developed in soil prepared for forcing cucumbers. The species is apparently more easy of cultivation than the Common mushroom, less subject to the attacks of insects and not so intolerant of unfavorable conditions. It is very productive, develops sooner after the planting of the spawn and probably will keep longer in good condition. Specimens picked in Washington on Monday night, reached Albany in a good state of preservation on the Thursday following, and some of them were eaten for supper on that day, making an interval of three days and three nights between the picking and the eating, and proving the possibility of supplying a distant market with this mushroom. Its flesh does not seem to me quite as tender as that of the Common mushroom, and its almond-like flavor may not be as acceptable to some tastes, but it is nevertheless an excellent mushroom and one which may yet supersede the old kind, especially in the hands of private individuals who are often disappointed in their efforts to raise mushrooms

Agaricus arvensis *Schæff.*

FIELD MUSHROOM. HORSE MUSHROOM.

Plate 8.

Pileus smooth or at first slightly flocculent, white or yellowish; lamellæ at first whitish or very faintly pinkish, soon dull pink, then blackish-brown; stem stout, hollow, somewhat thickened or bulbous at the base, white, the collar double, the upper part membranous, white, the lower part thicker, subtomentose, radiately split, yellowish; spores elliptical, .0003 to .0004 inch long.

The Field mushroom or Horse mushroom, also called Meadow mushroom, is so much like the Common mushroom that some botanists have supposed it to be a mere variety of that species. The most notable differences are its larger size, its hollow, somewhat bulbous stem, its peculiar veil or collar and the paler gills of the very young plant. The cap in dried specimens is apt to assume a yellow color, which does not pertain to the Common mushroom. The collar appears to be composed of two parts closely applied to each other and making a double membrane, the lower part of which is of a thicker, softer texture and split in a stellate manner into broad yellowish rays. This is perhaps the most distinctive character of the species, and a more detailed description is scarcely necessary. No serious harm could come, so far as utility is concerned, if it should be confused with the Common mushroom.

It grows in cultivated fields, grassy pastures and waste places. It is occasionally found under trees and even within the borders of thin woods. It has been supposed by some that its spores will not germinate unless they have passed through the alimentary canal of some animal. Whether there is any truth or not in such a supposition, it is common enough to find this mushroom growing in places where no trace of the dung of animals can be seen. It appears from July to September.

A similar mushroom occurs in open places in woods or along the borders of thin woods. The color of its cap and stem is white as in the Field mushroom. Its cap is perhaps a little thinner and more fragile, and its stem is usually longer and has a very abrupt or flattened bulb at its base. Its collar is usually the same as that of the Field mushroom, but plants sometimes occur in which it appears to be a single lacerated membrane. Such plants have been referred to the Wood inhabiting mushroom, *Agaricus silvicola;* but its general affinities seem to me to connect it more closely with *Agaricus arvensis*, to which I would subjoin it as an abrupt variety, Variety *abruptus*, the name having reference to the character of the bulb. I have eaten of this variety and consider it edible. Dried specimens assume a yellowish hue.

Opinions differ concerning the esculent qualities of the Field mushroom. According to Berkeley it is inferior to the Common mushroom, and Badham says its flavor and odor are strong, and it is generally shunned by English epicures. On the other hand, Persoon says it is superior to the Common mushroom in smell, taste and digestibility, and it is, therefore, generally preferred in France. Vittadini also says it is very delicate and easy of digestion, but has a stronger odor than the Common mushroom. "Very sapid and very nutritious," "odor feeble, but flavor anise-like and very agreeable," "delicious when young and fresh, but tough when old," are opinions expressed by various writers. One author says it is edible and of exquisite flavor, and both these expressions have been perpetuated in two of the synonyms of the species, *Agaricus edulis* Kromh. and *Agaricus exquisitus* Vitt.

Agaricus placomyces *Peck.*

Flat cap Mushroom.

Plate 9. Figs. 7 to 12.

Pileus thin, at first convex, becoming flat with age, whitish, brown in the center and elsewhere adorned with minute brown scales; lamellæ close, white, then pinkish, finally blackish-brown; stem smooth, annulate, stuffed or hollow, bulbous, white or whitish, the bulb often stained with yellow; spores elliptical, .0002 to .00025 in. long.

The Flat cap mushroom is a rare but a beautiful species. Its cap is convex or somewhat bell-shaped when young, but when mature it is nearly or quite flat. Its brown center and its numerous minute brown scales on a whitish background give it a very ornamental appearance. It becomes darker with age.

Its gills, which in the very young plant are white or nearly so, pass through the usual shades of pink and brown with advancing age.

The stem is rather long and swollen into a bulb at the base. It sometimes tapers slightly toward the top near which it bears a thin flabby membranous collar. It may be either stuffed with a pith or hollow. It is white or whitish, but the bulb is sometimes stained with yellow.

Cap two to four inches broad, stem three to five inches long, one-fourth to nearly one-half an inch thick.

It grows in the borders of hemlock woods or under hemlock trees from July to September. It has been eaten by Mr. C. L. Shear, who pronounces it very good. I have not found it in sufficient quantity to give it a trial. This mushroom is very closely related to the Wood mushroom or Silvan mushroom, *Agaricus silvaticus*, a species which is also recorded as edible, but which is apparently more rare in our State than even the Flat cap mushroom. This differs from the Silvan mushroom in its paler color, in having the cap more minutely, persistently and regularly scaly, and in its being destitute of a prominent center. In the Silvan mushroom the scales, when present, are few, and they disappear with age.

Having had no opportunity to make the drawings of the Bleeding mushroom, *Agaricus hemorrhoidarius*, and of the Silvan mushroom, *Agaricus silvaticus*, and not having tested their edible qualities, they are, for the present, dismissed from further consideration.

Coprinus *Pers.*

The genus *Coprinus* is easily distinguished from all others by the character of the gills of the mature plant. These assume a black color and slowly dissolve into an inky fluid which, in the larger plants at least, falls to the ground in drops. The thin caps of some species also partly or wholly waste away in this manner. Because of the production of this black fluid, which has sometimes been used as a poor substitute for ink, these plants have received the name "inky fungi." In a few species the spores are brown, but generally they are black. Some of the plants literally grow up in a night and perish in a day. Many of the species inhabit dung or manure heaps, as the generic name implies. Most of them are so small, thin and perishable that they are not valuable as food. Even the larger ones have thin caps, and those deemed edible should be gathered when young and cooked promptly if used as food. Three species are here noticed.

Cap whitish	C. comatus.
Cap grayish or grayish-brown..................	C. atramentarius.
Cap buff-yellow or tawny-yellow	C. micaceus.

Coprinus comatus *Fr.*

Shaggy Coprinus.

Plate 10.

Pileus at first oblong or nearly cylindrical, becoming campanulate or expanded and splitting on the margin, adorned with scattered yellowish scales, whitish; lamellæ crowded, white, then tinged with red or pink, finally black and dripping an inky fluid; stem rather long, hollow, smooth or slightly fibrillose, white or whitish, at first with a slight movable annulus; spores elliptical, black, .0005 to .0007 in. long.

The Shaggy coprinus, or Maned agaric as it is sometimes called, is one of the largest and finest species of the genus. When young the cap is quite long and narrow, but with advancing age the margin spreads outward, becomes split in several places and curves upward. The surface is adorned with loose fibrils and with scales or spots which appear to be due to the breaking up of an epidermis which remains entire in a small patch on the very top of the cap. Except the top and the scales the cap is white, but in mature plants it often becomes sordid or blackish toward the thin margin as if it were stained or soaked by the inky fluid formed from the gills.

The gills at first are closely crowded together and white, but soon pinkish, reddish or purplish tints appear, which quickly change to black. Sometimes all these hues may be seen at one time in one plant.

The stem is white, smooth and hollow. In the young plant it is furnished with a collar which is movable or but slightly adherent. It is easily destroyed and has often disappeared at maturity.

The cap is one and a half to three inches long before expansion. The stem is three to five inches long and one-fourth to one-third of an inch thick. It grows in rich loose earth by roadsides, in pastures, waste places or dumping grounds. It appears in autumn and may sometimes be found quite late in the season. It is quite fragile and must be handled with care. It is very tender and digestible and scarcely inferior to the Common mushroom in flavor, though some think it is improved in flavor by cooking a mushroom or two with it. It is fit for the table only before the gills have assumed their black color, but even after that it is sometimes used in making catsup.

"When young it is very sapid and delicate;" "cooked quickly in butter with pepper and salt, it is excellent;" "edible, tender and delicious;" "in flavor it much resembles the Common mushroom, to which it is quite equal, if not superior; it is clearly more digestible and less likely to disagree with persons of delicate constitutions," are opinions recorded in its favor.

Coprinus atramentarius *Fr.*

INKY COPRINUS.

Plate 11. Figs. 7 to 11.

Pileus at first ovate, becoming expanded, glabrous or with a few obscure, spot-like scales in the center, grayish-brown; lamellæ crowded, at first whitish and flocculose on the edge, then black; stem glabrous, hollow, white or whitish; spores elliptical, black, .0003 to .0004 in. long.

The Inky coprinus is much less attractive in its appearance than the Shaggy coprinus. Its cap is quite smooth except on the disk, which is sometimes spotted with a few obscure scales. The color is grayish or grayish-brown, sometimes with a slight suggestion of lead color. The margin is sometimes irregularly notched or lobed.

The gills are at first crowded and whitish, but they soon become black and moist and gradually dissolve away, forming an inky dripping fluid which is suggestive of the name of the species, and which may be used as ink.

The stem is rather slender, smooth and hollow. It sometimes has a slight vestige of a collar near the base, but it soon disappears.

The cap varies from one to three inches or more in diameter, the stem is two to four inches long, one-sixth to one-third of an inch thick.

It grows in clusters in rich soil, in gardens, waste places or in woods, and appears in late summer or in autumn. The form growing in woods is generally smaller and more beautiful than that growing in open places. It may be called var. *silvestris*.

The cap sometimes appears as if suffused with a bloom. It deliquesces rapidly and it is, therefore, more available for catsup than for food. If intended for the table it must be cooked as soon as brought to the house. In Europe both this and the preceding species appear in spring as well as in summer and autumn, but I have not seen them early in the season in our State.

Coprinus micaceus *Fr.*

GLISTENING COPRINUS.

Plate 11. Figs. 1 to 6.

Pileus thin, at first ovate, then campanulate or expanded, striate, sometimes glistening with shining particles when young, buff-yellow or tawny-yellow; lamellæ crowded, whitish, then tinged with pinkish or purplish-brown, finally black; stem slender, fragile, hollow, white; spores elliptical, brown, .00025 to .0003 in. long.

The Glistening coprinus is a small but common and beautiful species. Its cap is somewhat bell-shaped and marked with impressed lines or striations from the margin to or beyond the middle The center is smooth and often a little more highly colored than the rest. The glistening particles which are suggestive of the name of this little mushroom are not often noticeable, and when present on the young cap they often disappear with age. The margin is frequently notched or lobed and wavy and it is apt to become split as the cap expands. The color varies from a pale whitish-buff to tawny-yellow or reddish-ochraceous. It becomes sordid or brownish in old age, especially if wet or water-soaked.

The gills, as in the preceding species, are at first crowded and whitish, but they soon change color, becoming pinkish tinted and then brown and black.

The stem is slender, fragile, smooth, hollow and white. The brown color of the spores is unusual in this genus.

Cap one to two inches broad, stem one to three inches long, rarely thicker than a pipe stem.

The Glistening coprinus grows in clusters on the ground or on decaying wood. It occurs from May to November. It appears in wet weather and sometimes seems to anticipate rain, starting to grow two or three days before a rain storm. Several successive crops often come up about a single old stump in one season. When a cluster appears to grow from the ground it is quite probable that it really starts from some decaying root or other piece of wood buried in the earth. It is not uncommon to find it growing from places in the margin of the sidewalks of our cities where shade trees have been cut down, the decaying stump and roots furnishing the necessary habitat. In such cases the boys of the street delight in kicking the clusters to pieces and stamping them out of existence, thinking probably that they are abundantly justified in destroying a vile toadstool which might otherwise be the means of poisoning some one. These tufts are sometimes very large and composed of very many plants closely crowded together. Sometimes the caps crack into small areas, the white flesh showing itself in the chinks.

European writers do not record the Glistening coprinus among the edible species, perhaps because of its small size. But it compensates for its lack of size by its frequency and abundance, and it has the advantage of being easily and frequently procurable. In tenderness and delicacy it does not appear to me to be at all inferior to the Shaggy coprinus, and it certainly is harmless, for it has been eaten repeatedly by various persons and always without ill results. It was published as edible in the Twenty seventh Report.

Ochrosporæ.

Members of this section may be known by the ochraceous hues of their spores. The color may vary somewhat, being ochraceous, rusty-ochraceous or brownish-ochraceous in different species. The recorded edible species occur in three genera, Pholiota, Cortinarius and Paxillus. No species of the first genus has been proved by me.

Cortinarius *Fr.*

Of the genus *Cortinarius*, eight species have been classed as edible by English writers. Four of these occur in our State, and three of them have been tried. The genus contains many species, and it is almost certain that several others will yet be found to be esculent. The genus is distinguished especially by the rusty-ochraceous color of the spores and by the webby character of the veil. In the young plant fine webby filaments stretch from the margin of the cap to the stem, and in many species these are so numerous that they at first conceal the gills, but they mostly disappear with advancing age and leave little or no trace of a collar on the stem. In some instances a few filaments adhere to the stem and afford a lodgment for the falling spores, in consequence of which a rusty-brown stain or ill defined band of color is seen on the upper part of the stem.

In young plants the color of the gills is generally quite unlike that of mature ones. In these the gills become dusted by the spores and assume their color, so that there is great uniformity in the color of the gills of mature plants in all the species. It is, therefore, of the utmost importance in identifying species of *Cortinarius* to know the color of the gills of the young plant. In all the species they are attached to the stem at their inner extremity, and generally they are emarginate. Most of the species grow in woods or groves or along their borders, and are especially found in late summer and autumn in hilly or mountainous regions.

The three species here described may be tabulated as follows:

	Stem not bulbous	1
	Stem with a bulbous base	C. violaceus.
1	Cap viscid or glutinous when moist	C. collinitus.
1	Cap not viscid, dry and fibrillose	C. cinnamomeus.

Cortinarius violaceus *Fr.*

Violet Cortinarius.

Plate 12.

Pileus convex, becoming nearly plane, dry, adorned with numerous persistent hairy tufts or scales, dark violet; lamellæ rather thick, distant, rounded or deeply notched at the inner extremity, colored like the pileus in the young plant, brownish-cinnamon in the mature plant; stem solid, fibrillose, bulbous, colored like the pileus; spores subelliptical, .0005 in. long.

The Violet cortinarius is a very beautiful mushroom and one easy of recognition. At first the whole plant is uniformly colored, but with age the gills assume a dingy ochraceous or brownish-cinnamon hue. The cap is generally well formed and regular and is beautifully adorned with little hairy scales or tufts. These are rarely shown in figures of the European plant, but they are quite noticeable in the American plant and should not be overlooked. The flesh is more or less tinged with violet.

The gills when young are colored like the cap. They are rather broad, notched at the inner extremity and narrowed toward the margin of the cap. When mature they become dusted with the spores whose color they take.

The stem also is colored like the cap. It is swollen into a bulb at the base and sometimes a faint rusty-ochraceous band may be seen near the top. This is due to the falling spores which lodge on the webby filaments of the veil remaining attached to the stem.

Cap two to four inches broad, stem three to five inches long, about half an inch thick.

The Violet cortinarius grows among fallen leaves in the woods of our hilly and mountainous districts, in July and August. I have never found it in the open country. It is solitary or scattered in its growth and not very plentiful. Nevertheless it is a very good species to eat, and when botanizing in the extensive forests of the Adirondack region it afforded an excellent and very much relished addition to our bill of fare. It retains something of its color when cooked, and in consequence a dish of Violet mushrooms is scarcely as attractive to the eyes as to the palate.

Cortinarius collinitus *Fr.*

SMEARED CORTINARIUS.

Plate 13. Figs. 1 to 6.

Pileus convex, obtuse, glabrous, glutinous when moist, shining when dry; lamellæ rather broad, dingy-white or grayish when young; stem cylindrical, solid, viscid or glutinous when moist, transversely cracking when dry, whitish or paler than the pileus; spores subelliptical, .0005 to .0006 in. long.

The Smeared cortinarius is much more common than the Violet cortinarius and has a much wider range. Both the cap and stem are covered with a viscid substance or gluten which makes it unpleasant to handle. The cap varies in color from yellow to golden or tawny-yellow and when the gluten on it has dried it is very smooth and shining. The flesh is white or whitish. The young gills have a peculiar bluish-white or dingy-white color which might be called grayish or clay color, but when mature they assume the color of the spores. They are sometimes minutely uneven on the edge.

The stem is straight, solid, cylindrical and usually paler than the cap. When the gluten on it dries it cracks transversely, giving to the stem a peculiar scaly appearance.

The cap is one and a half to three inches broad, and the stem two to four inches long and one-fourth to one-half inch thick.

The plant grows in thin woods, copses and partly-cleared lands and may be found from August to September.

It is well to peel the caps before cooking, since the gluten causes dirt and rubbish to adhere tenaciously to them.

Cortinarius cinnamomeus *Fr.*

CINNAMON CORTINARIUS.

Plate 13. Figs. 7 to 20.

Pileus thin, convex, obtuse or umbonate, dry, fibrillose at least when young, flesh yellowish; lamellæ thin, close, adnate; stem slender, equal, stuffed or hollow; spores elliptical, .0003 in. long.

The Cinnamon cortinarius is smaller than either of the foregoing species, but it is more abundant. It is quite variable in size, shape and color. The cap is generally convex at first, but often expands until it is nearly flat. Sometimes it has a central prominence or umbo. It is more or less coated, at least when young, with minute silky fibrils, but sometimes becomes smoothish with age. Its color is commonly cinnamon-brown, brownish-ochraceous or tawny-brown. The gills are some shade of yellow when young, except in one variety, but when mature they assume the color of the spores. The stem is rather slender, often flexuous, fibrillose or silky, stuffed or hollow when old, and yellowish or colored like the cap, or a little paler.

In the Half-red variety, Variety *semisanguineus*, figures 15 to 20, the young gills have a dark blood-red color. This perhaps ought to be considered a distinct species.

The cap is usually one to two inches broad, the stem one to three inches long and one-fourth of an inch thick or less. The plant grows in woods or their borders, under trees or in mossy swamps. Like many flowering plants which have a wide range and are not particular as to their habitat, this mushroom is perplexing because of its variability, but it is believed that the description and figures here given will make it recognizable. The fresh plant often has a slight odor like that of radishes.

Paxillus *Fr.*

The genus *Paxillus* is characterized by its gills which are easily and smoothly separable from the cap just as the tubes of a Boletus are, from the cap that supports them. They are reticulately connected at the base in the single species here considered. The spores are ochraceous.

Paxillus involutus *Fr.*

Involute Paxillus.

Plate 28. Figs. 18 to 23.

Pileus compact, convex at first, soon expanded and centrally depressed, nearly glabrous, grayish-buff or ochraceous-brown or yellowish ferruginous, the margin involute and when young covered with a grayish tomentum ; lamellæ close, decurrent, branched and reticulately connected behind, whitish, then yellowish or subferruginous, changing to reddish-brown where cut or bruised ;

stem central or eccentric, solid, glabrous, colored like the pileus ; spores elliptical, .0003 to .0004 in. long.

The Involute paxillus is somewhat variable in color and exhibits a strange admixture of gray, ochraceous, ferruginous and brown hues, sometimes one being more prominent, sometimes another. It is apt to be viscid when moist and shining when dry. The margin is rolled inwards in the young plant, and is adorned with a grayish tomentum or villosity. It sometimes exhibits short markings as in figures 20 and 21. The flesh is not a clear white, but tinged with gray.

The gills are at first whitish, but they become yellowish or rust colored with advancing age and assume brownish or reddish brown stains where cut or bruised. They are decurrent and a little wavy and reticulately connected where they run down on the stem. The interspaces between them are marked with veins.

The stem is generally shorter than the diameter of the cap and solid. It is colored nearly like the cap and is sometimes adorned with a few darker spots.

Cap two to four inches broad, stem one to three inches long, one-third to one-half an inch thick.

The Involute paxillus grows in woods either on the ground or on decayed wood. It grows singly or in groups and seems to like damp mossy soil well filled with vegetable matter. It is common in cool hemlock or spruce woods, but occurs also in mixed woods, and along the borders of marshes. When growing on old decayed stumps or the prostrate moss-covered trunks of trees the stem is sometimes eccentric, but in other cases it is generally central. It appears from August to November.

It is sometimes called the Brown chantarelle, but it is scarcely a rival of the true chantarelle. Most authors record it as edible but they do not praise it highly. Richon and Rozé say it is edible but scarcely to be recommended. Letellier on the other hand says it can be employed as food with much advantage. It is also said to be held in high estimation in Russia. With us it is scarcely available except to people living near damp woods or swamps.

Rhodosporæ.

The name of this section, which in some works bears the name Hyporhodii, indicates that the spores are red, but their color is really a peculiar pinkish or rosy hue commonly described as flesh color or salmon color. It is a combination of ochraceous and pink. The mature gills usually have this color. Only a few species of this section are known to be edible and some have been thought to be unwholesome. There are several genera, but the species here considered belong to one only.

Clitopilus *Fr.*

The species of this genus are separable from all others of the section by their fleshy stem and decurrent gills. Mushrooms of similar structure occur in the genus Clitocybe which belongs to the section characterized by white spores. Their gills also are generally white in the mature plant. The pink-gilled species need not be confused with the Common mushroom and those of its relatives that have the gills of a pink color while young, for in them the pink color is soon replaced by brown or blackish-brown, but in these the gills retain their pinkish hue and never assume darker colors. Besides, in the Common mushroom and its allies the gills are not attached to the stem by their inner extremity, but in the species of this genus they are. Many species, not of this genus only but also of other genera in this section, have the gills white or whitish in the young plant, but with advancing age they assume the more permanent pinkish hue.

Clitopilus prunulus *Scop.*

PLUM CLITOPILUS.

Plate 14. Figs. 1 to 6.

Pileus fleshy, compact, broadly convex or nearly plane, sometimes centrally depressed, dry, suffused with a bloom, whitish or grayish, the margin sometimes wavy; lamellæ somewhat distant, decurrent, at first whitish, becoming salmon colored; stem glabrous, solid, white; spores oblong elliptical, pointed at each end, .0004 to .00045 in. long.

The Plum clitopilus is not a common species with us, and when it does occur it is not in abundance. Its cap is white or whitish inclining to grayish with the center sometimes decidedly darker than the margin. It is dry and firm and often seems to be covered with a bloom. Its flesh is white and the plant has an odor like that of meal.

The gills are at first nearly white but they assume a pale-pink or salmon color with age. They run down on the stem.

The stem is solid, smooth and white.

Cap two to three inches broad, stem one to two inches long, one-fourth to one-half an inch thick. This plant is found in woods in warm wet weather in July and August. It is solitary or there are but few individuals in a place. English writers speak highly of it as an esculent, and class it among the most delicious of edible species. Gillet says that it is one of the best mushrooms that can be found.

Clitopilus orcella *Bull.*

SWEETBREAD MUSHROOM.

Plate 14. Figs. 7 to 11.

Pileus fleshy, soft, broadly convex or nearly plane, generally irregular and wavy on the margin, silky, white or yellowish-white; lamellæ close, decurrent; stem short, solid, flocculose, sometimes eccentric; spores oblong-elliptical, pointed at each end, .00035 to .0004 in. long.

The Sweetbread mushroom is so much like the Plum mushroom that it is not surprising that they have been regarded as forms of one species. The differences indicated in the descriptions would make the Sweetbread mushroom generally a little smaller and less regular, the flesh softer, the cap slightly viscid in wet weather and a clearer white, and the gills a little closer together. Intermediate forms seem to connect the two supposed species, and however interesting the differences may be to botanists, the mushroom eater will scarcely try to keep the two forms separate. Both have the farinaceous odor and are not very different in taste. Some have considered the Sweetbread mushroom as slightly superior in the delicacy of its flavor. Both are good enough. The Sweetbread mushroom sometimes grows in pastures and open places. Miss Banning sometimes finds it growing in rings after the manner of the Fairy-ring mushroom. She finds some plants with the usual strong new-meal odor, others with but little odor and all with a flavor suggestive of cucumbers.

Leucosporæ.

The Leucosporæ or white-spored agarics are distributed among many genera. The species are more numerous than in any other section and many of them are edible. On the other hand, our most dangerous species occur in this section. The spores are generally white, as the name of the section indicates, but in a few cases they have a dingy or sordid-white hue, and in several species they are pale-yellow. In one or two species not found within the limits of our State they have a green color, but these are not yet recorded as edible species. In one mushroom the spores assume a pale-lilac tint after a brief exposure to the air and light. Pale-yellow spores occur especially in the genera Cantharellus, Lactarius and Russula.

Our edible species are found in about a dozen genera. The subjoined analytical table will serve to indicate the leading characters of each genus and may be used as a guide or an aid in tracing any species to its proper genus.

	Plant with a membranous sheath at the base of the stem or with superficial warts on the cap........	1
	Plant destitute of such sheath and warts	2
1	Stem furnished with a collar	Amanita.
1	Stem destitute of a collar	Amanitopsis.
2	Gills narrow, obtuse on the edge...............	Cantharellus.
2	Gills acute on the edge	3
3	Gills somewhat waxy in texture	Hygrophorus.
3	Gills not waxy in texture	4
4	Cap eccentrically or laterally attached to the stem or stemless	Pleurotus.
4	Cap centrally attached to the stem.............	5
5	Gills free from the stem	Lepiota.
5	Gills attached to the stem........................	6
6	Stem furnished with a collar	Armillaria.
6	Stem destitute of a collar	7
7	Stem brittle......................................	8
7	Stem not brittle	9
8	Gills exuding a white or colored juice where wounded	Lactarius.
8	Gills exuding no juice where wounded...........	Russula.
9	Dry plant reviving on the application of moisture...	Marasmius.
9	Plant putrescent, not reviving on the application of moisture	10
10	Edge of the gills notched or excavated at the stem	Tricholoma.
10	Edge of the gills even..........................	Clitocybe.

Amanita *Pers.*

In the genus *Amanita* the very young plant is enveloped in a membrane or a tomentose wrapper which is ruptured by the growth of the plant. In some species the remains of the ruptured wrapper persist about the base of the stem, forming a kind of cup or sheath; in others, a part of the wrapper is carried up on the surface of the cap and adheres to it in small irregular patches or in the shape of numerous small warts or prominences which are easily separable from it. It sometimes happens that these superficial warts are washed off by heavy rains. The cap in most of the species is regular and broadly convex or nearly flat when mature, and in some instances it is slightly sticky or viscid when moist. The gills are free from the stem and the stem is furnished with a membranous collar. These plants are generally large and attractive in appearance. Inasmuch as our most dangerous species belong to this genus it is very important that the specific characters of the edible ones should be thoroughly understood by those who would use them for food. Mistakes here are attended with too much risk to be lightly made. Some would counsel the rejection of all species of Amanita because of the presence in it of some poisonous ones; but it would be as reasonable to say we will eat no parsnips because the poison hemlock belongs to the same family, or no potatoes, tomatoes or egg plant because the deadly night shade is closely related. The only thing necessary is the ability to separate the good from the bad in one case just as we do in the other.

Amanita cæsarea *Scop.*

ORANGE AMANITA.

Plate 15.

Pileus glabrous, striate on the margin, red or orange, fading to yellow on the margin; lamellæ yellow; stem annulate; loosely sheathed at the base by the ruptured membranous white volva, yellow; spores elliptical, white, .0003 to .0004 in. long.

The Orange amanita is a large, attractive and beautiful species. When very young the cap and stem are contained in a white membranous envelope or wrapper not very much unlike a hen's egg in size, shape and color. As the parts within develop, the wrapper ruptures in its upper part, the stem elongates and carries upward the cap, while the remains of the wrapper surround the base of the stem like an open sack or loose sheath. The cap is at first red or orange, but with advancing age it fades to yellow on the margin. Sometimes the whole cap becomes yellow. In dried specimens the red color often wholly disappears. The margin, even in the young plant, is marked by distinct impressed parallel radiating lines or striations. The flesh is white but more or less stained with yellow under the separable epidermis and next the line of attachment of the lamellæ or gills. Its taste is mild and pleasant. As in most of our other species of Amanita, the cap, when fully expanded, is nearly flat above, and when moist its surface is slightly sticky or viscid.

The gills are rounded at the extremity next the stem and are free, that is, not attached or grown fast to the stem. They are yellow, and in this respect are unlike the gills of nearly all the other edible species of mushrooms here described. Generally the color of the gills in the mature plant resembles the color of the spores of that plant, but in this species we have an exception.

The stem and the flabby membranous collar that surrounds it toward the top are yellow like the gills, though sometimes they are stained in places by darker or saffron-colored hues. The stem of the young plant contains in its center a soft cottony substance or pith, but with advancing age this disappears and the stem is hollow. This character generally holds good in all the species of Amanita here described. In the very young plant the outer edge of the collar is attached to the margin of the cap and thereby it covers and conceals the gills, but with the elongation of the stem and the expansion of the cap, the collar separates from the margin and remains attached to the stem only.

The expanded cap is usually three to six inches broad, the stem four to six inches long and a half inch or more in thickness. Sometimes these dimensions are exceeded.

The plant grows chiefly during rainy weather or just after heavy rains, in July, August and September. It is found in thin woods and seems to be especially fond of pine woods and a sandy soil. It is not common. It sometimes grows in rings or in the arc of a circle.

This fungus has been held in high estimation as an article of food from very ancient times. It was used by the Greeks and Romans and having graced the table of a Roman emperor it received the name "Cæsar's mushroom," whence the botanical name. One ancient writer terms it "Cibus Deorum," the food of the gods. Imperial mushroom, Orange mushroom, true Orange, Yellow-egg and Kaiserling are other names applied to it.

All authors who have written concerning its esculent qualities agree in characterizing it as "delicious." Cordier says that it is an exception to the general rule that young plants are better for food than those fully grown. The inference is that the mature individuals are just as tender and sapid as the young ones. I have not tested this point. No charge or even suspicion of noxious quality seems to have been entertained against it in any case.

There is but one harmful species with which it is possible to confuse the Orange amanita. It is the Fly amanita, *Amanita muscaria*. These two resemble each other in size, shape and color of the cap, but in other respects they are quite distinct. The chief distinctive characters may be contrasted as follows:

Orange amanita. Cap *smooth*, gills *yellow*, stem *yellow*, wrapper *persistently membranous*, white.

Fly amanita. Cap *warty*, gills *white*, stem *white* or slightly yellowish, wrapper *soon broken into fragments or scales*, white or yellowish.

In Europe there is said to be a variety of the Orange amanita with the cap wholly white or whitish, but no such variety has yet been recorded in this country.

Amanita rubescens *Fr.*

Reddish Amanita.

Plate 16.

Pileus warty, even or but slightly striate on the margin, more or less tinged with dingy-red or brownish-red hues; lamellæ white or whitish; stem annulate, bulbous at the base, whitish, but generally with dull reddish stains, especially toward the base; spores elliptical, .0003 to .00035 in. long.

The Reddish amanita has a peculiarly sordid and uninviting appearance, owing to the dingy character of its colors. The wrapper which covers the young plant soon breaks up into small fragments, those on the cap being carried up with it in the growth of the plant and generally remaining on it in the form of small wart-like protuberances. The part remaining behind at the base of the stem is so fragile and fleeting that nearly all traces of it soon disappear, and were it not for the warts on the cap and the free lamellæ the plant would scarcely be suspected of being an Amanita. The warts on the cap are easily removable and are sometimes washed off by rain, leaving the cap entirely smooth. The margin of the cap is generally even, but sometimes, especially in fully matured individuals, it is more or less striated While the color is peculiarly dull and sordid it varies considerably. The cap may be whitish tinged with pink or red, brownish-red or dingy grayish-red. Sometimes it is not uni formly colored but has the margin paler than the center, or there may be darker stains in some places. The flesh is white or slightly tinged with red. Sometimes wounds of the flesh, gills or stem slowly assume a dull reddish color, but this is not a constant character.

The stem has a membranous collar near the top and a bulb at its base. In some cases this bulb is quite abrupt, in others it is pointed below and gradually narrowed into the stem above. The surface of the stem may be smooth in some plants, but generally it is more or less adorned below the collar with minute scales or mealy or branny particles. It is commonly of a whitish or dingy-white color, more or less stained with dull-red, especially toward and at the base. The center of the stem is of a looser, softer texture than the rest, and in mature plants it sometimes becomes hollow.

Cap three to five inches broad, stem three to six inches long, and generally about half an inch thick.

It grows either in woods or in open places, and may be found from July to September.

The Reddish amanita, as found in New York, is generally of a paler color than that indicated by most of the published figures of the species. Frequently the cap is almost white, with but a slight reddish or brownish-red tint. The strong distinguishing character of the species is the almost entire absence of any remains of the wrapper at the base of the stem. By this and by the presence of the dull-red hues and stains it may be distinguished from any of our poisonous species.

Some writers have referred to this species as of doubtful quality, suspected character or as poisonous, but later authors agree in classing it with the edible species. According to Cordier it is largely used in the eastern part of France, and is one of the most delicate mushrooms. Gillet agrees with him in this opinion. Cooke says it is pleasant both in taste and smell, and is a very common, safe and useful species. Stevenson records it as delicious and perfectly wholesome.

Amanitopsis *Roze.*

The principal feature wherein the genus *Amanitopsis* differs from Amanita is in the absence of a collar from the stem. Its species were formerly included in Amanita. We have one edible species.

Amanitopsis vaginata *Roze.*

SHEATHED AMANITOPSIS.

Plate 17.

Pileus rather thin, fragile, glabrous or adorned when young with one or more adhering fragments of the volva, deeply and distinctly striated on the margin ; lamellæ free, white or whitish ; stem destitute of an annulus, sheathed at the base by the torn remains of the rather long, thin, flabby volva; spores globose, white, .0003 to .0004 in. broad.

The Sheathed amanitopsis is distinguished from any species of Amanita by the absence of a collar from the stem.

In this plant the cap is quite smooth except in rare instances in which one or two fragments of the ruptured wrapper adhere to it for a time. The striations on the margin are deep and distinct, as in the Orange amanita. The cap is quite regular, but it is fragile and easily broken. In some instances a slight blunt protuberance or umbo develops at its center. It varies considerably in color, and several varieties depending on this variation have been described.

The flesh is white, but in the darker-colored forms it is grayish under the separable epidermis.

The gills are white or whitish and are gradually more narrow toward the stem. The stem is often smooth but generally it is sprinkled with minute mealy or branny particles or floccose scales, especially in young and vigorous specimens and in the dark-colored forms. It is either hollow or stuffed with a cottony pith. It is not bulbous, but it is sheathed at the base with a soft, flabby, torn membrane, the remains of the wrapper. This adheres so slightly to the stem that if the plant is carelessly pulled the sheath is left in the ground.

The cap is two to four inches broad; the stem, three to five inches long and one-fourth to one-half an inch thick.

The plant grows singly or scattered in woods or in open places. It is common in the deep damp vegetable mold of dense evergreen woods in mountainous regions, but is not limited to such localities. It is found in almost all parts of the State and on a great variety of soil. It sometimes grows on much decayed wood. It occurs from June to October.

In the white variety, Variety *alba*, the whole plant is white. This is *A. nivalis* (Grev.) and *A. fungites* (Batsch.).

In Variety *fulva*, *A. fulva* (Schæff) figures 1 to 4, the tawny variety, the cap is tawny-yellow or pale ochraceous.

In the livid variety, Variety *livida*, the cap has a livid or leaden-brown color and the gills and stem are more or less tinged with a smoky-brown hue. This is *A. livida* and *A. spadicea* (Pers.). See figures 5 to 9.

Some of the older authors placed the sheathed mushroom among the doubtful or suspected species, but more recent writers generally admit that it is edible. My own experience indicates that it is scarcely first class, though some pronounce it "delicate," "delicious," etc.

Lepiota *Fr.*

The species of *Lepiota* have the gills typically free from the stem, as in Amanita and Amanitopsis, but they differ in having no superficial or removable warts on the cap, and no sheathing or scaly remains of a wrapper at the base of the stem. In some species the epidermis of the cap breaks into scales which persistently adhere to the cap, and this feature, indeed, suggests the name of the genus, which is derived from the Latin word *lepis*, a scale.

Our State is favored with at least two very good edible species, both of which are easily recognized, if the generic characters are kept in mind.

Cap scaly, umbonate........................ L. procera.
Cap smooth, not umbonate.................. L. naucinoides.

Lepiota procera *Scop.*

PARASOL MUSHROOM. TALL LEPIOTA.

Plate 18.

Pileus thin, umbonate, adorned with brown spot-like scales; lamellæ white or yellowish-white, free, remote from the stem; stem very long, annulate, hollow, bulbous; spores large, elliptical, .0005 to .0007 inch long.

The Parasol mushroom is a very neat, graceful and attractive species. When young the cap is brownish or reddish-brown and somewhat resembles an egg in shape. Its reddish-brown epidermis soon breaks up into numerous fragments, and as the cap expands these become more and more separated from each other, except on and near the central boss or umbo. As the cap is paler beneath the epidermis it appears, when expanded, to be variegated by brown spots or scales. The paler surface has a somewhat silky or fibrillose appearance, minute fibrils radiating from the center toward the circumference. The cap sometimes becomes fully expanded, but usually it maintains a convex form like an opened umbrella or parasol. This form, together with the prominent umbo and the long slender stem, is very suggestive of the common name of this fungus. The flesh is soft, dry, slightly tough and white. It has no unpleasant odor or flavor.

The gills are whitish or slightly tinged with yellow. They are closely placed side by side, narrower toward the stem than toward the margin, and their inner extremity is so far from the stem that a conspicuous clear space is left about it.

The stem is very long in proportion to its thickness and is, therefore, suggestive of the specific name *procera*. It has a rather thick, firm collar, which in the mature plant generally becomes loosened and movable on it like a ring. At the base it swells out and forms a bulb. Generally the part below the collar is variegated by numerous small brownish dots or scales, but these are by no means a constant character. The stem is hollow or it sometimes contains a soft cottony or webby pith.

Cap three to five inches broad, stem five to ten inches long, one-fourth to one-half an inch thick.

This plant grows in thin woods, in fields and pastures and by roadsides. It usually grows singly or scattered, but sometimes in clusters. It may be found from July to September, but, unfortunately, it is not very common with us.

The Parasol mushroom has been highly commended and is evidently a first class edible species. "One of the most delicate species, although the flesh is slightly tough," "almost the greatest, if not the greatest, favorite with fungus eaters," "very delicate, of easy digestion and in great demand," are some of the recorded utterances in its favor.

There is no poisonous species with which it can be confused or for which it can be mistaken. The very tall slender stem with its bulbous base, the peculiarly spotted cap with its very prominent darker colored umbo, and the broad space or basin about the insertion of the stem and between it and the inner extremity of the gills, easily distinguish this mushroom.

There is a form in which the umbo and spot-like scales are paler than usual, and the whole plant, except these, is white. I regard it as a mere variety of the species. A form without an umbo and with a somewhat shaggy appearance to the cap has been found in the western part of the State. It closely resembles the Ragged lepiota, *Lepiota rhacodes*, a species which is also edible. Our plant, however, differs from the description of *L. rhacodes* in having larger spores; these being scarcely smaller than those of the Parasol mushroom. It is the opinion of some botanists that *L. procera* and *L. rhacodes* are forms of one species, so closely are they related, and in Massee's Fungus Flora the latter is considered a mere variety of the former.

Lepiota naucinoides *Pk.*

Smooth Lepiota.

Plate 19.

Pileus soft, smooth, white or smoky-white; lamellæ free, white, slowly changing with age to a dirty pinkish-brown or smoky-brown color; stem annulate, slightly thickened at the base, colored like the pileus; spores subelliptical, uninucleate, white, .0003 to .0004 in. long.

The Smooth lepiota is generally very regular and symmetrical in shape and of a pure white color. Rarely the central part of the cap is slightly tinged with yellow or with a smoky-white hue, which is occasionally dark enough to be called smoky-brown. Its surface is nearly always very smooth and even. In rare instances a slight mealiness or granular roughness develops on the central part of the cap. A very unusual form sometimes occurs in which the surface of the cap is broken into rather large thick scales which give it a singular appearance. To this form the name Variety *squamosa* has been applied.

The gills are a little narrower toward the stem than they are in the middle. At the inner extremity they are rounded and not attached to the stem. They are white or slightly tinged with yellow until maturity or old age when they acquire a slight pinkish-brown or even a smoky-brownish color. In dried specimens this last color prevails.

The stem has about the same color as the cap. It has a white collar of which the external edge is generally thicker than the inner. It sometimes breaks loose from its attachment to the stem and becomes a movable ring upon it as in the Parasol mushroom. Occasionally in old specimens it becomes torn and disappears entirely. Nearly always the stem gradually enlarges toward the base and forms a more or less distinct bulb. It is hollow, but as in most of the preceding species, the cavity often contains webby or cottony filaments, especially in the immature plants.

Cap two to four inches broad, stem two to three inches long, one-fourth to one-half an inch thick.

The Smooth lepiota grows in grassy places in lawns and pastures or by roadsides. Rarely it is found in cultivated fields, and even in thin woods. It may be found from August to November.

In my estimation this species is scarcely, if at all, inferior in its edible qualities to the Common mushroom. Its flesh is thick and white and usually tender and savory. It is very free from the attacks of insects and growing, as it often does, in places where the grass is short and dense, it has a neat, clean and attractive appearance. Its gills retain their white color a long time, and in this respect it has an advantage over the Common mushroom, in which they soon pass from the delicate pink of youth to the repulsive blackish hue of age. One of my correspondents in speaking of this species says "it grows abundantly here and is one of our finest edible mushrooms. I have taught our people to eat it and it is now highly prized in this region."

It being similar to the Common mushroom in size and color it is sometimes confused with that species. But a glance at the color of the gills is sufficient to separate the two. The color of the spores and the character of the stem and collar are also distinguishing differences. It still more closely resembles the Chalky mushroom, *Agaricus cretaceus*, but the darker color of the gills and the brown color of the spores of that species will also abundantly distinguish it. Our plant is apparently the American representative of the European *Lepiota naucina*, to which it was formerly referred, and from which it scarcely differs except in the shape of its spores and in its smoother cap. The spores are described by Fries as globose in the European plant. All the species here mentioned are edible, so that discrimination between them would not be necessary for safety in using any of them for food. It is, however, more satisfactory always to recognize without any doubt the species used for food. Our figures and descriptions will enable any one to do so. The Smooth lepiota was first recorded as edible in the Twenty-seventh Report, where it stands under the name *Agaricus naucinus*.

Armillaria *Fr.*

The species of *Armillaria* differ from all the foregoing white spored species in having the gills attached to the stem by their inner extremity. Like them their spores are white and the stem has a collar, but there is no wrapper at the base of the stem as in Amanita and Amanitopsis. By the collar the genus differs from the other genera which follow.

Armillaria mellea *Vahl.*

HONEY-COLORED ARMILLARIA.

Plate 20.

Pileus adorned with minute tufts of brown or blackish hairs, sometimes glabrous, even or when old slightly striate on the margin; lamellæ adnate or slightly decurrent, white or whitish, becoming sordid with age and sometimes variegated with reddish-brown spots; stem annulate, at length brownish toward the base; spores elliptical, white, .0003 to .0004 in. long.

The Honey-colored armillaria is very plentiful and extremely variable. The cap is generally adorned with numerous minute tufts or scales of brown or blackish hairs, which are often more dense on the disk or center than toward the margin. In young plants they are often so crowded on the disk as to cover it and give it a darker hue than the margin has, and they sometimes are so fine and matted that they have a kind of woolly or tomentose appearance. In some forms of the species they are entirely wanting, or they disappear with age. The cap is sometimes charged with moisture, and as this evaporates the color becomes slightly paler. Its color varies from almost white to a dark reddish-brown, which is shown in figure 4. The most common hue is a brownish-yellow shown in the lower figures of the plate. The margin of the cap in mature plants is commonly striated, but forms are not rare in which no striations appear. The center of the cap is sometimes prominent, as in figure 3. The flesh is white or whitish and its taste is somewhat unpleasant or acrid.

The gills are at first white or whitish, but with age they become less clear in color and are often more or less stained or spotted with reddish-brown. The inner extremity of those that reach the stem is attached to it and usually runs down slightly upon it. Sometimes there is a slight notch on the lower edge of the gills near the stem.

The stem is adorned with a collar which may be membranous or of a thick cottony texture, or so thin and webby that it entirely disappears in the older plants. Externally the stem is rather firm and fibrous, but centrally it is soft and spongy or even hollow. It varies considerably in color, but usually it assumes a reddish-brown or livid-brown hue, especially toward the base, remaining paler above. Sometimes a yellowish-green tomentum is noticeable at the base of the stem, and occasionally on the collar. The stem may be of uniform thickness or slightly thickened at the base or even narrowed almost to a point here. In one variety it has a distinctly bulbous base, in another a tapering base like a tap root which penetrates the earth deeply.

Cap one to six inches broad, stem one to six inches long, one-fourth to three-fourths of an inch thick.

The Honey-colored armillaria is very common and grows either in woods or in cleared land, on the ground or on decaying wood. A favorite habitat is about stumps and prostrate trunks in recently cleared places or in bushy pastures. Its mode of growth is either solitary, gregarious or in dense tufts or clusters. Tufts a foot in diameter and composed of twenty or more plants are not uncommon. The plants are especially abundant in hilly and mountainous districts in autumn. They rarely appear plentifully before the first of September, though occasional specimens have been seen as early as June.

Monstrous forms sometimes occur, and there is an abortive form which consists of a whitish irregular rounded mass of cellular matter without any distinction of stem cap or gills. This usually grows in company with the ordinary form, and is an inch or two in diameter. The mycelium of this fungus is thought to be destructive to the wood in which it grows. Probably most of the plants which appear to grow on the ground really take their rise from mycelium which permeates some fragment of wood or some root buried in the ground. It attacks both the hard woods and soft woods.

Authors disagree concerning its edible qualities. Some of the older authors considered it poisonous, but modern writers generally agree that it is harmless and edible, but of inferior quality. Cordier says it is edible and loses its acridity in cooking, but the stems are tough and not used.

Richon and Rozé affirm that its taste is astringent and that its acridity does not entirely disappear in cooking, but that it is edible though of indifferent quality.

According to Vittadini, it is preserved in vinegar, salt and oil for use in winter, and its acridity is lost in cooking. Gillet also says that in reality it is harmless, though it has an acrid, disagreeable taste, which disappears in cooking. "Esculent but not commendable," is the verdict of Berkeley; "edible but tough," says Stevenson, while Cooke tells us that it is very common and much used on the Continent, but is not recommended.

My own experience in eating it at various times, both fried and stewed, has always been without any harm. Cooking has appeared to me to dispel the unpleasant taste of the raw plant, but sometimes when the dish was prepared by stewing in milk and water, a slight, unpleasant burning sensation was felt in the throat a short time after eating. I consider it a perfectly safe and edible species, but not of first quality. Only the caps of young and fresh specimens should be used.

It is not improbable that such a variable plant as this may vary somewhat in flavor. We do not expect all varieties of apples to have exactly the same flavor, though the species may be one. The degree of toughness, too, may vary according to the age and the rapidity of the growth of the plants. Individual tastes may also differ, so that what would please one might be distasteful to another. Such facts may account, in part, at least, for the varying opinions concerning the edible qualities of this very common mushroom. The essential thing to know is, that the species is not dangerous. Then those who like it may eat it.

The following varieties of this species may be noted:

Variety *obscura* has the cap covered with numerous small blackish scales.

Variety *flava* has the cap yellow or reddish-yellow, but in other respects it is like the type.

Variety *glabra* has the cap smooth; otherwise like the type.

Variety *radicata* has a tapering, root-like prolongation of the stem, which penetrates the earth deeply.

Variety *bulbosa* has a distinctly bulbous base to the stem.

Variety *exannulata* has the cap smooth and even on the margin, and the stem tapering at the base. The annulus is very slight and evanescent or wholly wanting. The cap is usually about an inch broad, or a little more, and the plants grow in clusters, which sometimes contain forty or fifty individuals. It is more common farther south than it is in our State, and is reported to be the most common form in Maryland.

Notwithstanding the variability of the species, it is easily recognized when its characters are once known. I do not know of any dangerous species which could easily be mistaken for it.

The abortive form which often grows with it, is not distinguishable from the abortive form of *Clitopilus abortivus*. It has a farinaceous taste which is lost in cooking. It is not inferior to the normal form in flavor, and may be eaten with safety.

Tricholoma *Fr.*

The species of *Tricholoma*, and all the white-spored, gill-bearing fungi to be hereafter described in these pages, differ from all the preceding species in having no collar on the stem. In this genus the gills are attached to the stem, and are excavated or notched on the edge at or near the stem. It often happens that this notch is so near the extremity of the gill that the part attached to the stem is more narrow than the gill just beyond the excavation and causes the gill to appear as if rounded at the inner extremity. This is an important character, though not a very conspicuous one. The stem is fleshy and generally short and stout. Three species have been tried and approved, and are here described. Others reported as edible belong to our flora and await further trial.

Cap viscid when moist .... T. transmutans.
Cap not viscid, reddish-brown...... .... T. imbricatum.
Cap not viscid, reddish-violaceous .... T. personatum.

Tricholoma transmutans *Peck.*

CHANGING TRICHOLOMA.

Plate 21. Figs. 1 to 5.

Pileus viscid when moist, tawny-red, becoming reddish-brown with age; lamellæ whitish or pale-yellowish, becoming dingy or reddish-spotted when old; stem whitish, generally becoming reddish-brown toward the base, stuffed or hollow, spores white, subglobose, .0002 in. broad.

The Changing tricholoma has the cap moist and sticky when young and fresh, or during wet cloudy weather. Its color at first is tawny or tawny-red, but with advancing age it generally becomes darker, assuming a cinnamon-red or reddish-brown hue, but sometimes retaining a paler hue on the margin than in the center. The flesh is white and emits a mealy or farinaceous odor, especially when cut. The taste also is farinaceous.

The gills are placed closely side by side and are notched at the inner extremity where they are attached to the stem. At first they are whitish or slightly tinged with yellow, but when old they are much darker and more or less spotted with reddish brown.

The stem is about as long as the diameter of the cap. It is generally paler than the cap, being whitish when young, but assuming darker hues with age, especially toward the base. It is often stuffed with a softer substance or pith when young, but it soon becomes hollow.

Cap two to four inches broad, stem two to four inches long, about half an inch thick.

It grows in thin woods or open places in wet weather. It may be found from August to October. It is often found growing in tufts or clusters, but it is usually gregarious. It seems to prefer a sandy or light gravelly soil. It sometimes grows in company with the next species in groves of young spruce, balsam-fir and tamarack trees. Its edible qualities are very similar to those of the next species, from which it is easily known when moist, by reason of the viscidity of its cap. It was first recorded as edible in the Forty-second Report.

Tricholoma imbricatum *Fr.*

IMBRICATED TRICHOLOMA.

Plate 21. Figs, 6 to 11.

Pileus dry, innately squamulose, fibrillose toward the margin- brown or reddish-brown; lamellæ white, or yellowish white, becom, ing reddish or spotted with reddish-brown; stem solid, white and pulverulent at the top, colored like but generally paler than the pileus toward the base; spores elliptical, white, .00025 in. long.

The Imbricated tricholoma does not differ very greatly from the Changing tricholoma in size and color, but it can easily be distinguished from that species by the dry, not viscid, upper surface of its cap and by its solid stem. The cap is generally a little darker colored and its surface often presents a somewhat scaly appearance as if the epidermis had been torn into minute, irregular, scale-like fragments. The color is a cinnamon-brown or dark reddish-brown. The flesh is firm, white or whitish, and has a pleasant farinaceous odor and taste when fresh.

The gills have very nearly the same color and character as those of the Changing tricholoma.

The stem also is similar to the stem of that species, but it has no central cavity. Sometimes when old it becomes hollow by the mining of insects.

Cap two to four inches broad, stem two to three inches long, one-third to two-thirds of an inch thick.

This species grows under or near coniferous trees, such as pine, spruce, hemlock and balsam-fir. It appears in September and October. Like the preceding species it sometimes grows in clusters. It is often associated with *Tricholoma vaccinum*, a species very similar to it in size and general appearance, but which differs in three particulars. The margin in the young plant is covered with a soft downy or cottony coat, the stem is hollow and the taste is bitter or unpleasant. Nevertheless some writers class it among the edible species. Gillet says it is edible, but not of a very delicate flavor. So much do the two species resemble each other that so good a mycologist as Persoon seems to have confused them under the common name *Agaricus rufus*. A mistake of this kind by any one using the Imbricted tricholoma for food would not be serious, since this closely related plant has no dangerous properties.

Tricholoma personatum *Fr.*

Masked Tricholoma.

Plate 22.

Pileus moist, glabrous, variable in color; lamellæ crowded, rounded behind, free or nearly so, separable from the pileus, violaceous becoming sordid-whitish or fuscous; stem short, solid, fibrillose, whitish, commonly tinged with lilac or pale violet; spores elliptical, sordid-white, .0003 to .00035 inch long.

The Masked tricholoma is worthy of a place among the esculent species of the first class. When young the cap is very convex and firm, but when mature it is nearly flat and the flesh is more soft. It is very smooth and usually quite regular in shape when young, but in older plants the margin sometimes becomes irregular or wavy. In young plants the margin is rolled inwards and often whitened with downy or mealy particles or frosted with a slight bloom, but in old ones it is naked, and in wet weather it may even be curved upwards. The cap is apt to become water-soaked in wet weather, in which condition it has an uninviting appearance. It varies much in color, but generally it has a pale lilac hue, which is apt to change with age to a russety shade in the center. Occasionally the color of the cap is almost white or pale grayish. The flesh when dry is nearly white and has a pleasant taste.

The gills are closely placed and rounded at the end next the stem, to which they are but slightly attached, or from which they may be entirely free in some cases. They are generally more brightly colored in the young plant than in the mature one.

The stem is generally rather short and stout, its length being less than the diameter of the cap. It is solid, and externally adorned with fibrils and downy particles when young and fresh, but it soon becomes smooth. In color it is like the cap or paler than it. It is sometimes a little thicker at the base than at the top, and in one variety, which I have called var. *bulbosum*, and which is represented by figures 7 and 8, it is very distinctly bulbous.

Cap two to five inches broad, stem one to three inches long, one-half to one inch thick.

It grows in thin woods and in grassy open places. It does not often appear before September, but it may be found till freezing weather stops its growth. It generally grows singly or in groups, but occasionally it is found in clusters of several individuals.

Nearly all writers speak well of its edible qualities. Dr. Badham says that its taste is pleasant, and when not water-soaked it is a fine, firm fungus with a flavor like veal. Letellier states that it can be eaten with pleasure and without the least risk. Others pronounce it edible, very good, highly esteemed, very savory. My own experience leads me to place it among the first-class mushrooms.

In England this species is sometimes called *Blewits* and in France, *Blue stem*, although the color in our plant is more violet or lilac than blue. In Europe it is said to have been sometimes confused with *Tricholoma nudum*, a very closely related species, and also with *Cortinarius violaceus*, the Violet cortinarius, but such mistakes could result in no harm to the eater, for both these are edible and perfectly safe. So far as known, we have no hurtful species with which the Masked tricholoma would be likely to be confused. Its gills are somewhat separable from the hymenophore or flesh of the cap in the same manner as the gills of a Paxillus are, and for this reason the species has sometimes been referred to that genus, but mycologists generally place it in the genus Tricholoma. The spores, when dropped on white paper, have not the clear white color shown by those of most species of Tricholoma. The color is dingy-white or sordid-white.

Clitocybe *Fr.*

The genus *Clitocybe* differs from *Tricholoma* in the character of the gills. They are attached to the stem by their inner extremity as in that genus, but they are not notched or excavated on the edge near the stem, and they are generally decurrent. Several of our species have been recorded as edible, but trial has been made by us of only a few of them. Those here described are tabulated below.

	Cap thick-fleshed, with no reddish hues.......	1
	Cap thin-fleshed, more or less reddish	2
1	Cap grayish, gills close together.............	C. nebularis.
1	Cap brown or blackish-brown, gills wide apart.	C. media.
2	Cap funnel shaped when mature...........	C. infundibuliformis.
2	Cap convex or nearly plane when mature...	C. laccata.

Clitocybe nebularis *Batsch.*

Clouded Clitocybe.

Plate 23. Figs. 8 to 13.

Pileus fleshy, firm, at first convex, becoming nearly flat; lamellæ crowded, adnate or slightly decurrent, white or slightly tinged with yellow; stem firm, fibrillose, generally thickened at the base; spores elliptical, white, .0002 in. long.

The Clouded clitocybe is a rather large and firm mushroom with the cap at first convex, but when mature it becomes nearly flat or a little depressed. It is smooth and of a grayish or clouded-gray color, often becoming paler with age and sometimes evidently with a slight yellowish tint. The center of the cap is sometimes darker than the margin. In the American plant the color is generally paler than that of the European plant, as indicated by the published figures. The color of the flesh is white.

The gills are quite closely placed, and in the young plant are attached to the stem by the whole width of the inner extremity, but as the cap expands they appear to run down upon the stem and terminate in a narrow point. They are white or slightly tinged with yellow.

The stem is usually rather short and stout. It is thickest at the base and gradually tapers upward. It is firm and more or less adorned with longitudinal fibrils. It is generally paler than the cap. Its center is somewhat softer in texture than the exterior parts.

Cap two to five inches broad, stem one and a half to three inches long, one-half to one inch thick.

The usual habitat is among fallen leaves in woods where it appears in September and October. I have never seen it in fields. It is a rare species with us. It sometimes grows in clusters.

Some of the French mycologists do not admit this among the edible species, but English writers speak highly of it. Cordier says it is bad; Richon and Rozé say that its flavor is scarcely agreeable, and that it should be placed among the suspected species. Quelet asserts that he has eaten it often and found it good, but that sometimes it is indigestible and nauseous. Roques classes it as edible. Bulliard says "it is very agreeable to the taste." According to Badham it requires very little cooking and the flesh is perhaps lighter of digestion than that of any other. Stevenson quotes it as edible and very good, with a somewhat pungent taste and an odor of curd cheese. Cooke regards it as one of his favorite mushrooms, to which he gives special attention, and he thinks that no person, having a practical knowledge of its qualities, would place it among the suspected species.

Clitocybe media *Peck.*

Intermediate Clitocybe.

Plate 23. Figs. 1 to 7.

Pileus at first convex, becoming flat or slightly depressed, dry, dark grayish-brown or smoky-brown, the margin often wavy or irregular, the flesh white, taste mild; lamellæ broad, subdistant, adnate or decurrent, whitish, the interspaces somewhat venose; stem not at all or but slightly thickened at the base, colored like or a little paler than the pileus; spores elliptical, white, .0003 in. long.

The Intermediate clitocybe is very similar to the Clouded clitocybe in size and shape. Indeed, it might easily be mistaken for a dark colored variety of that species, but when examined closely it will be seen that the gills are not so close together as in that species, the spaces between them being noticeably wider, and often marked with little ridges or cross veins. The stem is also more cylindrical, scarcely tapering at all from the base upwards. In this respect it differs also from the Club foot clitocybe, *Clitocybe clavipes*, a species scarcely differing from the Intermediate clitocybe in color, although it has a more soft and spongy flesh and its cap is more narrow and more gradually tapering downward into the stem. It therefore appears somewhat like an inverted cone, while the stem may be compared to a long and narrow cone whose apex is united with the apex of the inverted one formed by the cap.

The Intermediate clitocybe is very scarce and has been found in cool deep woods only, growing among mosses that thickly carpeted the ground. It occurs in September. Its flesh is well flavored and it is a mushroom well worthy a place among the most desirable species. It is a matter of regret that it is not more abundant. It was first published as edible in the Forty-second Report of the State Museum, its edible qualities having been tested by the writer.

Clitocybe infundibuliformis *Schæff.*

FUNNEL-FORM CLITOCYBE.

Plate 24. Figs. 1 to 6.

Pileus at first convex and umbonate, becoming infundibuliform, dry, flaccid, reddish or pale tan color, fading with age; lamellæ decurrent, white; stem generally tapering upward from the base, colored like or paler than the pileus; spores somewhat elliptical, white, .0002 to .00025 in. long.

The Funnel-form clitocybe is a neat and rather pretty species, easily recognized by the funnel-like shape of the mature cap and its pale red color. When young the cap is slightly convex and often adorned with a very small prominence or umbo in the center. If observed closely it will be seen to be coated with a slight down or silkiness, especially on the margin. But as the cap expands it becomes depressed in the center, and in wet weather it resembles somewhat a large wine-glass in shape. The color is apt to fade and sometimes the margin of the cap becomes irregular or wavy. Occasionally specimens occur in which the cap is almost white. The flesh is thin and white.

The gills also are thin and white or whitish and rather closely placed. They run down on the stem in the mature plant, ending in a narrow point.

The stem is quite smooth and generally tapers upward from the base. It is sometimes white, but more often is colored like the cap. Usually a soft white down or felt is noticeable at its base. This is its mycelium which spreads in the soil or among the fallen leaves in which it grows.

The cap is two to three inches across, the stem is two to three inches long and one-fourth to nearly one-half an inch thick in the largest specimens.

It is not uncommon in woods in summer and autumn. Like many other species it is more abundant in wet weather. It delights especially to grow among fallen leaves in mixed woods, and though generally single or scattered in its mode of growth it sometimes forms clusters, in which case the cap is apt to be more or less irregular.

Although small in size and thin in flesh it affords a very delicate and delicious food.

When once known it is easily recognized, and I do not know of any hurtful mushroom in our flora with which it is likely to be confused.

Clitocybe laccata *Scop.*

LACCATE CLITOCYBE. WAXY CLITOCYBE.

Plate 25.

Pileus thin, convex or nearly plane, sometimes umbilicate, hygrophanous, glabrous or minutely scurfy-squamulose; lamellæ broad, distant, adnate or slightly decurrent, more or less tinged with flesh color; stem slender, equal, fibrous, stuffed, colored like the pilcus; spores globose, rough, .0003 to .0004 inch broad.

The Laccate clitocybe is a small but very common species which has a very wide range and is sometimes very abundant. It is also very variable, but easily recognizable when its peculiar characters are understood. It is thin in flesh, not highly flavored and apt to be tough, but because it has been classed among the edible species of Europe and because of its abundance and availability it is here admitted.

The cap is convex or nearly plane, even or umbilicate, smooth or with a slight scurfy roughness, When moist it has a watery appearance, and as this moisture dries the color changes more or less. In the moist state the color is some shade of pale red, buff red or flesh red, but when dry it fades to a grayish or pale ochraceous hue.

The gills are broad, rather wide apart and attached to the stem by their entire width. Sometimes they are slightly decurrent and occasionally emarginate, contrary to the generic character. They have a peculiar pale fleshy red hue which is more persistent than the color of the cap, and which is one of the best characters for the recognition of the species. When mature, they are apt to be dusted by the white spores.

The stem is rather long and slender, having a fibrous appearance and being either straight or flexuous. It is stuffed or almost hollow, rather tough and colored like the cap.

The cap varies from half an inch to two inches in horizontal diameter, and the stem from one to three inches in length and one to three lines in thickness.

There are several well marked varieties that have received names. One of the prettiest is the Amethyst variety, Variety *amethystina*, Figs. 23 to 27, in which the moist cap is much darker colored than in the ordinary form, and when dry it is of a grayish hue, but the gills have a beautiful deep violaceous color which is quite persistent. The spores are rather large and the lamellæ more decurrent than usual. It may be a good species.

In Variety *pallidifolia*, the pale gilled variety, the gills are much paler than usual, being but slightly tinged with the ordinary flesh color.

In Variety *striatula*, the striatulate variety, the plants are small, the cap is smooth, and so thin that shadowy lines or striations are seen on it radiating from near the center to the margin. This variety usually grows in very damp or wet places. Its spores are rather large, which may indicate a good species.

The Laccate mushroom may be found from the beginning to the end of the season, if the weather is not too dry. It is not particular as to its place of growth, but occurs in woods, groves, swamps or open fields, growing on naked ground or among grass, mosses or fallen leaves It is especially fond of pine woods or groves where the soil is kept shaded and moist.

Because of its departure from the generic character in its peculiar gills and spores it has been placed by some writers in a distinct genus under the name *Laccaria laccata*. It is closely related to *Clitocybe ochropurpurea* B. & C., a much larger species with a paler cap and brighter gills, and a short thick stem and often an irregular deformed development. This also should be associated with it generically under the name *Laccaria ochropurpurea*, if that genus is sustained.

Pleurotus *Fr.*

The genus *Pleurotus* scarcely differs from Tricholoma and Clitocybe except in the relative position of the stem and the cap. In these genera the cap is supported by a stem which is attached to it centrally. In Pleurotus the stem is attached to the cap at some point to one side of the center. Sometimes this point is on the very margin of the cap, and in a few species the stem is scarcely developed at all. Some of the species have the gills rounded or notched at the inner extremity as in the genus Tricholoma, and some have them decurrent on the stem as in Clitocybe. A distinctive character which is worthy of notice in this genus is found in the habitat. All the species, with which we have to do, grow on dead wood, while those of the two preceding genera, so far as here given, grow on the ground. Generally their flesh is more tough than in terrestrial species. Sometimes they grow from dead spots or dead branches of living trees, and are often out of reach, being far up from the ground.

	Stem present, distinct	1
	Stem wanting or indistinct..........................	P. ostreatus.
1	Spores white..	P. ulmarius.
1	Spores faintly lilac-tinted...............	P. sapidus.

Pleurotus ulmarius *Bull.*

Elm Pleurotus.

Plate 26. Figs. 1 to 4.

Pileus convex or nearly flat, firm, glabrous, white or centrally tinted with reddish-yellow or brownish-yellow, flesh white; lamellæ rather broad, rounded or notched at the inner extremity, adnexed, white or creamy white; stem firm, eccentric, generally curved, white or whitish; spores globose, white, .0002 to .00025 in. broad.

The Elm pleurotus, or elm tree mushroom, is a conspicuous object, growing, as it generally does, from dead places in or on the stumps of cut branches of standing elms. By its large size and white color it easily attracts attention. Its cap is broadly convex or nearly flat, quite smooth and usually white or whitish. Sometimes it is centrally tinged with a rusty or dull yellowish hue, and occasionally adorned with roundish spots as shown in figure 2. I have never seen the American plant as highly colored as some of the figures of the European plant. Sometimes the epidermis will be found cracked in small areas giving to the cap a scaly or tessellated appearance, and occasionally it cracks longitudinally. The flesh is firm and white.

The gills are quite broad and not very closely placed side by side. They are notched at the inner extremity as in species of Tricholoma. They are white, or when old, tinged with yellow.

The stem is firm and solid and united to the cap a little to one side of the center. It is generally more or less curved. This is especially the case when it grows from the side of the trunk of the tree. It is commonly smooth, but sometimes a little downy or hairy at the base. In color it is white or whitish.

Cap three to five inches broad, stem two to four inches long, one-half to three-fourths of an inch thick.

It appears from September to November. It is not uncommon to see this mushroom late in autumn growing on the elms that have been planted as shade trees along the streets of our cities and in our public parks. It grows especially on those that have been severely trimmed or had their tops cut away. Its time of appearance is so late in the season that it is not often infested by insects. It therefore persists a long time and will keep two or three days without harm. Its flesh is not as tender as that of many of the mushrooms that grow on the ground, but it has an agreeable flavor and is quite harmless. Most tree-inhabiting mushrooms grow more slowly and are, therefore, more tough and more slow to decay than those growing on the ground. They are also less easily collected since they often grow high up on standing trees. In consequence of their persistent character they are easily dried and preserved for winter use.

The Elm pleurotus sometimes grows on other than elm trees, as the maple and poplar. Occasionally when growing from the cut surface of an upright stump, or from the upper side of a branch, its stem is straight and attached centrally to the cap. Such a form has received the name Variety *verticalis*. A form is said to grow in Europe in which the whole stem is downy or hairy, but I have not found it in our State. According to Vittadini the Elm pleurotus is a fungus of first quality and very desirable. Letellier commends it as an article of food because of its large size, and Dr. Cooke mentions one specimen which was so large that it made a good meal for three or four persons. Quelet says that it is sapid, but should be eaten while young. When dried specimens are soaked several hours in water they resume their original size and are nearly as good as if fresh.

Pleurotus sapidus *Kalchb.*

Sapid Pleurotus.

Plate 27.

Pileus convex or depressed, glabrous, often irregular, variable in color, flesh white; lamellæ subdistant, decurrent, whitish; stems commonly tufted, growing from a common base, eccentric or lateral, glabrous, white or whitish; spores oblong, pale lilac, .00035 to .00045 in. long.

The Sapid pleurotus generally grows in tufts or crowded clusters, whose stems are more or less united at the base, and whose caps crowd and overlap each other. The caps are smooth and firm and in wet weather are somewhat moist. They are convex on the upper surface or centrally depressed, and owing to their crowded mode of growth are often very irregular in shape. They vary greatly in color, being white, yellowish, ashy-gray, dull lilac or even brownish. The flesh, however, is white.

The gills are rather broad and somewhat wide apart. They run down on the stem and there often branch and connect with each other. They are whitish or yellowish and sometimes present a ragged or torn appearance.

The stems are generally short and two or more usually grow from a common base. They are commonly white and smooth, solid and firm, and attached to the cap laterally or a little to one side of the center, though specimens occasionally occur in which the stem is quite central.

The peculiar character which distinguishes this species, and about the only one that is available for separating it in all cases from the next, is the lilac tint of the spores. When these are thrown down on black or brown paper they have a sordid, whitish appearance, but if caught on white paper the color of the mass is a very pale dull lilac as represented by figure 9. It has seemed to me that they are whitish, even on white paper, when first thrown down, but after a short exposure or after a greater accumulation the lilac tint appears. Notwithstanding this peculiarity in the color of its spores the species is classed among the white-spored mushrooms, and it is perhaps a question whether it is, after all, anything more than a variety of the next species.

Cap two to five inches broad, stem one to two inches long, one-fourth to two-thirds of an inch thick.

The Sapid pleurotus grows in woods and open places from June to November. It is quite common and more abundant in wet weather. It inhabits decaying wood and may be found about old stumps, prostrate trunks of trees or even on dead or dying trees while yet standing. Sometimes it appears to grow from the ground, but a careful investigation would show that it starts from some decaying root or some buried piece of wood. In Europe it is said to grow on elm and oak, but in our State it inhabits other trees also, such as beech, birch, maple and horse chestnut. I have eaten it both fried and stewed and consider it about the same as the Oyster mushroom in edible qualities. In Hungary, according to Dr. Kalchbrenner, it is eagerly sought for food in the woods, and is also cultivated on pieces of elm trunks in gardens.

Pleurotus ostreatus *Fr.*

OYSTER PLEUROTUS. OYSTER MUSHROOM.

Plate 26. Figs. 5 to 9.

Pileus convex, soft, imbricated, glabrous, moist, whitish, cinereous or brownish, flesh white; lamellæ broad, decurrent, anastomosing at the base, white or whitish; stem short, firm, mostly lateral and indistinct or absent; spores oblong, white, .0 03 to .0004 in. long.

The Oyster mushroom or Oyster fungus, so named because of its shape probably, rather than because of its flavor, is very similar to the Sapid mushroom. According to the descriptions of the European plant it is quite variable in color, but with us the prevailing colors are white or ashy-gray, changing to yellowish in the old or dried state. The stem when present is generally shorter than in the Sapid pleurotus and more often lateral. It is sometimes hairy at the base and sometimes wanting entirely. But the caps are clustered and overlapped very much as in that species, and the gills are the same in both. For table purposes there is little need of keeping the two distinct. Both are much more liable to be infested by insects than the Elm pleurotus. Both grow on decaying wood and at the same season and under similar conditions. The Oyster mushroom is apparently much less frequent in our State than the Sapid mushroom. It has long been classed among the esculent species, but in consequence of the toughness of its flesh it does not rank as a mushroom of first quality. Miss Banning states that she has eaten it both raw and cooked, but that she failed to detect any resemblance between its flavor and that of the oyster. Dr. Cooke says that it is a fleshy fungus, and when slowly and carefully cooked it is a pleasant and digestible one, but that it may be spoiled by bad treatment. French writers speak well of it and agree that it is both safe and excellent, but some recommend it only while young and tender. No charge of being deleterious is brought against it.

The remaining white-spored genera here represented differ from all the preceding either in the character of the gills or of the flesh.

Hygrophorus *Fr.*

In the genus *Hygrophorus* the gills of the mature plant have a soft waxy texture which distinguishes them from all others. They are not easily separable into the two membranes which form their two surfaces, as in the preceding genera. As in Pleurotus, the gills of some of the species are rounded or notched at the end next the stem, but of others they are decurrent on it. Those with decurrent gills bear considerable external resemblance to the species of Clitocybe, but the gills are generally thicker and much further apart than in that genus. No species of Hygrophorus is known to be dangerous, though two or three have been classed as suspected.

Hygrophorus pratensis *Fr.*

MEADOW HYGROPHORUS. PASTURE HYGROPHORUS.

Plate 28. Figs. 11 to 17.

Pileus compact, convex turbinate or nearly flat, glabrous, the margin thin; lamellæ thick, distant, decurrent, whitish or yellowish, the interspaces veiny; stem short, glabrous, white or whitish, sometimes yellowish; spores broadly elliptical, whitish, .00024 to .00028 in. long.

The Meadow hygrophorus, also called Pasture hygrophorus and Buff-caps, is a rather small but stout-appearing mushroom, which is quite variable in the color of its cap. This is commonly buff or yellowish, more or less tinged with red or tawny hues. Sometimes it is almost white. When young, the cap is nearly hemispherical or strongly convex, but with advancing age the thick fleshy center becomes more prominent. In full maturity the thin margin is apt to be extended horizontally so that the surface of the cap is nearly flat and its shape resembles an inverted cone whose sides are fluted by the widely separated gills. The flesh is white or nearly so and has a mild taste.

The thick gills extend far down on the stem in the mature plant, and in the bottom of the spaces between them cross veins may be seen connecting them together.

The stem is mostly white, or if tinged at all with the color of the cap, it is paler than it. Sometimes it tapers downward, becoming more narrow at the base than in the upper part. Its surface is smooth.

Cap one to two inches broad, stem one to two inches long, one-fourth to one-half an inch thick.

This species grows in old pastures and clearings or in thin woods. It is often found in old abandoned fields partly overgrown with brakes and bushes. It may be found from July to September.

It has, for many years and by nearly all writers on this subject, been classed with the edible species, and Dr. Cooke pronounces it to be thoroughly wholesome and of delicate flavor.

Hygrophorus miniatus *Fr.*

Vermilion Hygrophorus.

Plate 28 Figs. 1 to 10.

Pileus thin, fragile, at first convex, becoming nearly plane, glabrous or minutely squamulose, often umbilicate, generally red; lamellæ distant, adnate, yellow, often tinged with red; stem slender, glabrous, colored like the pileus; spores elliptical, white, .0003 in. long.

The Vermilion hygrophorus is a very highly colored, beautiful species. It is small, but in some localities it is so abundant that no difficulty need be encountered in procuring a quantity of it sufficient for a meal for a large family. The cap is thin and fragile, and it must be handled with care or it will be broken. In the young plant it is convex, but it expands with age until it is flat or even centrally depressed. Its surface is sometimes smooth and even shining, again it is roughened as if coated with minute scurfy scales. Frequently there is a little central depression or umbilicus in it. When young and moist the margin often shows slight striations, but in the dry or mature plant these are not seen. The margin is often irregular or wavy, and in very wet weather it may become curved upwards so that the cap becomes concave. The color is usually a bright red or vermilion, but sometimes it fades to paler or orange shades, and there is a variety in which the whole plant is yellow. This I have called variety *lutescens* and have represented it by figures 9 and 10. The bright color of this plant is apt to disappear in drying.

The gills are commonly yellow, but sometimes they are more or less tinged with the red color of the cap. They are not so wide apart as in the Meadow hygrophorus. They are generally attached to the stem by the entire width of the inner extremity, but specimens occur in which they are plainly notched at the inner end, and others are found in which they are slightly decurrent.

The stem is rather slender. In young plants it is solid, but in older ones it becomes wholly or partly hollow. It is colored like or sometimes paler than the cap.

Cap one-half to two inches broad, stem one to two inches long, one to two lines thick.

The Vermilion hygrophorus grows in woods, swamps and old fields in soil either wet or dry, among mosses or fallen leaves or on naked earth. It is sometimes found in great profusion in recent clearings over which fire has run. In such places it commonly attains a larger size than in dense woods, the cap attaining a diameter of even three inches. It is evidently fond of moisture and is more abundant in wet weather than in dry. It will grow even in the wet Sphagnum of peat bogs, and yet it is also found on the dry knolls and hillocks of the Adirondack region, growing freely under the shade of the brakes (*Pteris aquilina*) that cover them. It thus shows a great adaptability to varying conditions. It grows either singly, in groups or in clusters, and may be found from June to September. It is especially abundant in the Adirondack region.

Having experimented with this species twenty years ago I was agreeably surprised to find it scarcely surpassed by any in tenderness of substance and agreeableness of flavor. It was first recorded as an edible species in the Twenty-sixth Report of the State Museum.

A common species that closely resembles it is the Chantarelle hygrophorus, *Hygrophorus Cantharellus.* This is a smaller and more graceful plant, having a long slender stem and gills running very distinctly down on it. The colors of the two plants are the same, and they might easily be confused unless the character of the gills is noticed.

Lactarius *Fr.*

In the genus *Lactarius* the gills exude a milky or colored juice where cut or broken. This character alone is sufficient to distinguish this genus from all others, but there are other features which are quite characteristic. The texture is such that while the flesh seems firm and rigid it is nevertheless very brittle and easily broken. The fracture is quite even and not ragged or torn as in more fibrous or filamentous substances. The species are mostly stout and fleshy in appearance and resemble in outline those of the genus Clitocybe. In the mature plant the cap is generally somewhat funnel-shape or like a broad inverted cone. The gills are more or less decurrent and the stem is mostly stout and short. Some of the species have the cap adorned with circular zones or bands more highly colored than the adjacent parts. This feature is rarely seen in any other genus. The taste of the juice and flesh in many species is very acrid or hot and burning, like that of cayenne pepper. Unless this can be destroyed by cooking or drying such species must be considered wholly unfit for food. There is much uniformity in the spores of all the species. They are globose or nearly so and roughened by minute points or protuberances. Their color may be white or yellowish, according to the species.

Lactarius deliciosus *Fr.*

DELICIOUS LACTARIUS.

Plate 29.

Pileus at first convex and often slightly umbilicate, becoming nearly plane or centrally depressed, sometimes almost funnel-shaped, glabrous, yellowish-orange or grayish-orange varied with brighter mottled zones; lamellæ orange-colored; stem glabrous, often marked with a few orange-colored spots, colored like or paler than the pileus; juice orange-colored; spores globose, yellowish, .0003 to .0004 in. broad.

The Delicious lactarius is well marked by its peculiar colors and is easily distinguished from all our other species of Lactarius by its orange-colored juice The cap is convex when young, but in the mature plant it sometimes becomes centrally depressed or even shaped like a funnel. It is smooth, and when fresh and moist its surface is slightly viscid. Its color is some shade of orange enlivened by mottled circles or zones of deeper hue. These zones often appear as if composed of numerous confluent spots. They are less distinct in old plants, in which also the ground color fades and becomes tinged with greenish hues, as shown in figure 4. Such plants have an unattractive appearance and should not be used for food. The flesh is whitish, but tinged with orange, especially along the line of attachment of the gills. There is often a slightly acrid taste to it when fresh.

The gills are very similar to the cap in color. The orange-colored milk exudes from these in drops if they are cut or broken. This milk or juice pervades the whole plant and may exude from wounds in any part. Wounds and bruises slowly assume a dull greenish hue.

The stem is colored like or a little paler than the cap and is often adorned with a few bright orange spots. It is generally quite short when growing on naked ground, but longer if growing among mosses. In some cases it is narrowed at the base, in others not. It is generally hollow in mature plants.

Cap two to five inches broad, stem one to four inches long, one-third to two-thirds of an inch thick.

Common in woods, groves and damp, mossy places. It is especially fond of pine woods and mossy swamps, though not by any means limited to these. It may sometimes be found in swamps when dry weather prevents its growth elsewhere. It appears from July to October.

The following are some of the many quotations that might be made concerning the edible qualities of this mushroom. It is one of the best mushrooms with which I am acquainted and fully deserves its name and the high estimation in which it is held. Its flesh is firm, juicy, sapid and nutritious. *Badham.* It is the most delicate and the safest mushroom known. *Vittadini.* It is a species highly esteemed and generally liked. It is very good when properly cooked. It is also good preserved in vinegar. *Richon and Rozé.* It is certainly very good when cooked with care. *Quelet.* It is most excellent. *Berkeley.* Fried with butter and salt it has a taste like lamb. *Seynes.* It is edible but it is not as good as its name seems to indicate. *Gillet.* Served at the annual Woolhope dinners, it has always given satisfaction. *Cooke.* It is the most delicious mushroom known. *Smith.* My own experience with it leads me to consider it very good but scarcely equal to the best. Doubtless differences of opinion concerning it may be due in part to different methods of cooking. It is said to require delicate cooking, for too long or too rapid cooking will make it tough. One of the best methods is to bake gently three-fourths of an hour in a close covered dish, having seasoned it with butter, pepper and salt. I consider it one of our most valuable mushrooms, because of its common occurrence and goodly size, and because of the almost total impossibility of mistaking any deleterious species for it if regard be had to the color of its juice. From this it is sometimes called the Orange milk mushroom.

Lactarius volemus *Fr.*

Orange-brown Lactarius.

Plate 30.

Pileus convex or nearly plane, sometimes becoming centrally depressed or almost funnel-form, glabrous, dry, golden-tawny or brownish-orange, sometimes darker in the center; lamellæ crowded, adnate or subdecurrent, white or tinged with yellow; stem colored like or a little paler than the pileus, glabrous; juice white, abundant; spores globose, white, .00035 to .00045 in. broad.

The Orange-brown lactarius is a clean, firm and attractive species. It varies but little in color and is, therefore, easily recognized. The cap is at first convex and, as in nearly all species of Lactarius, with advancing age it expands and becomes nearly flat or is somewhat depressed in the center and slightly funnel form. It is very smooth and generally quite regular. Sometimes it has a slight umbo or protuberance in the center as shown in figure 2. In the mature plant the epidermis sometimes cracks into small angular patches or areas. In the descriptions of the European plant this is given as one of the distinguishing characters of the species, but it is by no means constant in the American plant. Indeed, it is more often absent than present. The color of the cap is a peculiar mixture of red, brown and yellow, somewhat difficult to describe. It has been called reddish-tawny, golden-tawny, brownish-orange and orange-brown. It varies somewhat in the depth of coloring, some being a shade darker or a shade paler than others, but the essential color is quite constant. In variety *subrugosus*, represented in figure 6, the margin of the cap is roughened with wrinkles which form irregular reticulations. In this variety the color is generally a little darker than in the normal forms. The flesh is white, sometimes tinged with yellow.

The gills are closely placed side by side and are attached to the stem by the whole width of their inner extremity, or in mature funnel-form caps they run down on the stem somewhat. They are white or yellowish. Where cut or broken a white juice or milk exudes in drops, and wounds or bruises quickly assume a brownish hue.

The stem is colored like the cap, but generally it is a little paler. It is quite firm and smooth and generally solid. It varies in length but is not often longer than the diameter of the cap.

Cap two to five inches broad, stem one to four inches long, one-third to three-fourths of an inch thick.

It grows in thin woods and open places. It is especially found in woods and groves of chestnut and oak. It is a common species and occurs from July to September. It is most abundant in warm showery weather. Usually many individuals will be found growing in company or in groups, so that it is not difficult to obtain a generous supply for the table. It is remarkably free from the attacks of insects, which is a point in its favor as an esculent. Sometimes in drying it emits an unpleasant odor, which is perhaps an indication that the specimens should not be kept too long before cooking. Many writers affirm that this fungus is quite as good raw as it is cooked, but to me it often has a slightly acrid or astringent flavor in the raw state. All acknowledge it to be edible.

Cordier says it is excellent and among the most agreeable edible mushrooms, and that in some countries it is eaten raw as well as cooked. Paulet declares it to be fine and delicate and that it is eaten with delight. Quelet asserts that it is better raw than cooked and that its sweet milk affords an agreeable drink for the botanist in the warm days of summer. Stevenson gives it as edible and delicious. My own experience with it would scarcely lead me to class it as more than an ordinarily good mushroom. Perhaps it might be improved by better cooking than I was able to give to it. I have not eaten it uncooked.

There are two or three species somewhat similar to the Orange-brown mushroom in color, but none of them are hurtful. We are sometimes cautioned against mistaking the Red lactarius, *Lactarius rufus*, for it. This is reported by Fries as very poisonous. I have found this on the high summits of the Catskills and in the cold mossy swamps and woods of the Adirondack region, but never in company with the Orange-brown lactarius. It is easily distinguished by its more red color, its smaller size, and especially by its exceedingly acrid burning taste. No one who had tasted it in the raw state could be induced to swallow the least particle of it.

Russula *Fr.*

The species of *Russula* are very similar to those of the genus Lactarius in size, shape, structure and texture. The spores also are of the same character. But this genus is at once separated by the absence of any milky or colored juice. The coloration is also peculiar in many of the species, bright or clear red and purplish hues prevailing. This character doubtless suggested the name of the genus. No species exhibits the colored circular zones seen on the caps of so many species of Lactarius. The taste of the flesh is very similar in both, in some species it being peppery or acrid, in others mild.

The following is the only species which I have tried, though several have been recorded as edible.

Russula virescens *Fr.*

Greenish Russula.

Plate 31.

Pileus at first nearly globose, then expanded and convex or centrally depressed, firm, dry, adorned with small flocculent patches or warts, greenish, sometimes tinged with yellow; lamellæ moderately close, free or nearly so, white; stem short, firm, white; spores nearly globose, slightly roughened, white, .00024 to .0003 in. broad.

The Greenish russula is quite distinct and easily recognized by its green or grayish-green and warty cap. In the young plant this is rounded or almost globular, but it soon becomes convex and sometimes when mature it may even be centrally depressed. Its surface is dry, not viscid as in some other greenish species, and it is broken up into small scales or wart-like patches. The margin in the typical form is even, but specimens often occur in which it is marked with impressed lines or striations as in figures 3 and 4. The margin of the expanded cap often becomes split. The flesh is white and has a mild taste.

The gills are white or whitish. They are narrow at the inner extremity and barely reach the stem. Generally some of them are forked and often a few shorter ones intervene between the long ones.

The stem is commonly shorter than the diameter of the cap. It is smooth, white and solid or somewhat softer and spongy in the center.

Cap two to four inches broad, stem one to two inches long, one-half to three-fourths of an inch thick.

In grassy grounds, groves or thin woods. July and August.

A green color in mushrooms is very rare, but in the genus Russula there are several species that exhibit it or an approach to it. But these all lack the wart-like adornments that characterize the Greenish russula, and therefore need not be mistaken for it. The color in our plant is not a bright green, but one more or less mingled with gray or yellowish. Sometimes the central part of the cap is more highly colored than the margin and sometimes it is paler, exhibiting here the yellowish tints.

Vittadini places this among the most safe and delicate species of Russula. Roques speaks highly of it, and says it can be eaten with entire confidence. According to Cordier it is a delicious mushroom with a pleasant taste and an agreeable odor. Richon and Rozé say it has excellent qualities but it needs proper seasoning. One of the most commendable of the edible russulas, edible, but its flavor is improved by cooking, edible but in little demand, are other opinions recorded concerning it. My own experience indicates it as of second-rate quality, but entirely harmless.

Cantharellus *Adans.*

The genus *Cantharellus* is separated from all the preceding genera by the character of the lamellæ. These have an obtuse or blunt edge, and are mostly forked or branched. They are generally narrow. In general appearance the species are not much unlike species of Clitocybe, for the gills are usually decurrent, but their thick branching and anastomosing habit and blunt edge give a very distinct character to the hymenium.

Cantharellus cibarius *Fr.*

Chantarelle.

Plate 32.

Pileus fleshy, firm, convex, becoming expanded or slightly depressed, glabrous, yellow, the margin at first involute, then spreading and often wavy or irregular; lamellæ narrow, thick, distant, decurrent, branched or anastomosing, yellow; stem firm, glabrous, solid, yellow; spores elliptical, pale yellowish, .0003 to .0004 inch long.

The Chantarelle is beautiful in color if not in shape, and is most easily recognized. Its color is a uniform rich egg-yellow, which is very constant. This extends to all parts of the plant except the inner flesh, which is white. The suface of the cap is smooth, but owing to the lobing and wavy character of the margin the shape is often irregular and unsymmetrical. The cap is generally convex or nearly flat above, but sometimes it is centrally depressed. It is gradually narrowed downwards to the stem, often presenting the general outline of a broad inverted cone.

The gills are narrow, with a rounded or blunt edge and with irregular branches which often connect with adjacent gills. In some individuals they are more branched than in others.

The stem is variable in length. It is often curved or slightly crooked, and sometimes tapers downward. It is smooth and solid, and by some it is considered as good as the cap for food.

Cap one to three inches broad, stem one to two inches long one-fourth to one-half an inch thick.

It grows in woods and open places. It is a common species, and may be found from June to September. A favorite habitat is in the deep shade of hemlock or spruce trees, but it also grows freely in thin woods of deciduous trees in wet, showery weather. It commonly grows in groups but sometimes in curved lines, as if trying to form a "fairy-ring." The European plant is said to exhale an odor like that of ripe apricots, but I have not been able to detect any decided odor in the American plant. The taste of the raw plant is often a little pungent or acrid.

The Chantarelle has long been celebrated for its edible qualities. Fries says that it is justly enumerated among the most sapid fungi; Badham, that no fungus is more popular; Cooke, that it is alike esteemed in France, Germany, Austria and Italy, where it is eaten regularly and exposed in the markets for sale; Gillet, that it is an excellent plant whether used as food or as a condiment; Stevenson, that it is edible and delicious. According to Berkeley, it is occasionally served up at public dinners at the principal hotels in London on state occasions, when every effort is made to secure the rarest and most costly dainties. Miss Banning affirms that she has eaten it both raw and cooked and that by a confirmed fungus eater it would be pronounced most charming. My own trials of it would lead me to place it among the best and most important of our wild mushrooms.

The Orange chantarelle or False chantarelle, *Cantharellus aurantiacus*, is the only species liable to be mistaken for the edible chantarelle. It may at once be recognized by the orange color of its gills, which are also thinner and more close and are regularly and repeatedly forked. The color of its cap is a paler and more dingy yellow, varied with smoky-brown tints.

Marasmius *Fr.*

The genus *Marasmius* differs from all the preceding genera by the tough texture of the small thin plants that compose it. The plant quickly withers or shrivels in dry weather and revives again under the influence of moisture. The gills are thin and have an acute edge. They are rather tough and flexible like the cap. The spores are white.

Marasmius Oreades *Fr.*

FAIRY-RING MUSHROOM.

Plate 14. Figs. 12 to 21.

Pileus fleshy, tough, glabrous, convex or nearly plane, often somewhat umbonate, reddish or tawny-red, becoming paler with age or in drying; lamellæ broad, distant, rounded behind or free, whitish or yellowish; stem slender, tough, solid, coated with a close dense villosity, whitish; spores nearly elliptical, white, .0003 to .00035 in. long.

The Fairy-ring mushroom has received this name because of its tendency to grow in rings or circles. In France it is called False mousseron and in England, Scotch bonnets. It is also called Fairy-ring champignon. When young and moist its cap is reddish, tawny-red or pale yellowish-red, but it becomes paler with age or as the moisture disappears. When dry it is generally pale-yellow or buff, as shown in figures 16 and 17. Sometimes it is slightly striated on the margin, especially when moist, as shown in figure 12. Often it is prominent in the center as if broadly umbonate. This is seen in figures 13 and 14. The flesh is rather thin, white and inclined to be tough.

The gills are rather broad and wide apart. They are rounded at the inner extremity and scarcely or but slightly attached to the stem. They are whitish or yellowish.

The stem is rather slender but solid and quite tough. It is covered with a fine close villosity or tomentum which can be scraped away, revealing the smooth surface of the stem beneath. Its color is whitish or pale grayish.

Cap one to two inches broad, stem one to two and a half inches long, scarcely one-fourth of an inch thick.

Common in pastures, lawns and grassy places by roadsides. May to October; appearing in wet weather or after heavy rains. It usually grows in groups, sometimes in arcs of circles or in complete circles or even in lines. It sometimes forms clusters.

It has long been esteemed as edible, but owing to its small size and somewhat tough substance it has not gained the general popularity it deserves. The following recorded opinions of it will not be without interest: It is very good while young. When young it may be eaten in an omelet. It has a very agreeable taste and odor and gives a delicious flavor to sauces, but it needs cooking a long time. There is little of it and it serves only as a condiment. It is edible and recommended especially as a condiment. It is delicious when broiled with butter. It may be pickled or dried for future use. It is very agreeable but in little demand because of its small size. It is a very delicious mushroom and the abundance in which it everywhere grows makes it a very valuable one. Its tendency to toughness is easily overcome by proper cooking.

There are two or three mushrooms which are somewhat similar to the Fairy-ring mushroom in size and color, and which might by carelessness be mistaken for it. One of these, the Semiorbicular naucoria, *Naucoria semiorbicularis*, sometimes grows in company with it. It may be distinguished from it by the color of the gills, which in the mature plant are rusty brown. Its spores when caught on white paper have a dark rusty or ferruginous color, and its stem is smooth.

The Oak-loving collybia, *Collybia dryophila*, also resembles it in the color of the cap and gills, but its gills are more narrow and very closely placed side by side, and the stem is very smooth and hollow. This usually grows in woods, but sometimes it occurs in open places and then might be taken for the Fairy-ring mushroom through carelessness.

An esteemed correspondent gives the following method of cooking this mushroom:

Throw the clean caps into sufficient boiling water to make a nice gravy when done, and cook them half an hour. Then rub together a small quantity of butter and flour and water, with salt and pepper, and add to the mushrooms, stirring for a moment. Pour on hot toast and serve in a hot dish.

Another method is to put the caps in water with butter and seasoning and let them simmer slowly ten or fifteen minutes. Then thicken with flour and serve alone, or if preferred pour over cooked meat.

As a condiment, chop in small pieces and add to cooking hash, stews, broths or meats just before time to serve.

Polyporeæ.

Boleti, Polypori and Liver Fungus.

In the family Polyporeæ the cap has no gills on the lower surface, but instead of them there are small tubes, holes or pores. The spores of the fungus are produced on the inner surface of these pores, and when mature, they are dropped or ejected from them into the open air. They may be caught in the same manner as the spores of agarics, but their color has not been ememployed in classification to the same extent that it has in that family. The edible species to be described belong to three genera, *Boletus*, *Polyporus* and *Fistulina*. The distinctive characters of these genera are indicated in the subjoined table.

	Pores compacted together and forming a continuous stratum	1
	Pores each in a distinct tube	Fistulina.
1	Stratum of pores easily separable from the cap	Boletus.
1	Stratum of pores not separable from the cap	Polyporus.

Boletus *Dill.*

The genus *Boletus* contains most of the edible species of this family. The substance of the cap is soft and fleshy and the cellular or porous stratum on the lower surface may be easily and smoothly removed by pressing it outwardly from the stem toward the margin. This is the chief character by which to separate a boletus from a polyporus. Nearly all boleti grow on the ground and have the stem centrally attached to the cap. Unfortunately for mushroom eaters, many of them grow only in warm and wet or showery weather when insects are numerous, and therefore they are very liable to be infested by larvæ. Care must be taken to reject such plants. The stems also must be discarded, for they are too tough to be good. The tubes or pores are apt to form a disagreeable mucilaginous mass if retained, and it is well to remove them before cooking. Some species have a viscid surface to the cap which causes dirt, sticks and leaves to adhere tenaciously to it. The caps of such plants should be peeled before cooking.

	Cap viscid when moist	1
	Cap not viscid	3
1	Stem furnished with a collar	2

1 Stem destitute of a collar .... B. granulatus.
2 Stem dotted above the collar .... B. luteus.
2 Stem dotted both above and below the collar ..... B. subluteus.
3 Stem rough with prominent colored dots........... 4
3 Stem with no dots................................ 5
4 Margin of the cap adorned with adhering fragments of a membranous veil.......................... B. versipellis.
4 Margin of the cap naked .... B. scaber.
5 Stem solid....................................... B. edulis.
5 Stem hollow or cavernous .... B. castaneus.

Boletus luteus *L.*

Yellow-brown Boletus.

Plate 33. Figs. 7 to 12.

Pileus viscid or glutinous, dingy or brownish-yellow, somewhat variegated with darker lines, spots or streaks, flesh white, sometimes tinged with yellow; tubes minute, yellow, becoming darker or ochraceous-yellow with age; stem short, stout, annulate, yellowish and dotted above the membranous annulus; spores yellowish brown, .00025 to .0003 in. long.

The Yellow-brown boletus is one of our rarest fungi. Its broadly convex or nearly flat cap is of a peculiar dingy color formed by a mixture of yellow and brown or reddish-brown, which is very obscurely varied by slightly deeper colored streaks or spots. When wet it is covered with a sticky gluten which is so tenacious that it can be peeled away with the cuticle. The flesh is white, but in mature plants it is sometimes tinged with yellow. The tubes are nearly plane in the young plant, that is, their mouths are in a plane surface. They are at first concealed by the white membranous veil which soon breaks from its attachment to the margin of the cap and shrinks to the stem, on which it forms a kind of collar. The young tubes are yellow, but they assume dingy ochraceous hues with age.

The stem is generally shorter than the horizontal diameter of the cap. It is yellowish above the collar and marked there with small brown dots. Below the collar it is generally more or less covered by a continuation of the veil, so that in very short-stemmed plants it appears as if sheathed by a wrapper as in the genus Amanita.

Cap two to five inches broad, stem one to two inches long, one-half to three-fourths of an inch thick.

I have found this species under pine trees only. It occurs in autumn.

European authors have written about its edible qualities as follows: Edible and highly esteemed; its flesh is very tender; it is excellent; it is good and extensively consumed in Germany.

Boletus subluteus *Peck.*

Small-yellowish Boletus.

Plate 33. Figs. 1 to 6.

Pileus viscid or glutinous when moist, often obscurely streaked or spotted, dingy-yellowish or ferruginous-brown, flesh whitish or tinged with dull yellow; tubes plane and yellow in the young plant, becoming dingy-ochraceous with age, and sometimes convex; stem slender, whitish or dingy-yellowish, annulate, dotted both above and below the annulus; spores oblong or subfusiform, .0003 to .0004 in. long.

The Small-yellowish boletus scarcely differs from the Yellow-brown boletus except in its smaller size and its more slender stem, which is dotted both above and below the collar. Its collar is less membranous in the mature plant, for it collapses or shrinks into a thick, often discolored, band instead of persisting as a flexible membrane. It is quite probable that it has often been confused with the larger species, and so far as its edible character is concerned such confusion would not be serious for there is but little difference in their flavor. This species is much more frequent than the other. It may be found from August to October. It occurs only in pine regions or in places where pine trees once grew. It is especially fond of a light sandy soil shaded by a thin or scattered growth of pine trees.

I do not know of any dangerous species with which these two boleti are liable to be confused.

Boletus granulatus *L.*

Granulated Boletus.

Plate 34. Figs. 1 to 5.

Pileus viscid or glutinous when moist, variable in color, usually grayish-yellow or tawny, the flesh white tinged with yellow;

tubes at first very pale-yellow, becoming dingy-ochraceous with age; stem short, thick, solid, dotted above, whitish or yellowish; spores oblong, rusty-ochraceous, .0003 to .0004 in. long.

The Granulated boletus has the cap viscid or glutinous when moist. It varies much in color. It may be pinkish-gray, grayish-yellow, reddish or ferruginous-brown or tawny. It is sometimes obscurely spotted from the drying gluten. The flesh is rather thick and white except along the lower surface next the tubes where it is generally tinged with yellow. The tubes are at first pale-yellow or almost white, but they assume the dingy-ochraceous hue which is common to many species in maturity. When examined closely, the mouths of the tubes are seen to be dotted with minute granules which give rise to the name of the species. These are at first in the form of drops of a thick juice, but with age they become dry and form brownish granules.

The stem is short, generally less than the horizontal diameter of the cap. It has no collar, but is dotted with small brown granules similar to those on the tube mouths. These granules are more numerous and distinct near the top of the stem. Sometimes they extend to the base, sometimes not.

Cap one and a half to four inches broad, stem one to two inches long, one-third to one-half an inch thick.

The Granulated boletus grows in pine woods and groves or under or near scattered pine trees. It may be found from July to October. It is one of our most common species in pine regions. It usually grows gregariously, many plants occurring in a small area. It sometimes grows in circles.

The absence of a collar on the stem at once distinguishes it from the preceding species.

The American boletus, *Boletus Americanus*, is often found growing with it and may be separated from it by the pale-yellow color, both of the cap and the flesh, and by its much more slender stem.

Nearly all authors agree in placing the Granulated boletus in the list of edible species. Dr. Cooke says that it has given him the greatest satisfaction and that he prefers it to the Edible boletus or, indeed, to any other which he has tried. This is a pretty strong recommendation, and is the more gratifying because this species is so abundant and so easily obtainable.

Boletus versipellis *Fr.*

ORANGE-CAP BOLETUS.

Plate 34. Figs. 6 to 10.

Pileus convex, dry, smooth or at first very minutely tomentose, reddish or orange-red, the flesh white or grayish, the margin adorned with the inflexed remains of a membranous concolorous veil; tubes small, depressed around the stem, whitish or grayish-white, becoming darker or more dingy with age; stem rather long, firm, solid, roughened with small reddish or blackish prominent dots or scales, whitish; spores oblong-fusiform, brown, .00055 to .0007 in. long.

The Orange-cap boletus takes its common appellation from the color of the cap. This is quite constantly a dull yellowish-red, less brilliant than orange. The peculiar distinguishing feature of the species is found in the torn or somewhat scalloped remains of the veil which adheres to the margin of the cap and is of the same color as it. It is generally turned under the margin and adheres slightly to the tubes also. It is not difficult to imagine it to be an extension of the epidermis of the cap.

The tubes are rather long, and in the mature plant they often form a convex mass, those near the margin and those near the stem being shorter than the intervening ones. The color is at first whitish or grayish, but in the mature plant it is considerably darker and not easily defined.

The stem is usually equal to or a little longer than the horizontal diameter of the cap. It is frequently a little narrowed at the top. Its color is similar to that of the young tubes, and it is adorned with numerous reddish or blackish prominent points, dots or scales. In some instances these are uniform in color, in others the two kinds of points are intermingled on the same stem.

Cap two to six inches broad, stem three to five inches long, one-third to three-fourths of an inch thick.

Woods and open places. I find this species especially in sandy soil of pine districts. It is single or scattered in its mode of growth and appears from August to October. It is by no means as common as the next species, to which, in my trials of it, it seemed inferior in esculent qualities. But differences in age or conditions of growth or in methods of cooking might make the difference in flavor. Dr. Cooke says it is equally as good as the next species.

Boletus scaber *Fr.*

Rough-stemmed Boletus.

Plate 35.

Pileus glabrous or nearly so, commonly convex, the flesh white or whitish; tubes small, long, soon convex in the mass, depressed around the stem, at first whitish, becoming darker, dingy or brownish; stem firm, solid, often narrowed at the top, whitish or grayish, roughened with numerous small prominent, reddish or blackish dots or scales; spores oblong-fusiform, brown, .00055 to .0007 in. long.

The Rough-stemmed or Scabrous-stemmed boletus may well be called our most common and, in respect to color, our most variable species. Its cap varies in color from white to almost black. It also varies somewhat in shape. It is generally convex or cushion-shaped, but sometimes it is hemispherical or even broadly conical. Its surface is commonly smooth, but occasionally specimens are found in which it is slightly downy or even scaly. The flesh is white or whitish, and the margin in mature plants is often thick and blunt by reason of the lengthening of the tubes.

The tubes are long and mostly convex in the mass in the mature plants. They are much shortened around the stem, thus leaving a depression or cavity there. When young and fresh they are whitish, but they become darker and dingy or brownish with age. Bruises or wounds of the whitish tubes and flesh sometimes produce a slight change in color, it assuming pinkish or blackish hues.

The stem scarcely differs in any respect from the stem of the Orange-cap boletus, and its characters need not be repeated here.

Several varieties have been described, most of which depend on the color of the cap.

Var. *niveus* has the cap white. Fig. 3. This is thought by some to be a distinct species.

Var. *aurantiacus* has the cap orange-red. Fig. 4. This differs from the Orange cap boletus only in the character of the margin of the cap.

Var. *fuligineus* has the cap fuliginous or cinereous-fuliginous. Fig. 5.

Var. *fuscus* has the cap brown or dark-brown. Figs. 2, 6 and 7.

Other variations in color are sometimes seen. The epidermis of the cap sometimes cracks into small angular areas or scales, which give it a peculiar appearance. This form has been designated as Var. *areolatus*, but neither this nor the varieties depending on color alone have a very substantial basis. They are probably mere forms rather than true varieties.

Cap one to five inches broad, stem two to five inches long, one-third to two-thirds of an inch thick.

The Rough-stemmed boletus occurs everywhere in woods, swamps and open places, and in sandy, gravelly, loamy or clayey soil. It may be found from June to November. It is easily recognized by its peculiar stem, no other species, except the Orange-cap boletus, having a stem like it. The dots are very different in character from those on the stems of the Granulated boletus and the Small-yellowish boletus. They are dry and fibrous, and not formed by the drying and hardening of a thick juice, as in those species.

Authors differ in their estimate of the edible qualities of this boletus. Some simply pronounce it edible; others say it is less agreeable than the Edible boletus, which is generally preferred to it. Gillet says that it can be eaten without the least fear, but that young plants should be selected for the table, old ones being generally more difficult of digestion. My own experiments with it were highly gratifying, and lead me to consider it a first-class species for the table.

Boletus edulis *Bull.*

EDIBLE BOLETUS.

(Plate 36. Figs. 8 to 12.)

Pileus glabrous, compact, becoming soft with age, grayish-red, brownish-red or tawny-brown, often paler on the margin, the flesh white or tinged with yellow, reddish under the epidermis; tubes soon convex, depressed around the stem, at first whitish, becoming greenish-yellow; stem stout, equal or thickened at the base, reticulated in the upper part, sometimes wholly reticulated, solid, pale or brownish; spores oblong-fusiform, .0005 to .0006 in. long.

The Edible boletus is one of our large species, though it is by no means as common as desirable. When young the cap is firm and the tubes white, with their mouths very indistinct. With advancing age the cap becomes softer and more yielding to pressure and the tubes assume a greenish-yellow or greenish-ochraceous hue and their mouths are then distinct. In color the cap is quite variable, exhibiting a mixture of red, yellow and brown hues. It is most often tawny-brown or reddish-brown on the disk, with paler and yellowish hues on the margin. The flesh is tinged with red under the cuticle.

The tubes form a convex mass, being depressed around the stem.

The stem is stout, solid and firm. It is adorned with a fine network of raised lines just below the tubes, and sometimes these reticulations extend to the base. It is most often somewhat swollen or thickened toward the base. Its color is generally paler than that of the cap, it being brownish or yellowish-brown or dingy white.

Cap four to six inches broad, stem two to six inches long, one-half to one and a half inch thick.

The Edible boletus grows in groves, woods and their borders, and sometimes in open waste places. It occurs in warm, showery weather, during July and August. It holds a prominent place among edible boleti, just as the common mushroom does among edible agarics. It has long been known as an edible species, and on this account its reputation has become widely spread. It has an agreeable, nutty flavor, even when raw, and it has secured favorable mention from nearly all writers on this subject. Badham recommends, especially, this and the Rough-stemmed boletus. Gillet says it is an excellent species, with an agreeable flavor, and that it is largely consumed in some parts of France. It is also cut in slices and dried for future use, and in this way is sold in the markets of Europe.

Boletus castaneus *Bull.*

CHESTNUT BOLETUS.

Plate 36. Figs. 1 to 7.

Pileus convex, becoming nearly plane or depressed, dry, firm, at first minutely velvety, commonly reddish-tawny or cinnamon, flesh white, unchangeable; tubes short, small, at first white, becoming yellowish; stem firm, short, stuffed or hollow, colored like the pileus; spores oval or broadly elliptical, pale-yellow, .0004 to .0005 in. long.

The Chestnut boletus is unlike any other species here described, in having a hollow stem. Its cap is at first convex, but it becomes expanded with age and sometimes the margin curves upward, as shown in figure 4. There is a minute velvety down on its surface, which is scarcely noticeable except to a close observer. The color is generally reddish-tawny or cinnamon. It is not always as dark as is indicated by the name.

The tubes are small and short. At first they are white, but they become yellowish as the plant matures.

The stem is short and not always straight. It is clothed and colored like the cap. Sometimes it tapers towards the top. When young it is soft and spongy in the center, but it becomes cavernous or hollow when old, as shown in figure 6. Its pale yellow spores are also a peculiar feature.

Some species of this genus quickly assume bluish tints where the substance is bruised or broken. The rule is sometimes given to avoid all such as poisonous. And yet one correspondent, an enthusiastic mycophagist, informs me that he eats such species, and has done so repeatedly without harm. In one instance however, which was brought to my notice, sickness and vomiting followed the eating of the sensitive boletus, *Boletus sensibilis*, a species which assumes a blue color in a remarkable manner where bruised, cut or broken. Even the pressure of the fingers in handling it causes it to assume blue spots where touched. All the family partaking of it were made sick, but all recovered.

Polyporus *Mich.*

In members of the genus *Polyporus* the stratum of pores is not smoothly or easily separable from the cap. Most of the species grow on dead or decaying wood and are too tough for food. A few grow on the ground, but even these are inclined to be tough. Very few of the wood-inhabiting species have a central stem and many have no stem at all. In some the texture is dry, hard, corky or woody, such as no one would think of eating, and of those classed as edible, it is generally better to select only the very young plants for food. My personal experience with these has not extended beyond the single species here described.

Polyporus sulphureus *Fr.*

Sulphury Polyporus.

Plate 37. Figs. 1 to 4.

Pileus broad, somewhat irregular and wavy, growing in tufts and closely overlapping each other, uneven, reddish or orange color when young and fresh, fading with age, flesh white; tubes very small, short, sulphur yellow; spores elliptical, white, .0003 in. long.

The Sulphury polyporus is easily recognized by its clustered mode of growth and its attractive colors. The caps are often five or six inches broad and they closely overlap each other, sometimes forming tufts or clusters of considerable size. Generally the flesh is not more than half an inch thick, white and easily broken. When young it is soft and juicy, and in warm, moist weather it sometimes exudes a yellowish milk or juice if cut or broken. In maturity it is dry and almost friable. The color of the young cap is yellowish-red or pale-orange, but the red or orange soon fades to yellow or becomes mingled with yellow. Its color is generally lost in drying. The margin of the growing cap is often beautifully yellow. It is more or less wavy or irregular.

The tubes are minute and short. They are of a bright sulphur-yellow color, which is more persistent than the red color of the cap.

There is no stem, but sometimes the cap is prolonged on one side into a stem-like base.

This species has a wide range and is found in all parts of our State. It grows in woods and in the open country. Its showy clusters are sometimes seen growing from dead spots in the trunks of living standing trees. It is perfectly at home on the dead wood of nearly all kinds of trees. Even fruit trees sometimes support it. It may appear at any time from June to September, but it delights in showery wet weather.

A variety sometimes occurs which might well be named variety *glomeratus*. In it a multitude of small caps are so closely and intimately united that their individuality is lost in the large mass which they form. Irregular and unequal holes or cavities in the general surface of the mass afford opportunity for a partial development of the pores of the imperfect caps. This variety is said to be more common in some of the western States than it is here.

In using the Sulphury polyporus for food, only the young and freshly grown caps were taken. These thinly sliced and fried in butter were much better than I had expected to find them. Mature specimens would probably be tough, dry, disagreeable and indigestible.

Fistulina *Bull.*

In the genus *Fistulina* the tubes stand close to each other, but are separate or distinct from each other and do not form a continuous compact mass as in *Boletus* and *Polyporus*. They are at first very short and resemble minute warts or papillæ, but they become cylindrical with age. We have only the single species here described.

Fistulina hepatica *Fr.*

LIVER FISTULINA.

Plate 37. Figs. 5 to 9.

Pileus fleshy, juicy, soft, dark-red, flesh red, variegated with brighter streaks; tubes small at first, yellowish or slightly tinged with pink, becoming dingy with age; spores elliptical, yellowish, .0002 to .00025 inch long.

The Liver fistulina has received various popular names in countries where its edible qualities are generally known. Among these are Oak tongue, Chestnut tongue, Beef tongue and Beefsteak fungus. Its cap when young is roughened on the upper surface with minute papillæ, which, with its shape and red color, are suggestive of the name Beef tongue. These papillæ disappear with age. In texture it is soft and juicy, but rather tough and somewhat fibrous. Its juice is reddish and the flesh is streaked with red. Its surface, when moist, is a little sticky or clammy to the touch. Generally there is a short lateral stem, but occasionally specimens are found without any stem.

The tubes are on the lower surface of the cap and quite small. At first they are like small pimples or papillæ, but they soon lengthen and become cylindrical. They are yellowish, more or less tinged with pink when young and fresh, but with age they assume a dingy, ochraceous hue which is almost indefinable.

The cap varies from two to six inches or more in breadth. It grows from old stumps of oak or chestnut in wet weather in July and August.

This Vegetable beefsteak or Beefsteak fungus has been highly commended by European writers. It has a slightly acid flavor, which is by no means disagreeable to some palates. Its toughness may be an objection with some, but it is not more tough than beefsteak. Some authors recommend only the young plant for food, but another says it is best when fully matured, the young fungus being somewhat bitter and astringent.

"It is good broiled with a steak and properly seasoned;" "if it is not beef itself, it is sauce for it;" "it is truly a vegetable beefsteak, for the taste resembles meat in a remarkable manner;" "no fungus yields a richer gravy, and, though rather tough when broiled, it is scarcely to be distinguished from broiled meat," are some of the expressions concerning the edible qualities of this fungus.

Hydneæ.

Hedgehog Mushrooms.

In the family Hydneæ, the cap, when present, has neither gills nor pores on its lower surface, but instead of these there are numerous spine-like or awl-shaped teeth projecting downwards. On the surface of these teeth the spores are developed. There are several genera in the family, in which these teeth are variously modified in shape and size, but as there are no edible species among them, they do not concern us now. Our edible species belong to the single genus *Hydnum*.

Hydnum *L.*

The distinct awl-shaped teeth or spines on the lower surface of the cap, when the cap is present, characterize this genus. In one edible species the cap is replaced by numerous branches, on whose inferior surface the teeth are developed. There are many species which are merely thin, effused membranous expansions, on whose surface the teeth are formed, but these furnish no edible species.

Teeth on the lower surface of a cap .... H. repandum.
Teeth on the lower surface of flattened branches .... H. coralloides.

Hydnum repandum *L.*

Spreading Hydnum.

Plate 38.

Pileus fleshy, fragile, convex or nearly plane, often irregular, nearly smooth, variable in color; spines pointed, whitish; stem stout, whitish or paler than the pileus, solid, often eccentric; spores globose, yellowish, .0003 in. broad.

The Spreading hydnum, or "hedge hog mushroom," figures 1 to 6, is not rare with us. Its cap is somewhat variable in color. It may be a pale-buff or rusty-yellow or pale-red or sienna-red. It is not often well formed and regular. The margin is apt to be wavy or lobed, and the stem attached to the cap a little to one side of the center. The substance is compact but easily broken. It is rather dry and whitish, but sometimes changes color slightly if cut or broken.

The spines or needles of the lower surface are about one-fourth of an inch long. They are whitish, often slightly tinted with yellow or pinkish.

The stem is mostly short, solid and stout, sometimes thickened at the base, sometimes at the top. It is commonly whitish, or at least paler than the cap.

Cap one to four inches broad, stem one to three inches long, one-half to three-fourths of an inch thick.

The Spreading hydnum grows in woods and in open places, either on naked soil or among grass or fallen leaves, either singly or in clusters. It appears from July to October.

The Reddish variety, Variety *rufescens* (*Hydnum rufescens* Pers.), figures 7 to 10, is smaller, thinner and more regular, with the stem mostly central. Its color is more red than in the typical form, and by some it is considered a distinct species. It is more common in woods. Its edible qualities are similar to those of the typical form.

According to Badham, the Spreading hydnum is as good as oysters, which it somewhat resembles in taste. Stevenson says it is one of the most delicious fungi, but that it requires about four hours slow cooking. Berkeley also pronounces it a most excellent fungus, but one that requires a little caution in its preparation for the table. One method of cooking it consists in first slicing the caps and steeping twenty minutes in warm water; then placing in a stew pan with butter, salt, pepper and beef gravy and simmering slowly for an hour. Cooke suggests that, owing to its slight pungency of flavor both raw and cooked, it may serve as a good substitute for mustard, and be placed with the meat in sandwiches. It may be dried and preserved for future use.

Hydnum coralloides *Scop.*

CORAL-LIKE HYDNUM.

Plate 24. Figs. 11 to 13.

Plant much branched, pure white, sometimes becoming yellowish with age; branches numerous, spreading, dense, angular or flattened, bearing the numerous crowded awl-shaped teeth along the lower side; spores globose, uninucleate, .0002 in. in diameter.

The Coral-like hydnum departs very decidedly from the usual form of the species of this genus, and is so unlike the others that it might easily be thought to belong to another genus, and, indeed, some French authors have included it in a separate genus *Dryodon.* It is so white, and its branches and spines are so numerous and dense, that it has been compared to a cauliflower in its general appearance. Others have evidently thought it resembles some species of coral. The plant is generally from two to four inches high and nearly or quite as broad, but sometimes it attains much larger dimensions The stem is very short, dividing into branches almost at the base. The larger branches are more or less angular or compressed. The terminal ones are often curved upwards and terminate in a crowded, somewhat spreading, mass of spines. Generally the spines are closely arranged along the lower side of the spreading branches and point downward toward the earth. They vary from one-sixth to one-third of an inch in length. They are easily broken. The pure white color of the whole plant, when young and fresh, and the unusual appearance of the branches, densely and stiffly fringed by the pendulous spines, make this fungus a very noticeable and an attractive object. It is said that a desire to study fungi was first awakened in the illustrious Fries upon his beholding for the first time this beautiful species growing in the woods.

It occurs on prostrate trunks of trees of various kinds, but with us it seems to prefer the beech. It is quite common in hilly and mountainous woods in rainy weather. It appears from August to October.

In our botanical expeditions in the extensive wilderness of the Adirondack region we were often obliged to camp in the woods several nights in succession. On such occasions this beautiful fungus sometimes contributed a luxurious dish to our ordinarily very simple and, sometimes, very limited bill of fare. In such cases it proved as good as it was beautiful.

It is scarcely possible to mistake any deleterious fungus for this, and it also has the advantage of generally being free from the attacks of insects and from dirt.

Thelephoreæ.

Cornucopia Mushrooms.

In the family Thelephoreæ the hymenium or spore-bearing surface is reduced to its utmost simplicity. It is a perfectly even surface of the hymenophore, or one rendered slightly uneven by obscure wrinkles or inconspicuous papillæ or granules. But few species have a distinct stem and cap. Probably no edible species will be found outside the genus *Craterellus.*

Craterellus *Fr.*

In the genus *Craterellus* the spore bearing surface is even or slightly rugose or wrinkled. The caps are generally thin and sometimes long and narrowly obconical or funnel-shaped. A single representative species is here described.

Craterellus cornucopioides *Pers.*

Cornucopia Craterellus.

Plate 24. Figs. 7 to 10.

Pileus thin, flexible, tubiform, hollow to the base, blackish brown, sometimes a little scaly; hymenium even or somewhat rugose-wrinkled, cinereous; stem very short, almost wanting; spores elliptical, whitish, .0005 to .0007 in. long.

The Cornucopia craterellus, or "Horn of plenty," is more common than attractive. It is easily recognized by its elongated tubular or narrowly trumpet-shaped cap and its dingy-gray or sooty-brown hue. It takes its name from its peculiar shape. Its flesh is quite thin, a little tough, flexible and dry. The surface of the cap is smooth or but slightly roughened with a few obscure fibrous tufts or scales. The color varies from grayish to a dark smoky-brown or sooty hue Th margin is sometimes erect, sometimes widely spreading and decurved like the margin of a trumpet's mouth. It is often wavy, lobed, irregular, folded or overlapping, or split. The cavity of the cap extends to the very base.

The spore-bearing surface is commonly a little paler than the upper surface and varies from ashy-gray to pinkish-brown or dark smoky-brown. It is generally a little uneven or rugose-wrinkled. It extends nearly or quite to the ground, the stem being very short or almost wanting.

The cap is from two to four inches long and one to two and a half broad at the top. The plants grow gregariously or in tufts in woods and shaded places. It is found especially in old roads in woods on naked soil, or on shaded banks, but sometimes it grows among fallen leaves or mosses. It may be found from July to September.

Cordier and some other French writers class this fungus among the edible species, but say that it is not very popular because of its thin flesh and dark color. Dr. Cooke admits that his first trial of this fungus was so satisfactory that he never missed an opportunity afterwards of gathering them for the table, and he says that a friend who learned of the edible qualities of this fungus from him now thinks nothing of walking six or eight miles to procure a dish of this craterellus.

Clavarieæ.

Fairy Clubs.

In this family no definite cap is developed, and no definite inferior fertile surface. The plants are of upright growth, either simple or branched, and the spores are developed on the upper or exterior surface of the plant or of its branches. The edible species are found in the single genus *Clavaria.*

Clavaria *Vaill.*

In this genus the fleshy plant is either simple or branched. When simple it is commonly slightly thickened upward, assuming a shape similar to a club, a character which has suggested the generic name. In some of the branched species the branches are very numerous and crowded and the plants have an appearance strongly suggestive of a bush in miniature. The flesh in some species is very tender and fragile.

In collecting them for eating care must be exercised to select only sound specimens, for insect larvæ usually enter the plant at or near the base, so that the branches may appear sound while the larvæ are at work below. Disappointment in the flavor will result from the use of the sound branches of such plants, for their flavor is spoiled by the presence of the larvæ in the base of the plant. No dangerous species are known in this genus, but some have a disagreeable flavor.

Tips of the branches yellow.... .... C. flava.
Tips of the branches red.............. .... C. botrytes.
Tips of the branches colored like the branches .... C. cristata.

Clavaria flava *Schæff.*

PALE-YELLOW CLAVARIA.

Plate 39. Figs. 1 to 4.

Stem short, thick, white, much branched; branches terete, even, fastigiate, whitish or yellowish, the tips pale yellow; spores oblong-elliptical, yellowish, .0003 to .00045 inch long.

The Pale-yellow clavaria has a very thick but short, fleshy, white stem, which supports many smooth crowded branches. These divide and subdivide until the upper part of the plant is a dense mass of small branchlets, each one of which terminates in one to three blunt tooth-like points. The stem and branches are white or whitish, sometimes slightly tinged with yellowish hues, but the ultimate branchlets or points are a clear, pale yellow while young and fresh. When old the yellow tips are apt to fade, and then the whole plant is nearly uniformly colored. The flesh is white and its taste agreeable. The plants are from two to five inches high, and the mass of branches is nearly as broad. It grows in thin woods and open places, and may be found from July to September.

Vittadini says that this clavaria is less esteemed in Italy thar the Red-tipped clavaria. Roques says it furnishes a healthfu food and one easy of digestion, that it is commonly eaten ii France and in great demand in Germany. My own experiment in eating it lead me to give it high commendation. Its flesh i tender and well flavored, and it seems to me nothing better coul be desired by the mycophagist.

Clavaria botrytes *Pers.*

Red-tipped Clavaria.

Plate 39. Figs. 5 to 7.

Stem short, thick, fleshy, whitish, much branched; branches often somewhat rugose-wrinkled, repeatedly branched, the tips red; spores oblong-elliptical, .0005 to .0006 in. long.

The Red-tipped clavaria differs but little from the preceding species in size and structure, but is easily distinguished by the red tips of the branches. The color elsewhere may be whitish or yellow or pinkish. When old the tips sometimes fade, and then it is less easy to separate this species from the Pale-yellow clavaria. The branches are sometimes longitudinally wrinkled. It grows in thin woods and open places, and may be found in wet weather in July, August and September. Nearly all mycologists agree in classing this among the edible species. They ascribe to it delicious qualities and an agreeable flavor. Unfortunately, it is not very common in our State.

Clavaria cristata *Pers.*

Crested Clavaria.

Plate 39. Figs. 8 to 12.

Stem rather slender, even, tenacious, stuffed, branched; branches dilated above, acutely incised or crested, the tips generally becoming brown with age; spores globose or broadly elliptical, white, .00025 to .0003 in. long.

The Crested clavaria is smaller than either of the two species already described, but it is much more abundant. It is not often more than two or two and a half inches high, but it often grows in tufts as broad as they are high. It varies in color, but is commonly white or whitish. Sometimes it has a dingy look as if it had been smoked. Again it is faintly tinged with dull pink or creamy-yellow. It is easily recognized by the peculiar tips of the branches. These are rather slender and acute or pointed, and sometimes so numerous as to give a crested appearance to the apically-flattened branch they terminate. When old they usually turn brown or blackish-brown at the tips. Unusual forms of the plant occur in which these acute terminal branchlets are wanting. The branches then end abruptly in a blunt point. Perhaps these forms are referable to *C. coralloides*, but that is described as having the tips of the branches acute.

The Crested clavaria grows in woods and in open places. It is especially common in the hilly and mountainous districts of the State. It loves cool, shaded and moist places, and grows on naked soil or among mosses and sphagnum. It usually grows in groups, sometimes in lines, and it is so plentiful that it is not difficult in some localities to gather enough for the table in a short time.

Poisonous and Unwholesome Fungi.

As has already been stated, the most dangerous fungi appear to belong to the single genus Amanita, and probably most of the fatal accidents from mushroom poisoning are due to two or three species. The characters of the genus need not be repeated here. The prominent distinctive features of the species here described are indicated in the brief tabular statement annexed.

	Cap warty, striate on the margin..................	A. muscaria.
	Cap not warty, even on the margin................	1
1	Remains of the membranous wrapper closely pressed to the base of the stem..........................	A. verna.
1	Remains of the wrapper distant from the base of the stem..	A. phalloides.

These plants are not ordinarily poisonous to handle, nor are they repulsive in taste or odor. They are clean and attractive in appearance, and the symptoms of poisoning that follow their use as food are slow in appearing.

On the other hand, those that are classed as unwholesome usually possess some character that may be taken as an indication of their unwholesomeness, though this is not always a sure guide to follow. Their toughness of texture, their nauseous and acrid taste, or their intolerable odor, will in most cases sound a note of warning.

A single species will here be illustrated and described as a representative of this class of fungi. It is the Bitter boletus, *Boletus felleus.*

Amanita muscaria *L.*

FLY AMANITA. FALSE ORANGE.

Plate 42.

Pileus warty, slightly striate on the margin; lamellæ white; stem annulate, bulbous-thickened at the base where it is more or less scaly from the fragments of the rupture l volva; spores broadly elliptical, white, .0003 to .0004 inch long.

The Fly amanita is our most common poisonous species. It is also very variable in size and in the color of its cap. It is generally a m st showy and attractive plant. The cap is adorned with numerous white or yellowish warts, the remains of the upper part of the wrapper. It is more or less striated on its margin, but individuals sometimes occur in which the striations are very inconspicuous or even wholly wanting. The color is bright-red, scarlet or orange in the young plant, but this nearly always fades to yellow on the margin in the mature plant. In one variety the cap is wholly yellow, and in another it is white. The fading process often goes on until the orange and yellow hues are replaced by whitish ones. The warts of the cap are sometimes washed off by heavy rains, so that it is possible to find specimens of this species without warts. The flesh is white, but except in white forms it is yellowish just under the epidermis. The gills are white, or in some cases slightly tinged with yellow. The same remark applies to the stem. This is furnished with a collar and terminates in a bulb at the base. This bulb is not broad and abrupt above as in the Poison amanita, but is gradually narrowed into the stem so that it has a somewhat ovate form. It, as well as the base of the stem, is more or less scaly from the adhering fragments of the wrapper, the remains of which do not adhere in an entire membranous sheath as in the Orange amanita and Sheathed amanita. As in other species, the stem may be either stuffed or hollow.

Cap three to eight inches broad; stem four to six inches long; one-half an inch or more in thickness.

It grows both in woods and in open places and pastures. It occurs from June till the freezing weather of October or November.

Very diverse statements concerning the properties of this fungus have been recorded. While some have attributed to it edible qualities, others have asserted that it is a most active poison and has caused numerous accidents by being confused with the Orange amanita. It is said to have caused death even when eaten in small quantities, and again it is said to have been eaten in abundance without any evil result. According to Quelet, it acts as a cathartic if eaten in small quantity, but causes death if eaten freely. One of my own correspondents assures me that he has eaten of the yellow variety, var. *formosa*, Fig. 6, without evil results, and that he regards it as very good. But there is no disputing the fact that the species possesses intoxicating and poisonous properties. It has long had the reputation of possessing properties fatal to flies that sip its juice. This suggests the names *muscaria*, *Fly amanita*, *Fly agaric* and *Fly killer* by which it is known. I have myself seen the cap of a single specimen surrounded by a circle of lifeless flies that had sipped the viscid juice from its moist surface and fallen victims to its virulent properties before leaving the place of their fatal repast.

Some have attempted an explanation of the contradictory statements concerning this plant by supposing that its poisonous properties are not always developed, that in some localities or under some favorable circumstances it is harmless. This explanation violates our sense of the constancy of Nature, and is not at all satisfactory. In the case of my own correspondent, the caps were peeled before cooking. May it not be that much of the noxious quality resides in the epidermis and the viscid substance upon it, and that by discarding this the dish is rendered less dangerous? In some instances may it not be true that it was eaten in too limited quantity to produce evil consequences? In some cases it is said that those who eat it freely and without harm boil it a long time in water and throw away the water. In this way, doubtless, much of the poison is abstracted. Long soaking in salt and water, also in vinegar, have been recommended as a means of rendering suspected or noxious species harmless, and may have been practiced in some of the cases in which this fungus has been eaten with impunity.* Whatever may be the explanation of the contradictory statements, the only safe way is to consider this species as deleterious and avoid its use under all circumstances. There is no need of taking any risks with suspected species, since there are so many good ones against which no charge of evil has ever been established.

* Since this was written another correspondent writes that he has eaten as many as four caps of the yellowish form of this species at one meal and without any evil consequences, and that the caps were not peeled. This makes pertinent the question, is this variety, indeed, a distinct and harmless species? It scarcely seems possible that the different experiences are explainable by reason of individual idiosyncrasy, or by variation in the properties of the plant.

It is said that some of the people of northern Asia make an intoxicating liquor of this fungus by steeping it in water.

Forms of this species occasionally occur which are wholly white or whitish. They are referable to Variety *alba*.

Amanita Frostiana, Frost's amanita, is found in more dense woods. It might easily be taken for a very small form of the Fly amanita. Its cap is only one or two inches broad, its gills and stem are often yellow, its collar is slight and often evanescent and the base of the stem is not scaly, the bulb being slightly margined by the remains of the wrapper.

Amanita verna *Bull.*

VERNAL AMANITA.

Plate 41. Figs. 4 to 7.

Pileus glabrous, even on the margin, white, viscid when moist; lamellæ white; stem annulate, white, floccose, stuffed or hollow, closely sheathed at the base by the remains of the membranous volva, bulbous; spores globose, .0003 inch broad.

The Vernal amanita scarcely differs from white forms of the Poison amanita except in the more persistent and more closely sheathing remains of the wrapper at the base of the stem. It is probably only a variety of that species, as most mycologists now regard it, and it should be considered quite as dangerous. I have not found it earlier than in July, although in Europe it is said to appear in spring, as its name implies.

Amanita phalloides *Fr.*

POISON AMANITA.

Plates 40 and 41. Figs. 1 to 3.

Pileus glabrous, even on the margin, white, greenish or brown; lamellæ white; stem annulate, abruptly bulbous at the base, the bulb slightly and loosely margined above by the remains of the volva; spores globose, white, .0003 in. broad.

The Poison amanita is very variable in the color of the cap, and yet is so definite in its structural characters that only the most careless observer would be likely to confuse it with any other species. There is, however, a sort of deceptive character about it. It is very neat and attractive in its appearance and "looks as if it might be good enough to eat." This appearance is fortified by the absence of any decidedly unpleasant odor or taste, but let him who would eat it beware, for probably there is not a more poisonous or dangerous species in our mycological flora. To eat it is to invite death.

The cap is wholly destitute of warts and of striations on its margin. It varies in color, from white to a dark smoky-brown. In the most common form it is white or a very pale greenish-yellow, as if it was white slightly tinged with yellow or greenish-yellow. I have never seen in it the decidedly green or olive-green colors which it appears often to have in Europe, and which are often indicated in figures of this species. There are two brown forms, one having the cap grayish-brown, as in figures 1 and 2, the other having it a dark smoky-brown, as shown in figures 3 to 5. The forms having a grayish or grayish-brown cap sometimes have the center of the cap darker colored or almost black. In Europe there is a white form with a black center to the cap.

The gills are persistently white. They are rather broad, rounded at the end next the stem and free from it.

The stem is white in the white-cap forms, but in those having a dark-brown cap it is usually tinged with brown, but is paler than the cap. The same is true of the collar. These dark-colored forms are more frequent in the cool woods of mountainous regions than elsewhere. When young the stem may be stuffed with a cottony pith, but it becomes hollow with age. The bulb at the base of the stem is an important character and should always be taken into consideration in the identification of the species. It is very abrupt, broad and distinct. Its breadth is often greater than its length. It is generally narrowly margined on the upper side by the remains of the wrapper. Sometimes this margin is reduced to a mere acute rim. It is distant from the stem, not closely pressed as in the Vernal amanita, and is frequently split or notched.

The cap is three to five inches broad, the stem three to six inches long and one-third to one-half an inch thick. The bulb is from one to one and a half inches broad.

The Poison amanita grows in woods, groves, open places and bushy pastures, and may be found from July to October. It is a common fungus.

I suspect that fatal cases of mushroom poisoning are especially attributable to the Vernal amanita and the white forms of the Poison amanita. But such accidents could only occur through ignorance or gross carelessness, for the distinction between these and the common mushroom is plain and unmistakable. It may be exhibited as follows:

Poison amanita. Gills *persistently white;* stem *equal to* or *longer* than the diameter of the cap, with a *broad distinct bulb* at the base.

Common mushroom. Gills *pink, becoming blackish-brown;* stem *shorter* than the diameter of the cap, with *no bulb* at the base.

From all forms of the edible Sheathed amanitopsis, the Poison amanita differs in its *distinctly bulbous* stem, in having a *collar* on the stem and in the *absence of striations* on the margin of the cap.

From the edible Reddish amanita, it is easily separated by the entire *absence* of any *reddish hues* or *stains* and of *warts* from its cap.

From the Smooth lepiota its distinct, *abrupt and margined* bulb at once distinguishes it.

Boletus felleus *Bull.*

Bitter Boletus.

Plate 43.

Pileus fleshy, convex above, glabrous or nearly so, grayish-brown, buff-brown, reddish-brown or tawny, flesh white, taste bitter; tubes long, convex in the mass in mature plants, at first whitish, becoming pale flesh color; stem equal or tapering upwards, usually reticulated at the top only, rarely wholly reticulated, commonly a little paler than the pileus; spores oblong-fusiform, pinkish, .0005 to .0007 inch long.

The Bitter boletus takes its name from the bitter flavor which its flesh persistently maintains. It is a common species, and one easily recognized by its reticulated stem and flesh-colored tubes taken in connection with its bitter taste.

The cap is rather thick, dry and smooth, but quite variable in color. This is generally some shade of brown tinged with red or yellow. The flesh is white, but when cut or broken and exposed to the air it sometimes assumes a pinkish tint.

The mass of tubes is generally somewhat convex in the mature plant, though it may be plane in the young plant. This also sometimes assumes a pinkish stain where bruised.

The stem varies greatly in length and thickness, and is sometimes crooked and deformed. It is usually reticulated at the top only.

Cap one and a half to four inches broad; stem one to four inches long, one-third to two-thirds of an inch thick.

The Bitter boletus occurs in woods and in open places. A favorite place of growth is in a soil largely composed of decayed wood and other vegetable matter. It is frequently found growing about much-decayed stumps and prostrate trunks of hemlock trees. It may be found from July to September.

The taste of the flesh in this Boletus, as well as in many species of Lactarius and Russula, is an important aid in the specific identification. In tasting fungi for this purpose care should be taken to select only fresh, sound specimens, and the part tasted should not be swallowed.

LIST OF PLATES AND SPECIES.

Plate			
A	Diagrammatic representation of parts of mushrooms		
1		Lycoperdon giganteum *Batsch.*	Giant Puff-ball
2		L. cyathiforme *Bosc.*	Cup-shaped Puff-ball
3	Figs. 1 to 3	Morchella esculenta *Pers.*	Common Morel
	Figs. 4 to 7	M. deliciosa *Fr.*	Delicious Morel
	Figs. 8 to 10	M. bispora *Sor.*	Two-spored Morel
	Figs. 11 to 13	M. semilibera *DC.*	Half-free Morel
4	Figs. 1 to 4	M. conica *Pers.*	Conical Morel.
	Figs. 5 to 9	M. angusticeps *Peck.*	Narrow-cap Morel
5	Figs. 1 to 3	Gyromitra esculenta *Fr.*	Esculent Gyromitra Edible Helvella
	Figs. 4 to 7	Helvella crispa *Fr.*	White Helvella
	Figs. 8 to 14	Mitrula vitellina v. irregularis *Peck.*	Irregular Mitrula
6		Agaricus campester *L.*	Common Mushroom
7		A. subrufescens *Peck.*	Slightly reddish Mushroom
8		A. arvensis *Schæff.*	Field Mushroom Horse Mushroom
9	Figs. 1 to 6	A. Rodmani *Peck.*	Rodman's Mushroom
	Figs. 7 to 12	A. placomyces *Peck.*	Flat-cap Mushroom
10		Coprinus comatus *Fr*	Shaggy Coprinus
11	Figs. 1 to 6	C. micaceus *Fr.*	Glistening Coprinus
	Figs. 7 to 11	C. atramentarius *Fr.*	Inky Coprinus
12		Cortinarius violaceus *Fr.*	Violet Cortinarius
13	Figs. 1 to 6	C. collinitus *Fr.*	Smeared Cortinarius
	Figs. 7 to 14	C. cinnamomeus *Fr.*	Cinnamon Cortinarius
	Figs. 15 to 20	C. cinnamomeus v. semisanguineus *Fr.*	Half-red Cortinarius
14	Figs. 1 to 6	Clitopilus prunulus *Scop.*	Plum Clitopilus
	Figs. 7 to 11	C. orcella *Bull.*	Sweet-bread Mushroom
	Figs. 12 to 21	Marasmius oreades *Fr.*	Fairy-ring Mushroom
15		Amanita cæsarea *Scop.*	Orange Amanita
16		A. rubescens *Fr.*	Reddish Amanita
17		Amanitopsis vaginata *Roze.*	Sheathed Amanitopsis
18		Lepiota procera *Scop.*	Parasol Mushroom Tall Lepiota
19		L. naucinoides *Peck.*	Smooth Lepiota
20		Armillaria mellea *Vahl.*	Honey-colored Armillaria

Plate			
21	Figs. 1 to 5	Tricholoma transmutans *Peck.*	Changing Tricholoma
	Figs. 6 to 11	T. imbricatum *Fr.*	Imbricated Tricholoma
22		T. personatum *Fr.*	Masked Tricholoma
23	Figs. 1 to 7	Clitocybe media *Peck.*	Intermediate Clitocybe
	Figs. 8 to 13	C. nebularis *Batsch.*	Clouded Clitocybe
24	Figs. 1 to 6	C. infundibuliformis *Schœff.*	Funnel-form Clitocybe
	Figs. 7 to 10	Craterellus cornucopioides *Pers.*	Cornucopia Craterellus
	Figs. 11 to 13	Hydnum coralloides *Scop.*	Coral-like Hydnum
25		Clitocybe laccata *Scop.*	Laccate Clitocybe
26	Figs. 1 to 4	Pleurotus ulmarius *Bull.*	Elm Pleurotus
	Figs. 5 to 9	P. ostreatus *Fr.*	Oyster Pleurotus Oyster Mushroom
27		P. sapidus *Kalchb.*	Sapid Pleurotus
28	Figs. 1 to 10	Hygrophorus miniatus *Fr.*	Vermilion Hygrophorus
	Figs. 11 to 17	H. pratensis *Fr.*	Meadow Hygrophorus
	Figs. 18 to 23	Paxillus involutus *Fr.*	Involute Paxillus
29		Lactarius deliciosus *Fr.*	Delicious Lactarius
30		L. volemus *Fr.*	Orange Lactarius Orange-brown Lactarius
31		Russula virescens *Fr.*	Greenish Russula
32		Cantharellus cibarius *Fr.*	Chantarelle
33	Figs. 1 to 6	Boletus subluteus *Peck.*	Small yellowish Boletus
	Figs. 7 to 12	B. luteus *L.*	Yellow-brown Boletus
34	Figs. 1 to 5	B. granulatus *L.*	Granulated Boletus
	Figs. 6 to 10	B. versipellis *Fr.*	Orange-cap Boletus
35		B. scaber *Fr.*	Rough-stemmed Boletus
36	Figs. 1 to 7	B. castaneus *Bull.*	Chestnut Boletus
	Figs. 8 to 12	B. edulis *Bull.*	Edible Boletus
37	Figs. 1 to 4	Polyporus sulphureus *Fr.*	Sulphury Polyporus
	Figs. 5 to 9	Fistulina hepatica *Fr.*	Liver Fistulina
38		Hydnum repandum *L.*	Spreading Hydnum
39	Figs. 1 to 4	Clavaria flava *Schœff.*	Pale-yellow Clavaria
	Figs. 5 to 7	C. botrytes *Pers.*	Red-tipped Clavaria
	Figs. 8 to 12	C. cristata *Pers.*	Crested Clavaria
40		Amanita phalloides *Fr.*	Poison Amanita
41	Figs. 1 to 3	A. phalloides *Fr.*	Poison Amanita (Whitish)
	Figs. 4 to 7	A. verna *Bull.*	Vernal Amanita
42		A. muscaria *L.*	Fly Amanita
43		Boletus felleus *Bull.*	Bitter Boletus

EXPLANATION OF PLATE A.

Fig. 1 An Amanita; *c* the *pileus* or cap; *m* the striated margin of the cap; *g* the *lamellœ* or gills; *a* the *annulus*, ring or collar; *s* the stem; *v* the *volva* or wrapper; *mc* the *mycelium* or spawn.

Fig. 2 A Boletus; *c* the cap; *p* the tubes or pores; *a* the collar; *s* the stem; *mc* the *mycelium*.

Fig. 3 A Hydnum; *c* the cap; *t* the *aculei* or teeth; *s* the stem; *mc* the *mycelium*.
Figs. 4 to 8 Vertical sections of caps and the upper part of their stems showing the relations of gills to stems.
Fig. 4 Gills free from the stem; stem hollow.
Fig. 5 Gills adnexed; stem stuffed.
Fig. 6 Gills adnate; stem solid.
Fig. 7 Gills emarginate, also adnate and having a decurrent tooth.
Fig. 8 Gills decurrent.
Fig. 9 A plant with its cap umbonate, also squamose, and its stem bulbous.
Fig. 10 A plant with its cap umbilicate, its gills decurrent and its stem equal.
Fig. 11 A basidium with its four spores.
Fig. 12 An ascus containing eight spores.

PLATE 1.

Lycoperdon giganteum *Batsch.*

Giant Puff-ball.

Fig. 1 An immature plant; about one-half the natural size.
" 2 A mature plant with its rind above breaking into fragments, falling away and exposing the dusty mass of spores; about half the natural size.
" 3 Two fragments of filaments from the spore mass, magnified about 400 diameters.
" 4 Several spores, × 400.

PLATE 2.

Lycoperdon cyathiforme *Bosc.*

Cup-shaped Puff-ball.

Fig. 1 An immature plant.
" 2 A full-grown plant with even surface.
" 3 A full-grown plant with the surface cracked into areas or broad spot-like scales.
" 4 A mature plant with the upper part of the rind breaking into fragments, falling away and exposing the purplish spore mass.
" 5 The ragged cup-shaped base of an old plant after the upper part of the rind and the spore mass have been dispersed.
" 6 Vertical section through an immature plant.
" 7 Two fragments of filaments from the spore mass, × 400.
" 8 Seven spores, × 400.

PLATE 3.

Morchella esculenta *Pers.*

Common Morel.

Fig. 1 A mature plant.
" 2 Vertical section through the center of a mature plant.
" 3 A spore sack containing eight spores, × 400.

MORCHELLA DELICIOSA *Fr.*

Delicious Morel.

Figs. 4 and 5 Mature plants, two forms.
" 6 Vertical section through the center of a mature plant.
" 7 A spore sack containing eight spores, × 400.

MORCHELLA BISPORA *Sor.*

Two-spored Morel.

Fig. 8 A mature plant.
" 9 Vertical section through the center of a mature plant.
" 10 A spore sack containing two spores, × 400.

MORCHELLA SEMILIBERA *DC.*

Half-free Morel.

Fig. 11 A mature plant.
" 12 Vertical section through the center of a mature plant.
" 13 A spore sack containing eight spores, × 400.

PLATE 4.

MORCHELLA CONICA *Pers.*

Conical Morel.

Figs. 1 and 2 Mature plants.
" 3 Vertical section through the center of a mature plant.
" 4 A spore sack containing eight spores, × 400.

MORCHELLA ANGUSTICEPS *Peck.*

Narrow-cap Morel.

Figs. 5, 6 and 7 Mature plants of various forms.
" 8 Vertical section through the center of a mature plant.
" 9 A spore sack containing eight spores, × 400.

PLATE 5.

GYROMITRA ESCULENTA *Fr.*

Esculent Gyromitra. Edible Helvella.

Fig. 1 A mature plant.
" 2 Vertical section through the center of a mature plant.
" 3 A spore sack containing eight spores, × 400.

HELVELLA CRISPA *Fr.*

Figs. 4, 5 and 6 Mature plants of various forms.
" 7 A spore sack containing eight spores, × 400.

MITRULA VITELLINA *Sacc.* var. IRREGULARIS *Peck.*

Irregular Mitrula.

Figs. 8 to 13 Mature plants of various forms.
" 14 A spore sack containing eight spores, × 400.

PLATE 6.

Agaricus campester *L.*

Common Mushroom.

Fig. 1 A cluster of three young plants, in one of which the veil has just separated from the margin of the cap, thereby revealing the gills.

" 2 and 3 Plants with their caps partly expanded and their gills yet pink-colored.

" 4 A mature plant with its cap fully expanded and its gills blackish-brown.

" 5 Vertical section of the cap and upper part of the stem of an immature plant.

" 6 Vertical section of the cap and upper part of the stem of a mature plant.

" 7 Four spores, × 400.

Variety hortensis.

Fig. 8 An immature plant.

" 9 A mature plant.

" 10 Four spores, × 400.

PLATE 7.

Agaricus subrufescens *Peck.*

Slightly Reddish Mushroom.

Fig. 1 A young plant whose veil has just separated from the margin of the cap, revealing the whitish color of the gills.

" 2 A cluster of four plants, two young, and two older ones with the caps partly expanded and the gills yet of a pinkish hue.

" 3 A single plant approaching maturity.

" 4 A mature plant whose gills have assumed the blackish-brown color.

" 5 Vertical section of the cap and upper part of the stem of a young plant.

" 6 Vertical section of the cap and upper part of the stem of a middle-aged plant.

" 7 Vertical section of the cap and upper part of the stem of a mature plant.

" 8 Four spores, × 400.

" 9 Branching strings of mycelium.

PLATE 8.

Agaricus arvensis *Schœff.*

Field Mushroom. Horse Mushroom.

Fig 1 A young plant with the veil just separated from the margin of the cap.

" 2 A plant with the cap partly expanded, showing the dingy pinkish hue of the gills.

Fig. 3 A mature plant with the cap fully expanded and the gills of a blackish-brown color.
" 4 Vertical section of the cap and the upper part of the stem of a young plant.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

PLATE 9.

AGARICUS RODMANI *Peck.*

Rodman's Mushroom.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded, showing the pinkish color of the gills.
" 3 A mature plant with the cap fully expanded.
" 4 Vertical section of the cap and upper part of the stem of an immature plant.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

AGARICUS PLACOMYCES *Peck.*

Flat-cap Mushroom.

Fig. 7 A young plant with the veil just separated from the margin of the cap.
" 8 A plant with the cap partly expanded.
" 9 A mature plant with the cap fully expanded.
" 10 Vertical section of the cap and upper part of the stem of an immature plant.
" 11 Vertical section of the cap and upper part of the stem of a mature plant.
" 12 Four spores, × 400.

PLATE 10.

COPRINUS COMATUS *Fr.*

Shaggy Coprinus

Fig. 1 A young plant.
" 2 and 3 Immature plants with the cap beginning to split on the margin and the gills beginning to assume the pinkish and blackish hues.
" 4 A mature plant with the margin of the cap much split and recurved and the gills blackened, deliquescing and dripping with an inky fluid.
" 5 Vertical section of the cap and upper part of the stem of a young plant.
" 6 Vertical section of the cap and upper part of the stem of a plant approaching maturity.
" 7 Four spores, × 400.

PLATE 11.

Coprinus micaceus *Fr.*

Glistening Coprinus.

Fig. 1 A cluster of seven immature plants.
" 2 A mature plant showing the blackened gills.
" 3 A mature plant with the margin of the cap split and somewhat recurved.
" 4 Vertical section of the cap and upper part of the stem of an immature plant.
" 5 Vertical section of the cap and upper part of the stem of a mature plant, the blackened deliquescing gills dripping with an inky fluid.
" 6 Four spores, × 400.

Coprinus atramentarius *Fr.*

Inky Coprinus.

Fig. 7 A cluster of four plants, one of them young.
" 8 A mature plant.
" 9 Vertical section of the cap and upper part of the stem of an immature plant.
" 10 Vertical section of the cap and upper part of the stem of a mature plant, showing the blackened dripping gills.
" 11 Four spores, × 400.

PLATE 12.

Cortinarius violaceus *Fr.*

Violet Cortinarius.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 A plant with the cap partly expanded, showing the color of the gills.
" 4 A plant with the cap fully expanded.
" 5 Vertical section of a cap and the upper part of the stem of an immature plant.
" 6 Vertical section of the cap and upper part of the stem of a mature plant.
" 7 Four spores, × 400.

PLATE 13.

Cortinarius collinitus *Fr.*

Smeared Cortinarius.

Fig. 1 A young plant showing the webby veil.
" 2 and 3 Immature plants showing the color of the young gills.
" 4 A mature plant with the cap fully expanded.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

CORTINARIUS CINNAMOMEUS *Fr.*

Cinnamon Cortinarius.

Fig. 7 A young plant showing the webby veil.
" 8, 9 and 10 Immature plants showing the color of the young gills.
" 11 and 12 Mature plants showing the color of the mature gills.
" 13 Vertical section of the cap and upper part of the stem of a mature plant.
" 14 Four spores, × 400.

Variety SEMISANGUINEUS *Fr.*

Half-red Cortinarius.

Fig. 15 A young plant showing the webby veil.
" 16 and 17 Immature plants showing the color of the young gills.
" 18 A mature plant showing the color of the mature gills.
" 19 Vertical section of the cap and upper part of the stem of a matured plant.
" 20 Four spores, × 400.

PLATE 14.

CLITOPILUS PRUNULUS *Scop.*

Plum Clitopilus

Fig. 1 A young plant.
" 2 and 3 Mature plants, one having the margin of the cap wavy or irregular.
" 4 Vertical section of the cap and upper part of the stem of a young plant.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

CLITOPILUS ORCELLA *Bull.*

Sweet-bread Mushroom.

Fig. 7 A young plant.
" 8 and 9 Mature plants.
" 10 Vertical section of the cap and upper part of the stem of a mature plant.
" 11 Four spores, × 400.

MARASMIUS OREADES *Fr.*

Fairy-ring Mushroom.

Fig. 12 A plant showing slight striations on the margin of the cap.
" 12, 13, 14 and 15 Plants showing the usual color when fresh and moist.
" 16 and 17 Plants showing the usual color after the evaporation of the moisture.
" 18, 19 and 20 Vertical sections of the caps and upper part of the stems of three plants of different forms or stages of development.
" 21 Four spores, × 400.

PLATE 15.

AMANITA CÆSAREA *Scop.*

Orange Amanita.

Figs. 1 and 2 Two young plants just emerged from the wrapper.
" 3 and 4 Immature plants with the caps partly expanded.
" 5 A mature plant with the cap fully expanded and its margin faded to a yellow color.
" 6 Vertical section of a cap and the upper part of its stem showing the color of the flesh and gills and the cavity in the stem.
" 7 Four spores, × 400.

PLATE 16.

AMANITA RUBESCENS *Fr.*

Reddish Amanita.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 A plant with the cap fully expanded and with reddish stains on the gills indicating places where they have been bruised or wounded.
" 4 Vertical section of a cap and the upper part of its stem.
" 5 A plant from whose cap the warts have disappeared.
" 6 A plant from whose cap the warts have mostly disappeared and on the margin of which are slight striations.
" 7 Vertical section through the center of a plant.
" 8 Four spores, × 400.

PLATE 17.

AMANITOPSIS VAGINATA *Roze.*

Sheathed Amanitopsis.

Variety FULVA (*Schæff.*)

Fig. 1 A young plant.
" 2 and 3 Plants with the cap partly expanded, one having an umbo on the cap and the tawny tint to the wrapper.
" 4 A plant with the cap fully expanded and darker colored in the center.

Variety LIVIDA (*Pers.*)

" 5 A young plant with two fragments of the wrapper adhering to the cap.
" 6 A plant with the cap partly expanded.
" 7 A plant with an umbonate cap fully expanded.
" 8 Vertical section of a cap and the upper part of its stem.
" 9 Four spores, × 400.

PLATE 18.

LEPIOTA PROCERA *Scop.*

Parasol Mushroom. Tall Lepiota.

Fig. 1 A young plant.
" 2 A mature plant.
3 A smaller mature plant with unspotted stem.
4 Vertical section of a cap and the upper part of its stem.
5 Four spores, × 400.

PLATE 19.

Lepiota naucinoides *Peck.*

Smooth Lepiota.

Fig. 1 A young plant.
" 2 and 3 Plants with the cap partly expanded.
" 4 A plant with the central part of the cap tinged with yellow.
" 5 A plant with the cap fully expanded and centrally tinged with a smoky-brown hue.
" 6 Vertical section of a cap and the upper part of its stem.
" 7 Four spores, × 400.

PLATE 20.

Armillaria mellea *Vahl.*

Honey-colored Armillaria.

Fig. 1 A young plant growing on decaying wood.
" 2 A cluster of five plants, one of them quite young and having its gills concealed by the veil.
" 3 A mature plant with the cap striated on the margin and centrally darker colored.
" 4 A mature plant with the cap brown and striated on the margin.
" 5 Vertical section of a cap and the upper part of its stem.
" 6 Four spores, × 400.

Variety glabra *Gill.*

Fig. 7 A plant with the cap glabrous and yellowish.
" 8 Vertical section of the cap and upper part of the stem of a mature plant.

PLATE 21.

Tricholoma transmutans *Peck.*

Changing Tricholoma.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 A cluster of two young plants and one mature plant, the latter showing the gills spotted with reddish-brown.
" 4 Vertical section of a cap and the upper part of its stem.
" 5 Four spores, × 400.

Tricholoma imbricatum *Fr.*

Imbricated Tricholoma.

Fig. 6 A young plant.
" 7 A plant with the cap partly expanded.
" 8 A mature plant showing spots on the gills.
" 9 Vertical section of the cap and upper part of the stem of a young plant.
" 10 Vertical section of the cap and upper part of the stem of a mature plant.
" 11 Four spores, × 400.

PLATE 22.

TRICHOLOMA PERSONATUM *Fr.*

Masked Tricholoma.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 A plant with the cap fully expanded.
" 4 Vertical section of the cap and upper part of the stem of a young plant.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

Variety BULBOSUM *Peck.*

Fig. 7 A plant with the cap partly expanded.
" 8 A plant with the cap fully expanded.

PLATE 23.

CLITOCYBE MEDIA *Peck.*

Intermediate Clitocybe.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 and 4 Mature plants.
" 5 Vertical section of the cap and upper part of the stem of an immature plant.
" 6 Vertical section of the cap and upper part of the stem of a mature plant.
" 7 Four spores, × 400.

CLITOCYBE NEBULARIS *Batsch.*

Clouded Clitocybe.

Fig. 8 A young plant.
" 9 An immature plant.
" 10 A mature plant.
" 11 Vertical section of the cap and upper part of the stem of an immature plant.
" 12 Vertical section of the cap and stem of a mature plant.
" 13 Four spores, × 400.

PLATE 24.

CLITOCYBE INFUNDIBULIFORMIS *Schæff.*

Funnel-form Clitocybe.

Fig. 1 A young plant.
" 2 and 3 Mature plants, one showing more fully the upper surface of the cap.
" 4 A mature plant with a wavy margin to the cap.
" 5 Vertical section through the center of a mature plant.
" 6 Four spores, × 400.

CRATERELLUS CORNUCOPIOIDES *Pers.*

Cornucopia Craterellus.

Fig. 7 A cluster of three plants of different degrees of development.
" 8 A single mature plant.
" 9 Vertical section of a small plant.
" 10 Four spores, × 400.

HYDNUM CORALLOIDES *Scop.*

Coral-like Hydnum.

Fig. 11 A plant growing from a piece of wood.
" 12 A branch with its branchlets and spines.
" 13 Four spores, × 400.

PLATE 25.

CLITOCYBE LACCATA *Scop.*

Laccate Clitocybe.

Figs. 1, 2 and 3 Plants showing the usual color when fresh and moist.
" 4 and 5 Plants showing the paler color of the caps when dry.
" 6 and 7 Vertical section of the cap and upper part of the stems of two plants of different form.
" 8 Four spores, × 400.
" 9 and 10 Two plants of a larger form, their caps yet fresh and moist.
" 11 A plant from whose cap the moisture has evaporated.
" 12 Vertical section of a cap and the upper part of its stem.
" 13 Four spores, × 400.

Variety STRIATULA *Peck.*

Figs. 14, 15 and 16 Three plants whose caps are yet moist and show the marginal striations.
" 17 A plant whose cap is dry and paler.
" 18 Four spores, × 400.

Variety PALLIDIFOLIA *Peck.*

Figs. 19 and 20 Plants whose caps are yet moist.
" 21 A plant whose cap is dry and paler.
" 22 Vertical section of a cap and the upper part of its stem.

Variety AMETHYSTINA *Bolt.*

Figs. 23, 24 and 25 Three plants with their caps yet fresh and moist.
" 26 A plant whose cap is dry and paler.
" 27 Four spores, × 400.

PLATE 26.

PLEUROTUS ULMARIUS *Bull.*

Elm Pleurotus.

Fig. 1 An immature plant.
" 2 A mature plant showing the central coloration and spotting sometimes seen on the cap.

Fig. 3 Vertical section of the cap and upper part of the stem of a mature plant.
" 4 Four spores, × 400.

PLEUROTUS OSTREATUS *Fr.*

Oyster Pleurotus.

Fig. 5 A cluster of plants growing from decaying wood.
" 6 A plant showing the upper surface of the cap.
" 7 A plant showing the lower surface of the cap.
" 8 Vertical section of a plant.
" 9 Four spores, × 400.

PLATE 27.

PLEUROTUS SAPIDUS *Kalchb.*

Sapid Pleurotus.

Fig. 1 A cluster of three plants growing from decaying wood.
" 2 A cluster of four plants branching from a common base.
" 3 A plant of reddish-brown color showing the upper surface of the cap.
" 4 A plant showing the lower surface of the cap.
" 5 A small pale plant with a lateral stem, the upper surface shown.
" 6 Vertical section of a plant.
" 7 Vertical section of a cluster of three plants.
" 8 Four spores, × 400.
" 9 Color of the spores as seen in a mass on white paper.

PLATE 28.

HYGROPHORUS MINIATUS *Fr.*

Vermilion Hygrophorus.

Fig. 1 A young plant.
" 2, 3 and 4 Various forms of mature plants.
" 5 A cluster of four plants
" 6 Vertical section of the cap and upper part of the stem of a small plant.
" 7 Vertical section of the cap and upper part of the stem of a larger plant with a hollow stem.
" 8 Four spores, × 400.

Variety LUTESCENS *Peck.*

Fig. 9 A young plant.
" 10 A mature plant.

HYGROPHORUS PRATENSIS *Fr.*

Meadow Hygrophorus.

Fig. 11 A young plant.
" 12, 13 and 14 Forms of mature plants.
" 15 and 16 Vertical sections of different forms of mature plants.
" 17 Four spores, × 400.

PAXILLUS INVOLUTUS *Fr.*

Involute Paxillus.

Fig. 18 A young plant.
" 19 An immature plant showing the involute margin of the cap.
" 20 A mature plant showing spots on the stem and gills where they have been bruised.
" 21 A plant with an eccentric stem.
" 22 Vertical section through the center of a plant.
" 23 Four spores, × 400.

PLATE 29.

LACTARIUS DELICIOSUS *Fr.*

Delicious Lactarius.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 A plant with the cap fully expanded and somewhat funnel-shaped, the gills wounded at 3a.
" 4 An old plant faded and tinged with green.
" 5 Part of a vertical section through the center of the cap and upper part of the stem of a mature plant, showing the orange-colored juice oozing from a wound in the gill at 5a.
" 6 Four spores, × 400.

PLATE 30.

LACTARIUS VOLEMUS *Fr.*

Orange Lactarius.

Fig. 1 A young plant.
" 2 A plant having a small umbo in the center of the cap.
" 3 A plant with a broadly convex cap.
" 4 A plant with the cap somewhat funnel-shaped.
" 5 A large plant with the cap broadly funnel-shaped, and the gills wounded, discolored and dripping the white milk at 5a.
" 6 A plant with the margin of the cap corrugated or wrinkled on its surface.
" 7 Vertical section of the cap and upper part of the stem of a small plant, a drop of the white juice issuing from a wound in the gill at 7a.
" 8 Four spores, × 400.

PLATE 31.

RUSSULA VIRESCENS *Fr.*

Greenish Russula.

Fig. 1 A young plant.
" 2 A plant with the cap partly expanded.
" 3 and 4 Two plants with the caps slightly striate on the margin, one mature and the cap fully expanded.
" 5 A mature plant with the cap fully expanded, split in two places on the margin and yellowish-green in the center.
" 6 Vertical section of the cap and upper part of the stem of a plant whose cap is convex.
" 7 Vertical section of the cap and upper part of the stem of a plant whose cap is centrally depressed.
" 8 Four spores, × 400.

PLATE 32.

Cantharellus cibarius *Fr.*

Chantarelle.

Figs. 1, 2, 3, 4 and 5 Plants of various sizes and shapes.
" 6 A plant with the margin of the cap wavy.
" 7 A stout plant with the cap somewhat funnel-shaped.
" 8 Vertical section through the center of a plant.
" 9 Four spores, × 400.

PLATE 33.

Boletus subluteus *Peck.*

Small yellowish Boletus.

Fig. 1 A young plant with the tubes or hymenium yet concealed by the veil.
" 2 An immature plant showing the yellow color of the tubes.
" 3 and 4 Mature plants showing the ochraceous color of the tubes.
" 5 Vertical section of the cap and upper part of the stem of a mature plant.
" 6 Four spores, × 400.

Boletus luteus *L.*

Yellowish-brown Boletus.

Fig. 7 A young plant with the tubes yet concealed by the veil.
" 8 A plant whose veil has just separated from the margin of the cap.
" 9 and 10 Mature plants.
" 11 Vertical section of the cap and upper part of the stem of a mature plant.
" 12 Four spores, × 400.

PLATE 34.

Boletus granulatus *L.*

Granulated Boletus.

Fig. 1 A young plant.
" 2 and 3 Mature plants differing in the shape and color of the caps.
" 4 Vertical section of the cap and upper part of the stem of a mature plant.
" 5 Four spores, × 400.

Boletus versipellis *Fr.*

Orange-cap Boletus.

Fig. 6 A young plant.
" 7 A plant with the dots on the stem of the same color as the cap.
" 8 A plant with the dots on the stem of different colors.
" 9 Vertical section of the cap and upper part of the stem of a mature plant.
" 10 Four spores, × 400.

PLATE 35.

Boletus scaber *Fr.*

Rough-stemmed Boletus.

Figs. 1 and 2 Young plants with differently colored caps.
" 3 A plant with a white cap.
" 4 A mature plant having a reddish cap.

Fig. 5 An immature plant having an ash-colored cap.
" 6 A mature plant with a blackish-brown cap.
" 7 A plant with a brown cap.
" 8 Vertical section of the cap and upper part of the stem of a plant.
" 9 Four spores, × 400.

PLATE 36.

Boletus castaneus *Bull.*

Chestnut Boletus.

Fig. 1 A young plant showing the whitish tubes.
" 2 and 3 Mature plants.
" 4 A mature plant with the margin of the cap slightly curved upwards.
" 5 Vertical section through the center of a young plant.
" 6 Vertical section through the center of a mature plant.
" 7 Four spores, × 400.

Boletus edulis *Bull.*

Edible Boletus.

Fig. 8 A young plant showing the white tubes.
" 9 A mature plant of small size.
" 10 A mature plant of medium size.
" 11 Vertical section of the cap and upper part of the stem of a mature plant.
" 12 Four spores, × 400.

PLATE 37.

Polyporus sulphureus *Fr.*

Sulphury Polyporus.

Fig. 1 A cluster of four plants growing from decaying wood.
" 2 A single plant showing the upper surface of the cap and the yellow freshly grown margin.
" 3 Vertical section of a plant.
" 4 Four spores, × 400.

Fistulina hepatica *Fr.*

Liver Fistulina.

Fig. 5 A plant showing the upper surface of the cap.
" 6 A plant showing the lower surface of the cap.
" 7 Lateral view of a plant growing from decayed wood.
" 8 Vertical section of a plant showing reddish streaks in the flesh.
" 9 Four spores, × 400.

PLATE 38.

Hydnum repandum *L.*

Spreading Hydnum.

Figs. 1 and 3 Plants whose caps are of a pale color.
" 2 and 4 Plants whose caps are of a reddish color.
" 5 Vertical section of the cap and upper part of the stem of a plant.
" 6 Four spores, × 400.

Variety RUFESCENS (*Pers.*)

Fig. 7 A plant whose cap is somewhat wavy on the margin.
" 8 A plant whose cap is more regular.
" 9 Vertical section of the cap and upper part of the stem of a plant.
" 10 Four spores, × 400.

PLATE 39.

CLAVARIA FLAVA *Schæff.*

Pale-yellow Clavaria.

Fig. 1 A young plant.
" 2 A full-grown plant.
" 3 One of the principal branches with its branchlets.
" 4 Four spores, × 400,

CLAVARIA BOTRYTES *Pers.*

Red-tipped Clavaria.

Fig. 5 A young plant.
" 6 A full-grown plant.
" 7 Four spores, × 400.

CLAVARIA CRISTATA *Pers.*

Crested Clavaria.

Figs 8 and 9 Plants with few branches.
" 10 A plant with many branches and a dingy whitish color.
" 11 A mature plant in which the tips of the branches have assumed a brown color.
" 12 Four spores, × 400.

PLATE 40.

AMANITA PHALLOIDES *Fr.*

Poison Amanita.

Fig. 1 A young plant with the cap slightly expanded, and of a grayish-brown color.
" 2 A mature plant with the grayish-brown cap fully expanded and blackish-brown in the center.
" 3 A very young plant just bursting from its wrapper, two fragments of which still adhere to the cap.
" 4 A plant with its blackish-brown cap partly expanded.
" 5 A mature plant with its blackish-brown cap fully expanded.
" 6 Vertical section through the center of an immature plant.
" 7 Vertical section of the cap and upper part of the stem of a mature plant.
" 8 Four spores, × 400.

PLATE 41.

AMANITA PHALLOIDES *Fr.*

Poison Amanita.

Fig. 1 A plant with its whitish cap partly expanded.
" 2 A plant with its whitish cap fully expanded.
" 3 Vertical section through the center of a mature plant.

AMANITA VERNA *Fr.*

Vernal Amanita.

Fig. 4 A young plant just emerging from its wrapper.
" 5 An immature plant with the cap slightly expanded.
" 6 A mature plant with the cap fully expanded.
" 7 Four spores, × 400.

PLATE 42.

AMANITA MUSCARIA *L.*

Fly Amanita.

Fig. 1 A young plant just breaking from its wrapper.
" 2 A plant with its red cap partly expanded.
" 3 A mature plant with its cap fully expanded and faded to yellow on the striated margin.
" 4 Vertical section of a part of the cap and upper part of the stem of a mature plant.
" 5 Four spores, × 400.

Variety FORMOSA *Fr.*

Fig. 6 A plant with its yellow cap partly expanded.

PLATE 43.

BOLETUS FELLEUS *Bull.*

Bitter Boletus.

Fig. 1 A young plant.
" 2 A young plant showing the color of the young tubes.
" 3 and 4 Mature plants with stems of different shapes.
" 5 A mature plant with the stem reticulated to the base.
" 6 Vertical section of the cap and upper part of the stem of a mature plant.
" 7 Four spores, × 400.

CORRECTIONS OF PLATES.*

PLATE 1.

Fig. 2. The exposed inner substance shown in the upper part of the figure is too black; it should be dingy-olivaceous.

PLATE 6.

Figs. 7, 10. The spores should be brown, not pink.

PLATE 8.

Fig. 5. The gills should be blackish-brown, as in figure 3.
Fig. 6. The spores should be brown, not pink.

PLATE 13.

Figs. 2, 3. The gills should have no pink tint.
Figs. 7 to 12. There should be no stripes on the caps.

PLATE 14.

Fig. 21. The spores should be white.

PLATE 17.

Fig. 9. The spores should be white.

PLATE 19.

Fig. 7. The spores should be white.

PLATE 24.

Figs. 1, 2, 3, 4. The upper surface of the cap is too pale.
Under the name CLITOCYBE INFUNDIBULIFORMIS insert FUNNEL-FORM CLITOCYBE.

PLATE 28.

Figs. 8, 17. The spores should be white, not pink.

PLATE 29.

Fig. 4. The upper surface of the cap should have a dull greenish tint.

PLATE 30.

Fig. 8. The spores should be white.

* The failure of the artist to follow the copy and corrected proof closely makes necessary several corrections.

PLATE 34.

Fig. 10. The spores should be brown, not pink.

PLATE 35.

Fig. 2. The stem should be dotted as in the other figures.
Figs. 3, 4, 5, 6, 8, 9. The tubes and spores should have no pink hues. For the name SOABER read SCABER.

PLATE 36.

Fig. 4. The lower surface of the cap should be yellowish.
Fig. 7. The spores should be yellowish, not pink.

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(Synonyms are in *italics*.)

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REPORT.

Office of the State Entomologist,
Albany, *November* 30, 1894.

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

Gentlemen.— The Entomologist, in accordance with the provision of chapter 355 of the Laws of 1883, presents herewith to your honorable board the following report:

Owing to an unusual pressure of official work — principally in an increased correspondence and several special insect investigations which have not been completed — there has not been the opportunity for preparing the usual report embracing the observations and studies made during the year. It is, therefore, thought better to present the following partial report, and postpone a more extended one until the material in hand can be suitably prepared for presentation hereafter.

In former reports reference has been made to the steadily increasing correspondence of the office, but in no preceding year had it attained to such magnitude as to engross almost the entire time of the Entomologist. The simple statement of the number of letters received and answered could give no adequate idea of the time occupied in the correspondence. Inquiries for information of the names of insects — whether they are injurious or not — of their habits and means of control, when received from remote parts of the United States to which they are peculiar, may require an entire day, or more, in their study and in examination of their scattered literature before they can be satisfactorily answered and record made of such portion of the study as may be desirable to record for publication. Although such inquiries might more appropriately be made elsewhere — either to the Agricultural Experiment Station of the State or to the Entomological Division of the United States Department of Agriculture at Washington — than of the New York State Entomologist, still it has been thought proper to give them all the attention they merit, in consideration of the value of the study (when required) to your Entomologist and to entomological science at large. Many of these replies have been communicated to agricultural journals, while those of general interest may hereafter be given in following numbers of my annual reports.

During the year correspondence has been had with residents in each one of the States and Territories except two. The number of letters pertaining to the work of the office, sent out during the year, so far as they have been listed, is 1,583. Of the more important ones, or those which might be useful for reference, copies have been retained; of the others their subjects have been noted. The number of letters received and filed during the same time is 1,310.

Although the year has not been remarkable for widespread insect attacks of unusual severity, still there have been many which deserved and have received careful study, which will be reported hereafter. Some of these are of special interest, as being new to the State, and others, from extending their range into, and occupying portions of, the State, which had been previously exempt from their presence.

The one event that has made the year a notable one in the annals of entomological science is the appearance of the periodical Cicada or "the 17-year locust" in the Hudson River Valley, and the opportunity afforded for studying in many localities the remarkable above-ground structures made by the pupæ for a purpose unknown. Much interesting information relating to the insect was secured during its brief stay, from personal observation, correspondence, and the public press, and it is a matter of regret that the more pressing duties of the office have not left the time for the preparation of the material for presentation in this report.

The publications of the Entomologist during the year in agricultural, scientific, and other journals, and society proceedings, are 38 in number. A list of them with brief summary of contents is given in the Appendix, together with that for the preceding year (62 in number), which was not included in the printed report for that year, and also a list of some earlier entomological publications (1862–1869).

Three reports of the Entomologist have been published during the present year, viz., for the years 1891 and 1892 (long delayed by the State printer), and 1893, and are contained in the forty-fifth, forty-sixth, and forty-seventh reports on the New York State Museum. Separate editions on heavy paper of 700 copies each, of the first two of these, have been printed for the use of the Entomologist. These are entitled "Eighth Report on the Injurious and Other Insects of the State of New York for the Year 1891" (223 pages and 53 figures, issued in February, 1894), and "Ninth Report on the Injurious and Other Insects of the State of New York for the Year 1892," (211 pages and 34 figures, issued in March, 1894). The "Report of the State Entomologist to the Regents of the University of the State of New York for the Year 1893" (of 24 pages, and issued in November, 1894), is contained in the Forty-seventh State Museum Report, and a small edition on ordinary paper, under the same title, has also been printed separately.*

* A few pages of this report have been reprinted in the present one.

The additions to the collection by the Entomologist have been — of mounted and labeled specimens, about 1,800 examples (a complete record was not kept), and of alcoholic and unmounted, exceeding 700 specimens. Among the more important of the additions are a number of slides prepared for the microscope, exhibiting minute insects or insect stages; species of Lepidoptera, Diptera, etc.— reared from the egg or larva, permitting notes of their life-history to be made; and Lepidopterous and other larvæ beautifully prepared by inflation by my assistant, Miss Davis.

Contributions to the collection have been made by 54 persons, aggregating about 500 examples. The list of donors, with their contributions, may be found in the appendix.

The collection, in part, is arranged in small folding boxes, the size of which, 11 by 14½ inches, has been found convenient for arrangement of the contained material and for holding in the hand while being studied. The remainder is in drawers, 15 by 18 inches inside, patterned after those used in many of the continental museums of Europe and in the entomological department of the Museum of Comprative Zoölogy at Cambridge, Mass. They were made under personal inspection of Dr. Hagen while director of the museum, and are believed to be almost, if not entirely, proof against the entrance of museum pests. Naphthaline, in the convenient form of pin-pointed cones, is employed for insuring additional protection from insect depredations. The entire collection is given inspection from time to time, and is believed to be at the present wholly free from insect attack.

Considerable progress has been made in the arrangement, classification, and labeling of the collection. The alcoholic portion has been put in better condition for its preservation through the application of paraffine to the corks where rubber ones of proper size were not available. It is proposed to replace these with rubber as soon as it can conveniently be done. In the Hymenoptera, the *Andrenidæ*, which have been gradually accumulating for a number of preceding years, but left unstudied from the difficulty attendant upon their close resemblances, have been carefully studied and all — so far as it could be done — determined and labeled. The *Apidæ* have been partly gone over in the same manner. In the Diptera special study has been given to the interesting family of *Bombylidæ*, and most of them have been named. In the Orthoptera all of the *Acrididæ* have been studied and their determinations made. Work of this character is necessarily slow, but it will be carried on as rapidly as the time that can be devoted to it will permit, with the view of putting the entire collection in such shape that the duplicates that are accumulating may be named and labeled, and ready for distribution to the educational institutions of the State whenever it shall be feasible to enter upon so desirable a work. With the increasing attention that is being given to the study of natural history in our schools, a series of cases representing typical insects in each of the seven older orders, and another series to illustrate the more injurious species, with their transformations and their injuries — all authoritatively labeled, could not but prove a valuable contribution toward the educational material of the schools.

It is specially desirable that such collections, and still more extended, should be placed in each of the Normal schools. Some of them are already provided with them, and are giving valuable instruction in entomology. The study of injurious insects, the nature of their injuries, and methods for preventing their ravages has, during recent years, become so indispensably connected with successful agriculture that the demand will soon be imperative for instruction in economic entomology in our principal schools. Teachers, therefore, should be in training that may be prepared to respond to such demand.

As illustrating both the importance of entomological investigation to the agricultural interest, and the recognition that these studies, in their utilitarian aspect particularly, have — after years of indifferent regard — finally obtained and secured, the following remarks are quoted. Their source lends them additional weight. They are from an address made by Governor Flower, in August last, at Jamestown, N. Y., to a concourse of the farmers and others of Chautauqua county, estimated at 8,000 persons. The subject of the address, as announced, was "Scientific Farming."

Premising that the State was doing much for the promotion of scientific agriculture — the admirable work that was being done in this direction at the agricultural experiment station at Geneva, and at Cornell University and the experiment station connected therewith — was detailed at considerable length, and the great benefits that were accruing to the State from these institutions in various directions were pointed out.

The Governor, in continuation of his remarks, said:

"Another important field of State effort in the application of science to agriculture is that of entomology. Not only is this a subject of study at the experiment stations, but there is a special State officer to pursue investigations in entomology and furnish information based on his researches to the farmers. Prof. Lintner is a thoroughly trained entomologist, and his work has been of great benefit to the agricultural interests of the State. Few of us appreciate what an important bearing on agriculture insect life has. You farmers, who have lost whole crops of grapes, or wheat, or potatoes, or hops, by the wicked ravages of these little animals, do appreciate their power and do appreciate the value of some sure means of preventing their inroads. They are mysterious creations — these mischievous destroyers of crops. They come suddenly at times, they work quietly and assiduously, they breed so rapidly that it seems impossible to exterminate them. No State function is more useful or necessary than that which employs the best ability of science to exterminate these pests. Why, the entire grape culture of France was threatened with destruction by the grapevine phylloxera — which you in this country know something about, I dare say — and the French government has not only spent nearly $200,000 for investigations, but has also offered a reward of $60,000 for the discovery of an effectual remedy. The successful ravages of this little animal (which is not nearly as big as the head of a pin) in this State would mean a loss of over $5,000,000 a year. Surely a State would be remiss which was unwilling to appropriate a few thousand dollars for experiments to prevent such a catastrophe. When it is considered how many farm plants, grains and fruits are endangered by injurious insects of one kind or another — wheat, hops, potatoes, peaches, currants, cabbages, cherries, plums — indeed nearly all varieties of plant life — it would seem of the highest importance that the State relax no effort to overcome these public enemies. Prof. Lintner estimates that with our present scientific knowledge and with the means now at our command, we can, if we will, lessen insect depredations to the extent of at least one-half of their present magnitude. That, indeed, would be a remarkable triumph, but it is only an assurance of greater results in the future. Scientists are learning to depend not alone on poisons to destroy these insect enemies, but they are enlisting in their efforts the aid of other insects — parasites which prey upon the injurious species and drive them from the field. I read the other day in the Albany *Argus* that Postmaster-General Bissell had issued an order allowing the importation of lady-bugs through the mails from Australia, because they were of such value in destroying insect enemies. Scientists give us reason to hope that perhaps in the near future, when we find the hop-louse on our hops, or phylloxera on our grapevines, we can turn loose some other insect which will help us exterminate them. So let us encourage our entomologists in their good work that our farmers may get the greatest possible benefit from their valuable discoveries."

The additional office-room which the Regents have kindly provided for the use of the Entomologist, through the inclosure and fitting up of a portion of the adjoining corridor, has proved of the greatest possible convenience, relieving, as it does, the discomforts of an overcrowded apartment and affording all needed room, for the present, for the arrangement of the collection and the growing library.

Provision having been made for an assistant to the Entomologist, Miss R. L. Davis, who had had three years' experience in the work of the Insectary connected with the Hatch Agricultural Experiment Station, at Amherst, Mass., under direction of Prof. C. H. Fernald, was selected for the position; and having been duly appointed, entered upon her duties in November, 1893. Her services have been of material aid in extending the work of the department.

The entomological collection continues to be an interesting feature in visits made to the Capitol. Although a very limited public display can be made of its material, owing to its liability to injury from exposure to light, yet the drawers of the more attractive insects and cases, illustrating the manner of mounting, preparation, classification, and labeling, are always gladly shown and explained to those who give evidence of appreciation of the study and interest in its progress. The pupils connected with our schools are especially welcomed at all times, and every pains is taken to enlist their interest in the insect world and to encourage them in its study, by pointing out to them the fascination that it presents, the ease with which it may be pursued, its almost ever-at-hand source of enjoyment, and its growing importance in its practical applications.

In the preceding nine reports of the entomologist, aggregating 1,950 pages, hundreds of species of insects have been noticed at greater or less extent. The same species has also, in several instances, been treated of in different reports, in additions to former histories, or in correction of the earlier statements. To facilitate reference by those who have occasion to refer to or study these reports, a general index, which will include the present report, has been prepared and will be found at the end of this volume. It has not been made as full as the separate ones that have been presented, but it will contain the scientific names of insects by their generic and specific designation, family and ordinal names, the common or popular names, the insects infesting the more important food-plants, the principal remedies and preventives, and reference to figures used in illustration. So far as possible from the literature at hand, the more important synonymy has been brought down to the present time, omitting, however, many of the changes that have been lately proposed (especially in the Lepidoptera) but are still purely tentative, and in which there is an almost entire absence of accord among our recent writers, both in nomenclature and classification.

With grateful acknowledgment of the interest taken by your Board in the work of the department during the year, and the aid extended to it,

Respectfully submitted,

J. A. LINTNER.

INJURIOUS INSECTS, ETC.

Ants on Fruit-Trees.

(Ord. HYMENOPTERA: Fam. FORMICIDÆ and MYRMICIDÆ.)

From a not uncommon belief that all insects are injurious, fruit-growers are often unnecessarily alarmed by the appearance, in large numbers, of ants in fruit-trees, especially when found in association with apparent insect injury; and inquiries are made of the precise nature of the damage caused by them and how they may best be destroyed. The following is one of many similar letters received:

Do the small ants that nest in ant-hills in the ground, especially about the drives and walks, injure fruit-trees? I have noticed them running about young apple, pear, and peach-trees, some of which have leaves curled and otherwise showing the ill effects of something. There are also some green lice on the leaves. What will destroy both ants and lice, and how can ants be kept off the trees if they are detrimental? Trees have been sprayed with solution of London purple, but I do not see that it stops the ants or kills the lice. E. M.

An Ant Frequenting Apple-Trees.

The ants that are so often to be seen running up and down the trunks and main branches of fruit-trees, are not known to be injurious to the tree or its fruit. A large black ant with a deep chestnut-red thorax is quite common on apple-trees. It was described by Dr. Fitch in his *First Report on the Insects of New York*, as *Formica Novœboracensis*, but has since been identified with an European species bearing the name of *Camponotus herculaneus* (Linn.). It is also, according to Cresson, the *Formica Pennsylvanica* of many writers. Its occurrence on apple-trees is always associated with the presence of plant-lice or aphides. It feeds on the "honey-dew" secreted by the aphides and given out from the pair of honey-tubes projecting from their abdomen, and in return the ant gives them protection from their insect enemies in consideration of the grateful food they supply.

The Cherry-Tree Ant.

Another smaller ant is, according to Dr. Fitch, a constant attendant of the cherry-tree plant-louse, *Myzus cerasi*. The worker is only 0.14 of an inch long, of a dark-brown color, with a shining, black, pointed abdomen. Its scientific name is *Cremastogaster cerasi* (Fitch). Sometimes a half-dozen or more of these ants may be seen upon a single aphis-infested cherry leaf, touching or rubbing the aphides with their antennæ to induce them to yield their honey-dew. They are more faithful nurses of the aphides than the preceding species, and despite their smaller size they are abundantly able, by means of their sting, to defend themselves against the powerful *C. herculaneus*, to conquer it, and even to rob it of its flock of aphides. Dr. Fitch gives an interesting detailed recital of the manner in which this is accomplished, through the use of its sting when seized by the larger species, and then marking each plant-louse with the pungent venom thrown out from its sting which apparently makes them repulsive to their former guardians.

The Little Yellow Ant, Common in Walks.

If our correspondent is correct in his identification of the ants frequenting his fruit-trees with those that make the little ant-hills in and about the drives and walks, then the species must be the "little yellow ant," *Monomorium molestum* (Say). The worker measures 0.06 of an inch in length, "is of a honey-yellow color with the head and abdomen tinged with brown, the abdomen being broadly oval and almost globular." I do not recall any record of this species ascending fruit-trees for its food, but it is undoubtedly injurious at times to succulent vegetation, for Dr. Fitch has stated (First Report, p. 129) of it, that it sometimes does much injury in corn-fields by gnawing the blades of corn when they are but a few inches high, for the purpose of drinking the sweet juice which flows from the wounds.*

Ants Injurious to Orange-Trees.

Two species of ants are injurious to orange-trees in the South, as we learn from the studies of Mr. H. G. Hubbard, contained in his volume, entitled *Insects Affecting the Orange*, 1885. Of these, *Monomorium carbonarium* Smith, eats holes into the leaves when they are young and tender, but seldom causes any material damage. The other, *Solenopsis xyloni* McCook,† "frequently and seriously injures the orange by gnawing away the bark and causing an exudation of the gum. The ants make their attack in force, and either girdle or kill the shoots or cut so deeply in their bases that they bend over or break off by their own weight. Sometimes, but rarely, the ants attack the old bark of the trunk and larger branches and gnaw holes therein,

* See an interesting account in the *Transactions of the New York Agricultural Society*, xxv, for the year 1865, p. 133, of attacks made by this species upon cut-worms.

† Subsequently referred to *Solenopsis geminata* (Fabr.).

eating away the cambium layer without waiting for the gum to exude" (*loc. cit.*, pp. 129, 130).

Ants Usually Harmless to Fruit-Trees.

It will appear from the above that, as a rule, it is not necessary to destroy the ants that frequent our fruit-trees, although it is thought by some — Dr. Fitch among the number — that from the protection that they give the aphides, these serious pests become more numerous than they possibly could without such fostering care. The aphides may be killed when they first make their appearance and before they are sheltered in the cavities of the curled leaves, by spraying them with tobacco water, soapsuds or kerosene emulsion. The London purple spraying mentioned in the inquiry could have had no effect upon them, as it is only serviceable upon biting insects, and not upon the suctorial class, which draw their food through a needle-pointed proboscis, unaffected by the external poisoning of the foliage.

Should careful observation show, in any instance, that the ants are really detrimental, for any reason, when frequenting fruit-trees, they may be driven away by a free application of tobacco in the form of dust or factory waste spread around the base of the tree. Where tobacco is grown, the following method, recommended by Rev. W. P. Smith, of Fayetteville, Texas, might be employed :

" I was raising some tobacco, and operated with the green leaves in the following manner: I removed the earth from around the tree as much as I could without injuring the roots; then I put a handful of tobacco leaves around the tree where the ants worked, covered them nicely with the earth and pressed it well. In a few cases I had to repeat the dose, but I have tried it often with uniform success in driving away the ants and saving the tree." (*Rept. Commis. Agricul. for* 1868, p. 433–434.)

To Prevent Ants from Ascending Trees.

Different methods have been proposed for this. A band of fur with the hairs pointing downward and tied closely to the trunk, is said to form an almost impassable barrier. The skin of a rabbit has been found effective, but probably that of almost any stiff, closely-set, long-haired animal would do as well. A broad band of chalk eight or ten inches wide, completely covering the bark and encircling the trunk, is also efficient in the absence of rain or excessive dews, if occasionally renewed. Insect-lime, when it can be obtained, applied in a broad band, will serve for weeks for preventing the ascent of ants, as well as a number of other insect pests of fruit-trees.

Ants Regarded as Valuable in Orchards.

A correspondent of the *Country Gentleman* (vol. lvii, 1892, p. 689), writing from London, presents the following plea for the introduction and protection of ants in orchards:

The *Horticultural Times* (London) has recently published a statement that many of the leading orchardists of southern Germany and northern Italy hold the black ant [*Formica nigra* L.] in high esteem, and take measures to promote their increase. They establish ant-hills in their orchards, and leave the police service of their fruit-trees entirely to their tiny colonists, which pass all their time in climbing up the trunks of the trees, cleaning the boughs and leaves of malefactors, matured as well as embryonic, and descend laden with spoils to the ground, where they comfortably consume or prudently store away their booty. They never meddle with sound fruit, but only invade such apples, pears, and plums as have already been penetrated by the insects, in pursuit of which they get to the very heart of the fruit. Nowhere else in the orchards are the apple and pear trees so free from insect ravages and blight as in the immediate neighborhood of a large ant-hill five or six years old. In China, ever since the sixteenth century, and probably earlier, ants have been used to protect the fruit-trees from the ravages of insect pests. In the province of Canton the orange-trees are injured by certain worms, and the orchardists rid themselves of the pests by importing ants from the hill country.

Ants on Peonies.

A correspondent has written: "The peony bushes in my garden are thickly populated with black ants, which I find on no other plant. Few of the blossoms reach handsome perfection, but show the effects of insect attack. Are the ants to blame for the mischief, or are they really friends, visiting the peonies only to destroy small aphides or other minute creatures which do the harm? In either case, is there a better remedy than hellebore? How would pyrethrum answer?"

Ants are not known to be injurious to peonies. They are often drawn to them in numbers, either to feed on the minute insects that are attracted to the plant, or on the sweet and sticky secretion which it gives out so abundantly. I am not sure that any of the aphides occur on the peony, and I have not the means of ascertaining at the present writing whether they do or not. I find, however, no species recorded in our lists as infesting that plant; still, it may sustain one peculiar to it, as many of our species are still undescribed. I am under the impression that several years ago, when my attention was called to the presence of ants on peonies, and to injuries which it was supposed they were inflicting on the flower as it was about opening, I found that the injury was caused by some small plant-bugs (Hemiptera) that were puncturing and deforming the leaves of the calyx and the corolla; and furthermore, that the ants were actively engaged in capturing and carrying off for their food some of the smaller insects.

Derostenus sp.?

(Ord. HYMENOPTERA: Fam. CHALCIDIDÆ.)

Parings of apple-tree bark received from Mr. F. A. Fitch, of Randolph, Cattaraugus county, N. Y., in April, 1893, bearing numerous crushed or broken cocoons of the apple-tree Bucculatrix, *Bucculatrix pomifoliella* Clemens, contained within the cocoons and on the bark around them, a large number of small, shining black pupa-cases, from which the insects had escaped. Ten of them were counted packed against, and partly underneath, one of the cocoons near to three round holes made in the cocoon from which doubtless the parasites had emerged.

The pupa-cases were identified by Dr. C. V. Riley as those of a species of *Derostenus*, probably undescribed.

The genus belongs to the subfamily of *Entedoninæ* of the *Chalcididæ*. No American species of this genus have been described. One appears in Cresson's *Hymenoptera of North America*, 1887, under the name of *D. primus* Howard MS., which had been bred by Dr. Riley from a leaf-mining Coleopter, *Odontota suturalis*. Mr. Howard remarks: "A number of the brilliant little species of this genus have been bred in this country from the leaf-mines of both lepidopterous and coleopterous larvæ. None have ever been described; they are very difficult of separation and approach very closely to the European species. * * * The fact that a species of this genus has been bred from the pupa of an *Eulophus* [a Chalcid] would seem to indicate that *Derostenus* may consist of secondary parasites" (*Entomologica Americana*, i, 1885, p. 117–18).

This same Derostenus parasite has been reared (March 3, 1887) from the larvæ of *Bucculatrix Canadensisella* Chamb., occurring in New York (*Insect Life*, v, 1892, p. 16).

Operations against the Gypsy-Moth in Massachusetts.

(Ord. LEPIDOPTERA: Fam. BOMBYCIDÆ.)

In preceding reports I have written of the accidental introduction into the State of Massachusetts, in the year 1869, of the destructive

European Bombycid, "the gypsy-moth," *Ocneria dispar* — of the probability of its entering New York and spreading over adjoining States — and of the efforts being made, under the direction of the Massachusetts State Board of Agriculture, for its extermination while within the limited locality of the northeastern part of the State, where it is at present confined.

This is the fourth year of active operations against this insect under annual appropriations by the State Legislature, which have now amounted in the aggregate to $275,000.*

In June last an invitation was extended to me by the committee of the State Board of Agriculture to visit the infested district in company with the State Entomologists of adjoining States, for the purpose of inspecting the work of the committee, and to offer such suggestions or criticisms as it might be thought proper to make.

Every facility was afforded for thorough examination, such as witnessing the field operations for spraying, kerosening and burning rocky and waste places; banding and liming trees for preventing the ascent of the caterpillars; personal inspection of the present condition in most of the twenty towns in which the insect has occurred; the experimental work being conducted at the Insectary at Amherst, in testing the susceptibility of the larvæ to various insecticides, and the study of the life-history of the insect and its habits; the method of recording by the office staff the field observations made by the force of nearly two hundred employees; the various instruments and appliances used in the field-work, with the manner of their use, etc., etc.

The inspection was very satisfactory and gratifying and at the same time instructive, as showing what may be done in arresting insect depredations, when the task would seem almost a hopeless one. I had not expected to find that such progress had been made toward the extermination of the myriads of the notorious gypsy-moth. It was a surprise to me that in the brief space of three years, the fearful ravages of the insect, as described to me and as pictured in photographs, could have been reduced to such a degree of comparative harmlessness, that to the ordinary observer no indication of its presence was visible; and in a ride of an entire day through several of "the worst infested towns," including a visit to localities which had been frightfully scourged, not a single example of the larva could be found by me, although diligent search for it was made.

How a work of such magnitude – extending over two hundred square miles, with the insect so abundant that in one locality the entire

* Including the two following years, 1894 and 1895, the appropriations have reached $525,000.

side of a house was so closely covered with the caterpillars that the point of a pencil could not be thrust among them without touching them — could have been accomplished, was an enigma to me, until the means by which it was done had been shown and explained.

The only suggestions that occurred to me to offer to the committee in response to their request, were these two: Now that the mechanical details of field-work were rapidly diminishing with the steady reduction of the insect, there was both the greater need and the opportunity of such scientific work as might serve to complete the labors of the committee and present the result in form that would render it available for future use whenever the necessity might arise for a resort to similar methods in other insect invasions hereafter. A volume or two, which should treat exhaustively of the gypsy-moth and the methods employed for its extermination, might be another contribution to natural science, which would rank with those which Massachusetts had already made.

It was also recommended that at this stage of the committee's work, the cultivation of the parasites of the gypsy-moth (of which about a score of native ones are already known) be entered upon and conducted with all the knowledge and skill that could be brought to bear upon it.

A plan for the artificial rearing proposed was suggested, embracing in brief these points: The entire collection of the pupæ for this year, which might amount to twenty thousand, should be preserved, placed in suitable cases, and kept, through cold storage, from giving out their parasites until caterpillars of suitable age and reared from eggs gathered for the purpose, could be inclosed with them to receive the entire parasitic oviposition. The parasitized caterpillars should be properly guarded until their pupation, when the parasites that they would disclose within the cases should have a caterpillar supply in readiness for them. This round could be repeated as long as there seemed to be the necessity for it and the parasites could be obtained.

By the above method, or by some modification of it, it would seem that an actual extermination of the insect can be effected, and possibly in no other way.

In view of what has already been accomplished, there is abundant reason for a continuance of the appropriations by the Legislatuie of Massachusetts until the desired extermination is secured, or until the insect shall have been reduced to entire harmlessness and in position never again to develop in injurious numbers or to invade other States. Knowing as we do, the frightful ravages of the gypsy-moth in the past, and the certainty that, if left to itself, its natural multiplication would soon carry it over the entire State, it would unquestionably be a wise economy if its extermination could be attained through the expenditure of a million of dollars. It may be recalled in this connection that the wheat-midge inflicted upon the wheat crop of the State of New York in one year — 1854 — an estimated loss of fifteen millions of dollars. (*Report of the Entomologist to the Regents of the University S. N. Y. for the Year* 1893.)

Gortyna immanis (Guenée).

The Hopvine Grub.

(Ord. LEPIDOPTERA : Fam. NOCTUIDÆ.)

A correspondent, Mr. A. B. Ryder, writing from Barnersville, in Schoharie county — one of the principal hop-growing counties in the State of New York — makes complaint of the ravages of "the grub," and asks for an effective remedy for it. He writes:

Operations of the Grub.

The hop grub is the greatest enemy that the hop-growers of this county have to contend with. It makes its appearance in the spring about the time that we are making our first tying. We notice that the tops of the vines are stung by some insect, and on examination we find a tiny worm in them, which in a few days falls to the ground. Here it eats into the hop roots so that the hill winter-kills the following winter. The grub gets to be about an inch long. I suppose that it is a fly or some other insect that deposits an egg in the head of the hopvine and develops into the grub. If so, where does the fly come from, and how can we prevent having so many grubs? Any information that you can give me will be thankfully received, and a remedy for the prevention or destruction of the grubs would be worth thousands of dollars to our hop-growers.

A copy of the *Second Report on the Insects of New York*, containing the life-history of the insect as worked out by Prof. J. B. Smith, was sent to Mr. Ryder, which would tell him what the insect was, of its habits, nature of its injuries, its transformations, etc. For the remedies and preventives to be used, he was referred to the excellent and full study of the insect by Professor Smith, published in Bulletin 4 of the Division of Entomology — U. S. Department of Agriculture, Washington, 1884. As this bulletin is now virtually out of print, the following summary of its provisions is here given for the benefit of hop-growers.

Remedies for the Grub.

First. Cultivate skunks, which are invaluable as hunters and destroyers of the grubs and their pupæ. Where they are left alone and protected and given convenient hiding and breeding places they will visit and clear every infested hill in a hop-yard.

Second. Search for and destroy the pupæ in early spring, which will involve but little labor when grubbing and cleaning the roots. A little experience will render them readily recognizable. They are formed in a rude earthen cell lying close to the roots. The pupa is an inch or more in length, stout, of a cylindro-conical shape, and of a deep-brown or blackish color. [By examining it, as in others of the same group of moths, the position of the future wings and legs will be found upon it, held firmly together, while the several rings of the abdomen can be made to move slightly upon one another.]

Third. Destroy the young grubs while tip-worms and in the "muffle-heads" when the vines commence to climb and the growers are beginning to tie. Do this by picking off the "muffle-heads" and by pinching between the fingers the contained larva. As the larvæ only remain in the head for about a week, by going through the field every second day and picking the muffle-heads as they appear, a yard of considerable extent can be cleared with little trouble.

Fourth. If the above have failed, then expose the roots for a few days in early June, after the larvæ have come to the ground, by drawing away enough earth to expose the junction of the growing vine with the old root. This will force the grubs to enter the ground to feed on the old roots where they will do little harm. After five or six days' exposure apply a handful of a mixture of coal and wood ashes or ammoniated phosphate, and hill high. This will cause the vine to throw out rootlets above the main root to sustain the vine while the grub may be working below.

Nothing that seems to promise better than the above has been proposed by later writers, if, indeed, anything in addition has been given.

Gortyna cataphracta Grote.

As a Raspberry-cane Borer.

(Ord. Lepidoptera: Fam. Noctuidæ.)

A raspberry cane was brought by State Botanist Peck on June 19 from his garden at Menands which had been bored upward for five inches, with the six inches of the tip beyond bending over. The larva found in the burrow was in all probability that of *Gortyna cataphracta* Grote, described and figured in *Proc. Ent. Soc. Phila.*, iii, 1864. The following brief notes were made of it: It was six-tenths of an inch long, the head and collar pale red, head and first segment with a black stripe laterally; body with a dorsal and lateral stripe of white, which are widened over segments 8 to 10; beneath black on segments 3 to 6, elsewhere white. Caudal plate pale red, with a broad black lateral line. Legs black, stout. Spiracles in the black stripe oval, black, annulated with white. Prolegs on 8 and 9 white, with the two spots above them brown; prolegs on 7 and the terminal pair also white. The caterpillar, not maturing, was placed in alcohol in the State collection.

Not Frequent in the Raspberry.

This attack of *G. cataphracta* is either rare, or its operations, when noticed, are referred to the work of some other of the well-known and common raspberry-cane borers. It is not mentioned in Saunders' *Insects Injurious to Fruits*, nor in Professor Webster's *Insects Affecting the Blackberry and Raspberry*, published in December, 1892, wherein 87 species are noted. (*G. nitela*, the "stalk-borer," is recorded without particulars as boring in the stems of the raspberry.) No mention of it is made by Dr. J. B. Smith in his several notices of insects affecting the raspberry in New Jersey.

Bred from Various Plants.

The caterpillar, as might be suspected from the known habits of that of *Gortyna nitela*, by no means confines itself to raspberry canes, and its occurrence therein may be exceptional.

In the *Sixteenth Annual Report of the Entomological Society of Ontario* (1886), Mr. Fletcher reports his having bred for the first time (in 1885) *Gortyna cataphracta*, which had been very destructive during the last three seasons by boring into the stems of various kinds of plants, more especially lilies and raspberries.

Later, in 1893, Mr. Fletcher wrote me, in reply to inquiry made, that he had several times bred *G. cataphracta* from raspberry stems; also from the stems of lilies, burdock, *Amarantus* and, in fact, from almost any kind of large, juicy-stemmed plant, even including grasses. He has kindly sent me, with permission for its use, the following careful and detailed description of the caterpillar, found by him on July 14, boring into the fruit of a gooseberry:

Description of the Caterpillar.

Larva slender, 35 mm. long, dark purplish-brown, with three white, conspicuous, unbroken lines, one dorsal extending from segment 3 to posterior margin of 12; two lateral on same segments. On segments 2 and 3 at the base of the thoracic feet, which are black, is a short line showing only on those two segments and very pale on 8, 9, and 10, at the base of the prolegs. Head yellow at the top, with a black line on each side running from the ocelli to the posterior margin of segment 2, where it passes along the lower edge of the large cervical shield and joins the dark brown color of the body beneath the white lateral lines. Cervical shield yellow, conspicuous, almost covering the second segment, lined at the bottom by the black line that runs from and surrounds the ocelli. Spiracles dark, with pale-edged orifice, conspicuous on segment 2, where they lie in the short white line at the base of the thoracic feet. Anal shield yellow and conspicuous like the cervical shield, with two dark lines in continuation of the lower edges of the white lateral lines. Tubercles conspicuous, dark brown, shining, piliferous. Dorsal tubercles in two series, the anterior touching the edge of dorsal line and larger than those of the posterior series, which just touch the lateral line. Below the lateral lines are five series of tubercles, one suprastigmatal (No. 3 counting from the dorsum) just beneath lateral line anterior to spiracles. Another series (No. 4) on stigmatal line, immediately beneath series No. 3, the tubercle half the size. Another series (No. 5) posterior to spiracles and equidistant with series No. 4 from spiracles, composed of large tubercles, twice the size of those in No. 3. Immediately beneath spiracles and stigmatal folds is series No. 6 of tubercles, not quite as large as those in No. 5. Posterior to this there is a supraventral series (No. 7) of spots slightly larger than those of No. 3.

On segment 3 are three tubercles in the subdorsal area, a large anterior blotch, and a median row of two spots on each side of the dorsal line. Beneath lateral line are, 1st, two small spots in continuation of the median row, and beneath these two tubercles above ventral fold, the posterior of which is much the larger. The tubercles of the supraventral series is on the base of thoracic foot. On segment 4 the tubercles are arranged in the same pattern, but the anterior dorsal spot is very small. Segment 12 has but 6 tubercles in a transverse row, two dorsal very large, and the two of series 6 and 7.

Pupated August 4. Moth emerged Sept. 4, *Gortyna cataphracta*, male.

Of several specimens which I have bred from the stems of raspberries and lilies, I found about half pupated (in the breeding jars) in the stems, while others burrowed into the ground.

Some of the Literature of the Species.

A brief description of the full-grown larva has also been published by Mr. Wm. Beutenmuller, in the *Bulletin of the American Museum of Natural History*, vol. v, 1893, p. 94.

Mr. H. G. Dyar has also described in the *Canadian Entomologist*, xxiii, 1891, p. 157, the mature larva and pupa of *Gortyna cataphracta* — the larva "boring in the leaf-stems of rhubarb, and pupating in its burrow after biting a hole, across which it spins a few threads." The larval description differs in several particulars from the others given, and it may be questioned if some error has not occurred in the identification of the moth.

The above is all of the literature of the species, except list references, known to me, while that of its congener, *G. nitela*, is voluminous.

Distribution.

Mr. Grote gives as the habitat of this species, "Canada in September; Massachusetts; Northern New York in October; Colorado." I have received the moth from Wisconsin: it has not been taken in my New York collections.

Collections in the Adirondack Mountains in 1893.

The additions made to the State collection have been mainly, as in preceding years, in the Adirondack region of the State. The collections made in Keene valley, Essex county, this season, during portions of the months of July and August, were larger than usual. Lepidoptera attracted to light were unusually abundant. Over six hundred examples, mostly belonging to the *Noctuidæ*, were taken by this means. Two species of *Plusia*, a genus containing perhaps the most beautiful of our Noctuids — *P. u-aureum* and *P. mortuorum* which in former years have been comparatively rare in the Adirondacks, although belonging to high altitudes, were this year really common — more common, indeed, than any other species. The first *Plusia purpurigera* ever taken by me was captured on August 6th. As the Plusias have place among the rarer of our Noctuidæ, and are always regarded as desirable additions to collections, the several species taken at Keene valley this season, with the number of each, is herewith given:

Plusia	(Deva) purpurigera *Walker*, 1	Plusia	precationis *Guenée*, 10
P.	æerea *Hübner*, 1	P.	u-aureum *Grote*, 84
P.	æroides *Grote*, 9	P.	mortuorum *Guenée*, 58
P.	balluca *Geyer*, 8	P.	simplex *Guenée*, 8
P.	bimaculata *Stephens*, 4		

The total number of Plusias — all taken within doors — was 183, not including many worn and rejected examples appearing in August.

Comparing the above with the collections reported by Mr. W. W. Hill, in the western portion of the Adirondacks (Lewis county) during the four years, 1875–1879,* we find that nearly twice as many

* In *Seventh Report on the Survey of the Adirondack Region of New York*, 1880, p. 387.

examples of *P. u-aureum* and *P. mortuorum* were taken this year as in the four years cited — or 142 as against 82. Of species contained in the Hill List, and not seen at Keene valley this season, are the following: *Plusia Putnami* Grote, *P. thyatiroides* Guenée, *P. formosa* Grote, *P. mappa* Gr.-Rob., *P. viridisignata* Grote, *P. epigæa* Grote, and *P. ampla* Walker. These, however, are among the rarer species, and only thirteen examples are reported in the List.

The following of the *Noctuidæ* were among the most common that came to light, and of each from ten to thirty examples were obtained:

Adelphagrotis prasina (*Fabr.*)	Agrotis redimicula *Morr.*
Noctua baja *Fabr.*	Mamestra purpurissata *Grote*
Noctua Normaniana (*Grote*)	Mamestra meditata *Grote*
Noctua bicarnea *Guenée*	Mamestra olivacea *Morrison*
Agrotis (Feltia) subgothica *Steph.*	Xylophasia dubitans (*Walker*)
Agrotis (Feltia) tricosa *Lintn.*	Tricholita signata *Walker*

In contrast with the abundance of *Noctuidæ*, there was almost an entire absence of some other insects which in other seasons have been observed in large numbers. Thus, of the attractive and conspicuous family of the "hover-flies" or *Syrphidæ*, scarcely any were seen except the small form of *Sphærophoria cylindrica*, which seems almost inseparably associated with the golden-rods of August. The *Bombylidæ* were much less abundant on the damp spots in roadways than usual. Scarcely any of the "Dragon flies" or Odonata, were seen; and indeed but few Neuroptera, except three species of *Phryganidæ*, which shared with the moths in attraction in the evening to lighted rooms. Coleoptera were not common. In a locality — a dried roadway ditch — where in 1892 hundreds of *Cicindela repanda* could be taken by simply swinging the net from side to side as one walked rapidly along, hardly any were met with. (*Report of the Entomologist to the Regents of the University for the year* 1893.)

Sitotroga cerealella (Oliv.).*

The Grain-Moth.

(Ord. Lepidoptera: Fam. Tineidæ.)

Additional Bibliography to that contained in the 2d Rept. Insects New York, 1885.

Packard: Guide Study Ins., 1869, p. 350, figs. 265, 266 (larval food); Entomol. for Begin., 1888, p. 151 (figure of moth and larva).

Ladd: in Psyche, iv, 1885, p. 337 (life-habits at Geneva, N. Y.).

* Mr. Meyrick refers the species to *Sitotroga*; the other writers cited, with one or two exceptions, to *Gelechia*.

LINTNER: 2d Rept. Ins. N. Y., 1885, pp. 102–110, figs. 18–21 (general account). 6th Rept. do., 1890, p. 190 (mite associated with it); in Count. Gent., lviii, 1893, pp. 188, 189 (general notice).
WEBSTER: Ins. Affect. Corn (in Ind. Agr. Rept. for 1885), 1886, p. 24, pl. 5, f. 3, pl. 6, fig. 2, (brief general notice); in Insect Life, i, 1889, p. 354 (injurious in Australia to stored grain).
HUNT: in Miss. Ess. Econom. Entomol., 1886, pp. 89, 90 (bibliography).
RILEY-HOWARD: in Insect Life, iii, 1891, p. 339 (reply to inquiry from Va.); id., iv, 1892, p. 207 (remedy for, in granary), p. 283 (in Florida), p. 293 (in Miss., reference), p. 296 (in India, reference).
WEED: Bull. 17 Miss. Agr. Exp. St., 1891, pp. 3–6, figs. 1–3 (general notice).
SMITH: in Ann. Rept. N. Jer. Agr. Exp. St., 1891, pp. 347, 405–408, f. 22 (general account with remedies); List Lepidop. Bor. Amer., 1891, p. 100, no. 5335.
BECKWITH: Bull. 12 Del. Agr. Exp. St., 1891, p. 14 (brief notice); Bull. 21 do., 1893, pp. 10, 11, figs. 6, 7 (brief notice).
DORAN: Bull. 16 Md. Agr. Exp. St., 1892, pp. 437–441 (general account).
KELLOGG: in Insect Life, v, 1892, p. 116 (in two years' stored grain in Kansas); Com. Inj. Ins. Kans., 1892, pp. 50–52, f. 24 (description and remedies).
HOWARD: in Insect Life, v, 1893, pp. 325–328 (history, preventives, remedies, etc.).
SLINGERLAND: in Rur. N. York., lii, 1893, p. 493 (remedies); in do., liii, 1894, p. 425 (at World's Fair).
BRUNER: in Ann. Rept. Nebr. Agr. Exp. St. for 1893, pp. 408–410, f. 53 (habits, etc., from Riley).
RILEY: in Insect Life, vi, 1894, pp. 216, 222 (at World's Fair).
FLETCHER: in Prairie Farmer for July 7, 1894, lxvi, p. 9 (not abundant or destructive in Canada).
CHITTENDEN: in Yearbook U. S. Dept. Agricul. for 1894, 1895, pp. 281–283, figs. 44, 45 (history, injury to grain, life-history, remedies).
COMSTOCKS: Manual Stud. Ins., 1895, p. 258 (brief notice).
MEYRICK: Handbook British Lepidop., 1895, p. 571 (description and distribution).

The letter given below, received from one of the southern counties of Pennsylvania, illustrates forcibly the great injury that may be caused to wheat between its reaping and November threshing — at least one-half of its flour product — by the larva of the Angoumois moth, or the "fly weevil" of the southern wheat belt, during the larval growth of a single brood.

EDS. COUNTRY GENTLEMAN.— I have just returned from Montgomery county, Pa, where I learned of a new (at least to me) enemy to wheat. It is a small worm that eats the grain after harvest, just as the bean-weevil develops in the bean, and then feeds upon it. During harvest and when seed wheat was threshed in September, the wheat was apparently all right. But in November, while threshing, as the eaves were handed out of the mow, thousands of small white millers re seen coming out of the sheaves and flying confusedly about in the barn. Bushels of light wheat were blown out with the chaff, being nothing but hulls of bran; the rest of the grain had been eaten by the worms. After threshing some time the man feeding the thresher found that the cylinder did not draw the sheaves into the machine as usual, and some time later not at all. Upon examination the concave was found clogged with dust and mashed worms, which adhered to the concave teeth, until the spaces between them were closed, excepting passage ways kept open by each cylinder tooth.

The wheat was put in sacks from the machine as threshed, and would heat over night in the bags. I was told that a farmer took 100 measured bushels of wheat to a mill, and when weighed he had only 59 bushels, which was then kept separate and ground, and it made five barrels of flour.

These worms first appeared in 1890, and have now spread about ten miles from their starting point. I enclose a sample of wheat damaged by these worms. Is it a new enemy to wheat, or is it an old one just appearing in a new territory, and how can it be successfully destroyed? Can it be carried and introduced by sowing infected wheat from where it is now?

The insect, so destructive to wheat in Montgomery county, Pa., is an old grain pest, which has been known in Europe for over a century and a half, although it was first given a scientific name by Olivier in 1789. Réaumur wrote extensively of its ravages in France in 1736. In 1760 it had increased to so alarming an extent that the attention of the government was enlisted, and commissioners of the Academy of Science of Paris were appointed to visit the province of Angoumois and investigate and report on the insect. As stated in their report: "The insect was found to swarm in all the wheat fields and granaries in Angoumois and of the neighboring provinces, and the afflicted inhabitants were thereby deprived not only of their principal staple wherewith they were wont to pay their annual rents, taxes, and tithes, but were threatened with famine and pestilence from the want of wholesome bread." It is shown in its several stages in Fig. 1.

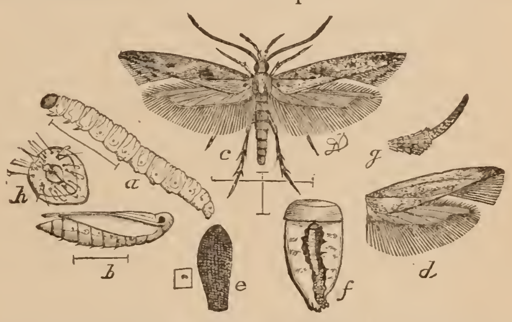


FIG 1—SITOTROGA CEREALELLA: *a*, the larva; *b*, the pupa; *c*, the moth; *d*, the wings of a paler variety; *e*, the egg; *f*, kernel of corn showing the work of the larva; *g*, labial palpus of the male moth; *h*, anal segment of the pupa—all enlarged except *f*. (From Riley.)

History in the United States.

As early as in 1730, it was operating in North Carolina. In 1768, a communication upon it was sent to the American Philosophical Society of Philadelphia, entitled "Observations Concerning the Fly-Weevil that Destroys Wheat." Before the middle of the present century, it had become largely distributed over the "wheat belt" from the Atlantic westward to the Mississippi river, but, fortunately, it seems to be less destructive as it extends northward, not being able, apparently, to endure the cold of severe winters.

Rare in New York State.

It has never been particularly injurious in New York -- indeed, it is rather a rare insect therein, having only come under my notice on three or four occasions. Dr. Fitch, writing of the insect in 1861, states that it had made its appearance in the museum of the State Agricultural Society ten years before, in wheat preserved in closely-corked bottles, and had so multiplied in them that the contents were entirely ruined. (Reports 6–9, p. 127.)

Operations at the New York Experiment Station.

In the autumn of 1884, corn infested with it was received by me from the State Agricultural Experiment Station at Geneva. It had been working within the corn in the museum for the preceding two years. At my suggestion, careful examination was made for its operations in the field. Answer was returned that no indications of its presence there were found, and it was believed that it was entirely confined to the dried corn contained in the museum. The following observations upon it in the museum, were made by Mr. E. F. Ladd, at that time the horticulturist of the station:

Hundreds of moths emerged daily, and it became necessary to burn much of the collection, while the remainder was packed in boxes and treated to bisulphide of carbon. An examination seems to show that the larvæ feed only upon the deposit of starchy matter in the kernel. Larvæ were not found in the varieties of sweet corn in which the starch is distributed throughout the kernel, but they were found, frequently, two and occasionally three, in a kernel of the flint corn, in which the starch is deposited in a mass. In pairing, the moths remained together twenty-five minutes. One moth laid thirty-six eggs, in two patches of seventeen and nineteen, which hatched in seven days, from 2d to 9th of November. The eggs were at first milky white, showing an orange tint at the end of twenty-four hours, and gradually becoming deep orange at the end of thirty-six hours. They were laid on the bottom of a dish, in threes, touching at the ends.

It is probable that in each of the above instances the insect was brought into New York in infested grain or corn, and it is doubtful if it ever attacks growing crops, or newly grown, within our State.

A Parasitic Attack.

About the middle of February, 1893, ears of "eight-rowed Shaker" corn, from South Dakota, of the crop of 1891, were brought to me from a commission house in Albany, which contained the larvæ of the insect and numerous holes from which the moth had emerged. Some small ears of the pointed kernels, known as "Egyptian Rice," and used for popping, grown in this State in 1891, were quite badly infested; nearly every kernel had been burrowed.

Three weeks thereafter, several examples of a chalcid parasite emerged, which, being submitted to Dr. Riley at Washington, were found to belong to the genus *Catolaccus*, and was probably an undescribed species.

It was subsequently learned from the firm that not long before the infested corn had been sent to me, thousands of a minute and delicate-winged insect had been noticed flying in the room where the corn was stored, when aroused by a light brought into it. In the belief that their presence was connected with the injury to the corn, sulphur was burned to destroy them. It accomplished its work so effectually that when I visited the room to see the condition of the attack, no living examples could be found, but the identity of the reported myriads with the Catolaccus parasite bred by me was established by dead specimens that were lying upon the beams and in folds of paper in the room.

Number of Broods.

Under natural conditions, abroad, there are, except in the South, two annual broods of the insect. According to Réaumur, the moths emerge in June from the stored grain and deposit their eggs upon the growing grain as it is beginning to head. The second brood of moths appears in August, and from these the larvæ are produced which operate within the grain throughout the winter. European writers record two broods of the moth, which appear in May and June, and in November. It seems, however, that the number of broods depends on the latitude, for while Dr. Harris records but two in Massachusetts, five are claimed in Southern Virginia, between June and October; and Prof. H. E. Weed, of the Mississippi Agricultural Experiment Station, states *loc. cit.*, that "there are, at least, eight annual generations" in that State, and that "in warm weather it takes but a month to pass from the egg to the moth, and the various stages of the insect can be found in infested grain at all times in the year."

Writers do not agree in their statements of when the eggs of the first brood are laid. In Europe the moths are said, as above, to appear in May or June, and oviposit on "growing grain." According to Mr. L. O. Howard, "it lays its eggs only on hard grain. After the time of harvest, the moth flies out from the granaries to the wheat fields and lays its eggs upon grains of wheat in the shocks."

The "thousands of small white millers seen coming out of the wheat-sheaves in the barn" at the time of threshing during November, in Montgomery county, Pa. (in the extreme southeastern portion of the State, latitude about 40°), were probably of the third brood. Their larvæ were undoubtedly operating within the wheat at the September threshing, but had not sufficiently advanced to have injured the kernels perceptibly. A portion of this brood would, perhaps, hibernate in the larval stage, to appear the following spring. That it could not have been the pupæ alone which clogged the teeth of the cylinder of the thresher is evident from the statement made in regard to the subsequent heating of the grain.

The Heated Grain.

The statement in regard to the heat observed in the grain after it had been threshed and put into sacks is an interesting one. The heat was evidently the result of the friction attending the gnawing of the interior of the hard-dried grain by the larvæ contained within This phenomenon, so far as I remember, has not been recorded before in connection with the Angoumois moth, but has been several times mentioned in notices of our bean-weevils. It has been observed where the common bean-weevil, *Bruchus obtectus* Say, was operating in dried stored beans, and is not at all uncommon with a southern species of bean-weevil, *Bruchus Chinensis* Linn. (formerly known as *B. scutellaris* Fabr.), which so often infests the "cow-pea" of the Southern States. Mr. Howard has recorded an instance where the surrounding temperature of a paper bag containing about a quart of these beans being 71° Fahr., a thermometer thrust within the beans rose 25° (to 96° Fahr.) in a few minutes (*Insect Life*, i, 1888, p. 59).

Results of the Attack.

Not only is the yield of the flour very greatly diminished by the operations of this insect, but the flour produced from infested grain is decidedly unwholesome. A distinguished French savant has written of it: "The bread made from wheat attacked by it, and especially when the flour has not been suitably bolted, contains the debris of the bodies and excrement of the insects. It has a disagreeable and loathsome taste, which is very lasting. It is even said that a very dangerous throat disease results from the use of this unhealthy food — a disease which has been epidemic for some years in regions infested by the *Alucita* [Sitotroga]. It manifests itself by gangrenous ulcerations which form in the back of the mouth; the sick succumb in a few hours and cannot be aided." (*Report Dept. Agricul. for* 1889, p. 317.)

In reply to the inquiry regarding the introduction of the insect into Montgomery county — the insect can easily be carried from one locality to another in seed wheat, and introduced in places where it was before unknown.

Distribution of the Insect.

In the United States the Angoumois moth is distributed more or less over the Eastern, Middle, and Southern States where wheat is grown, but it is especially a southern insect. It is occasionally seen in Canada, but, according to Mr. Fletcher, it has not occurred there in destructive numbers. It infests middle and southern Europe and also occurs in England. Prof. Webster found it causing serious damage to stored grain in Australia. Its origin is unknown. Mr. Meyrick does not believe it to be a true native of Europe.

Remedies and Preventives.

Various methods have been used for the destruction of this insect, as violent agitation, or frequent stirring of the grain to destroy the eggs and possibly the contained larvæ; application of heat at about 165° Fahr. for an hour; spraying with kerosene; subjecting to the fumes of sulphur, etc., etc. But beyond question the cheapest and the best is the use of bisulphide of carbon — purchasable at drug stores at about 25 cents per pound. As soon as the corn or grain is found to be infested, it should be put into a bin tightly closed at the sides, but not necessarily so at the top, where a heavy close cloth covering would suffice, and the bisulphide of carbon placed in open vessels on the top of the grain. The heavy vapor given off from the volatile liquid descends and permeates the grain and destroys all the animal life contained therein. A day or two of exposure to the vapor is sufficient. One pound, or a pound and a half, may be used for each ton of grain.

For use in a reasonably tight room, Mr. Howard has made the following computation: One pound to be evaporated for every one thousand cubic feet of space, or in a space 10x10x10, one-third of a pound in each of three shallow vessels. For a room 10x10x20, use two pounds divided among six vessels; for a room 10x20x20, use four pounds in twelve vessels and in like proportion for larger apartments.

Some writers have recommended the simple sprinkling of the liquid over the surface of the grain.

For use in large quantity it might be desirable to order the carbon bisulphide of Edward R. Taylor, Cleveland, Ohio, manufacturer of "fuma" carbon bisulphide, at the following advertised prices: In 10-pound cans, 12 cents per pound; in 30-pound cans, 11 cents per pound; in 50-pound cans, 10 cents per pound. So long as any of the vapor remains, no light or fire of any kind should be brought near it, as the vapor is very explosive. It has been known to ignite even from the heat of a hot-air register.

As the insect is often local in its occurrence,—in consideration of the fact that it passes the winter in granaries in a continued succession of broods, where the temperature is moderate, it would not be difficult to destroy the insect and arrest the continuation of the broods, through concert of action in any one locality. If all the grain holders would unite in disinfecting their granaries and storehouses by the use of the carbon bisulphide in the early summer, there would be no moths to leave them for the deposit of eggs upon the ripe grain in the fields, and consequently future attacks would be prevented until the insect could again be introduced from some other locality.

It is stated that corn can be kept for years *nearly* exempt from injury by this insect and the grain-weevils, by being housed in the shuck or husk: it has been thus kept through the third year. Mr. Ruffin has also stated: "If wheat be threshed and well-fanned early in July [in the South] there will be no weevils worthy of notice. The eggs previously laid do not exist on the grains, but on the chaff or shuck, in which they are inclosed, and upon hatching, the maggots must perish for want of food. As in the case of corn, the wheat is not exposed to subsequent layings except on the grain at the surface of the bulk."

But evidently the best reliance is to be placed upon the destruction of the egg-bearing moths in the granaries in the early summer before harvest.

The Angoumois Moth Destroyed by a Mite.

Several years ago (October 1, 1889) a sample of infested wheat was sent to me by a correspondent at Charlottesville, Va. Statement of the nature of the attack may be of interest in connection with its unusual termination. The gentleman wrote:

Wheat harvest in our section was followed by continuous rains which resulted in serious sprouting in the shuck. As soon as possible I hauled up and threshed, storing the wheat in a large barn, spreading as thin as possible, say 12 to 15 inches deep, ventilating all we could, and turning it over frequently with shovels. In from three to four weeks after storing I noticed a small fly crawling and flying on and over the wheat, followed in three or four weeks thereafter by what seems to be an egg-deposit. These latter appeared mainly in depressions on the surface [of the bed], such as foot-tracks, etc. I inclose a sample of the wheat-fly and eggs (or are they embryo flies)? * * * * * My crop is probably from 1,500 to 1,600 bushels, and I fear serious loss if some remedy is not promptly applied. In an experience of over twenty years at the business I have never seen such an insect before. I should add that the wheat was fanned after coming from the separator, which took out the sprouted grain. It is now almost entirely dry and seemingly in good condition, barring the insect attack.

The insect was readily identified as the Angoumois moth. With the wheat sent was a large quantity of the exuviæ or the dried remains, or both, of the mite, *Heteropus ventricosus* Newport, first brought to notice in this country by Prof. F. M. Webster, in the *Twelfth Report on the Insects of Illinois*, as having been found in the autumn of 1882 in a sack of wheat received from Southern Illinois. For two or three months thereafter, the mites were observed, as opportunity offered, to be feeding voraciously on the larvæ of the grain-moth. Reference to the above has been made in my *Second Report on the Insects of New York*, and the illustration of the mite therein given, after Newport, and reduced from the figure in Murray's *Economic Entomology — Aptera*, is reproduced in this.

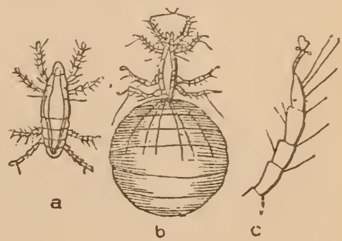


Fig 2.— HETEROPUS VENTRICOSUS, a mite preying upon the Angoumois moth: *a*, a mature individual; *b*, female distended with eggs — both enlarged; *c*, leg greatly enlarged. (After Newport.)

The gentleman was informed of the nature of the attack — usually serious and calling for active measures for its arrest. In this instance, however, it was highly probable, that he need give himself no further trouble in the matter, for from the large number of the remains of the carnivorous mite that he had sent me with the wheat, and from what was known of its habits, assurance was felt that the attack of the moth was already arrested, or speedily would be.

On October 29th, the gentleman wrote as follows, after thanking me for the information given:

I am pleased to be able to report to you that your predictions have been verified, and that the insect attack upon the wheat has resulted in no injury. I, therefore, conclude that your diagnosis of the case was the correct one, and that the mites preyed upon and destroyed the insect. I am yet holding the wheat, and with perfect confidence that it is now entirely safe. As evidence that there was absolutely no injury to the germ, I have delayed reply to your letter until I seeded from the pile, and have the pleasure of reporting that it is coming up beautifully.

Professor Webster's notice of this mite is the only one that I can recall in our economic literature. Dr. Packard has figured it on plate 10 of his "Guide." It was "discovered by Newport on the body of a larva of a wild bee," *Anthophora retusa*, in England (see Newport, "*Trans. Linn. Soc.*, 1850"). Professors Osborn and Underwood, for some reason, have not included it in their "Preliminary List of the Species of Acarina of North America," given in the *Canadian Entomologist*, xviii, 1886.

Diplosis pyrivora Riley.

The Pear-Midge.

(Ord. DIPTERA: Fam. CECIDOMYIDÆ.)

The eggs of this insect are known to be deposited within the unopened blossom buds of the pear as soon as a petal shows itself between the segments of the calyx (see Ninth Report, p. 149). The larvæ produced therefrom have usually been seen when they have grown sufficiently to deform and discolor the fruit, by which time they nearly fill a large irregular central cavity therein, as represented in figure 3 (from the Eighth Report). Upon opening pears that gave the first indication of an abnormal form, I have found the larvæ imbedded within the upper half of the fruit.

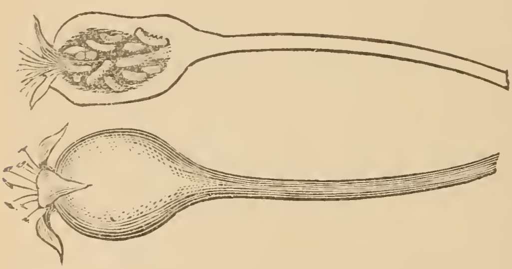


FIG. 3.— Section of a pear containing the larvæ, and an uninfested one for comparison of forms.

Early Observation of the Larvæ.

In some young pears of the Beurre Bosc variety, less than one-fourth of an inch in diameter, received on May 22d from Theo. A. Cole, of Catskill, N. Y., the larvæ were seen at an earlier stage of development than in any record of their observation. The pears were just out of blossom and had some of the petals still attached. Numerous larvæ were found quite near the calyx end imbedded in the broken down structure of the fruit, and not yet imparting the slightest discoloration to either the interior or exterior, or perceptible distortion.

The Lawrence pears of Mr. Cole are, as usual, badly infested this year, also, the Beurre Bosc, while the Bartlett is but slightly attacked.

Mr. S. B. Huested, of Blauvelt, Rockland county, N. Y., writing under date of June 18th, states that the pear-midge has been discovered in that vicinity this year for the first time.

Spread of the Insect.

At the time of notice of this insect in my Eighth Report, in 1891, it was not known to have been extensively distributed in the Hudson River valley, or, indeed, was there knowledge of its occurrence outside of Greene and Columbia counties. It is undoubtedly steadily spreading, for it has been heard from in several localities in Dutchess, Orange, Ulster, and Rockland counties, and it is presumably present in all of the river counties south of Saratoga and Washington counties. Its introduction into New Jersey must have been direct from Connecticut and not through New York, for Dr. Smith records its occurrence there in 1891, and is of the opinion that it had then been in the State for some years: it has already reached to nearly the central portion of the State.

A correspondent writing from Mountainville, Orange county, N. Y., reports that the attack was first seen by him on a single tree two years ago, and this year every pear upon it has been destroyed by the larvæ. In the other localities where it has been lately heard from, it is said to be a new insect pest. Its spread is evidently a slow one, from which it may be inferred that much good may be expected from the prompt destruction of the infested fruit — easily to be recognized when looked for — when first observed. The figures given on page 145 of the Report, above cited, of the deformed and infested fruit may be referred to.

At Menands, three miles north of Albany, the most northern locality known for the midge, the pear-trees which have been infested with it for the preceding two years have, this year, from some unknown reason, been entirely free from the attack.

For illustrations and the history of this insect in its several stages, its literature, etc., see pp. 140–151 of the Report above-named.

Notes on Sciara.

(Ord. DIPTERA: Fam. MYCETOPHILIDÆ.)

Some Literature of Sciara.

MEIGEN: in Illiger's Magazin, ii, 1803, p. 263 (genus established).

MACQUART: Hist. Nat. Ins.— Dipt., i, 1834, pp. 147–150 (characters of 15 species occurring in France).

FITCH: 2d Report (of 1st and 2d), 1856, pp. 252–255 (*Molobrus mali, vulgaris, fuliginosa, inconstans*).

CURTIS: Farm Insects, 1860, pp. 460-462 (habits and description of *S. fucata, quinquelineata, pulicaria?, punctata*).

LOEW: Mon. Dipt. N. Amer., Pt. I, 1862, p. 13 (differs greatly from the rest of the family).

OSTEN SACKEN: in Proc. Ent. Soc. Phil., i, 1863, pp. 153–157, pl. ii, figs. 3, 16, 18, 20 (larval characters), p. 158 (pupal characters), pp. 163–165 (larval habits), p. 165 (descr. of *S. toxoneura*), pp. 169–171 (literature); Cat. Dipt. N. A., 1878, pp. 12, 13 (list of 24 species); Char. Larv. Mycetoph., 1885, as in Pr. Ent. Soc. Ph., with pp. 27, 28 of additional literature.

WINNERTZ: Beit. Monog. des Sciarinen, in Verh. Zoöl. Bot. Gesellsch., 1867.

WALSH: 1st Rept. Ins. Ill., 1868, pp. 18, 19 (of *S. mali*); in Pract. Entomol., ii, 1867, pp. 71, 72 (in potatoes ?causing scab).

WALSH–RILEY: in Amer. Entomol., i, 1869, p. 186 (in rooms of dwelling).

PACKARD: Guide Study Insects, 1869, p. 386 (habits of larvæ).

GLOVER: in Rept. Commis. Agricul. for 1872, pp. 115, 116, f. 5 (snake-worm and other species); MS. Notes Journ.— Dipt., 1874 (habits, etc., of several species).

RILEY: in Cole. Rur. World, 1876, p. 220 (habits in congregating); in N. Y. Tribune, Dec. 4, 1878, p. 237 (habits); in Amer. Nat., xv, 1881, p. 150 (food habits, yellow-fever fly).

SCUDDER: in Rept. Prog. Geolog. Surv. Can. (1876–1877) 1878, p. 457 (*S. deperdita*, fossil); the same in Rept. U. S. Geolog. Surv. Terr., xiii, 1890, p. 586, and on p. 588, *S. scopuli*, fossil.

HAGEN: in Psyche, iii, 1880, p. 111 (yellow-fever fly).

COMSTOCK: in Rept. Commis. Agricul. for 1881, pp. 202–204, pl. xvii, (*Sciara ocellaris*).

SAY: Compl. Writ. Lec. Ed., i, 1883, pp. 249, 250, 308 (description of 5 species); ii, pp. 70, 351, 352 (description of 3 species).

SAUNDERS: Ins. Inj. Fruits, 1883, p. 136 (account of apple-midge).

WILLISTON: in Kingsley's Stand. Nat. Hist., ii, 1884, p. 408 (mention of *S. mali* and the snake-worm *Sciara*).

FORBES: 13th Rept. Ins. Ill., 1884, pp. 57–59, pl. 4, figs. 5–9 (larvæ); 18th Rept. do., 1894, pp. 19–21, pl. 3, figs. 3–7 (describes "black-headed corn-maggot" in corn and hot-houses, in all stages).

LINTNER: 5th Rept. Ins. N. Y., 1889, pp. 264, 265 (Sciara in wheat, *S. mali*, and the "army-worm" Sciara, European species, etc.); in Gardening for June 15, 1893, p. 313 (infesting a greenhouse, and of other species).

RILEY-HOWARD: in Insect Life, iii, 1890, p. 126 (larvæ under pear-tree bark), iv, 1891, p. 115 (snake-worm), vi, p. 273 (yellow-fever fly).

THEOBALD: British Flies, 1892, pp. 107–112 (description and habits of 10 British species, synoptic table of 25 species).

SCUDDER: in Psyche, vi, 1892, p. 262 (larvæ on snow in midwinter).

SMITH: in Insect Life, vii, 1894, pp. 151, 152 (injurious to mushrooms).

HOPKINS: in Insect Life, vii, 1894, p. 147 (*Sciara* sp. and *Epidapus* causing potato scab); the same extended in Sp. Bull. 2 W. Va. Agr. Expt. Station, 1895, pp. 100–114, and in Proc. Wash. Ent. Soc., iii, 1895, pp. 149–161 (detailed figures of *Epidapus*).

SOUTHWICK: in Insect Life, vii, 1894, p. 136 (the injurious sap-fly, probably a species of *Sciara*).

COQUILLETT: in Insect Life, vii, 1894, pp. 406–408, fig. 48 (habits, description of *S. tritici* n. sp., all stages illustrated).

COMSTOCKS: Man. Stud. Ins., 1895, p. 443 (*S. mali* and army-worm).

The genus *Sciara* is a member of the family of *Mycetophilidæ* or "fungus gnats," and is closely allied to the well-known *Cecidomyidæ* in appearance and in habits. Indeed the two families can not be separated by any clear lines of demarcation, and the true position to be held by the genus *Zygoneura* is still in question among dipterologists. Of the eight sub-families into which the *Mycetophilidæ* have been divided by late writers, the *Sciarinæ* are numerous in species, both in this country and in Europe,— 175 species having been described by Winnertz in his "Monograph of the Sciarinæ."

The Limited Study Given to Sciara in America.

From the resemblance that they bear to one another — the species having often been separated by little beyond their wing or antennal coloration — so little critical study has been given them by our entomologists that published descriptions will hardly permit positive identification of any of the number. For this reason, the little that has been observed of the habits and life-histories of our North American forms can not be positively referred to any one named species. It is doubtful if, of the twenty-six species of *Sciara* listed in the Osten Sacken *Catalogue of the Diptera of North America* a half dozen could be positively identified — their descriptions being so brief and general,— their types possibly all lost, and only two of the number (Loew's species -- possible types) having representation in the Museum of Comparative Zoölogy at Cambridge. In marked contrast with this apparent lack of study of *Sciara* stands the fact that of the closely allied genus of *Mycetophila* -- of the eighteen N. A. species listed, all but three (Say's species) have place in the Cambridge Collection, where comparison for identification can be made.

Larval habits of Sciara.

The habitat of *Sciara* is quite varied. Several of them are known to live in their larval stage in decaying vegetable matter of various kinds and in fungus growths. They have been reared in vegetable mold; beneath the bark of trees; in decayed wood and in the roots of decaying trees; in putrid potatoes, turnips and other vegetables; in excavations in potatoes and in connection with "the scab" thereon; in flower-pots in rooms; in manure beds; as guest flies in apples and grapes in association with other insect attack; some species are met with in cow-dung (Theobald).

A Notable Species of Sciara.

A species (perhaps more than one) is noted in Europe, for its gregarious and migratory habits. It is there known as the army-worm or *Heerwurm* from its collecting at certain seasons in companies — sometimes consisting of millions — and traveling along in a body of often from twelve to fifteen feet in length and two or three inches broad and perhaps a half inch thick. "M. Guérin Méneville observed columns as many as thirty yards in length." The species has not been positively determined, but it is accepted as either *Sciara Thomæ* (Linn.) or *S. militaris* Now.— but probably the latter, according to the statement of Baron Osten Sacken. Similar gatherings have been observed in this country, one of which is narrated in *Insect Life*, iv, 1891, page 214; two others recorded by Glover in the *Report of the Commissioner of Agriculture for* 1872, p. 115, as observed in Virginia (figures of the larva and fly are given); and two others by Prof. F. M. Webster, in *Science* for Feb. 23, 1894, p. 109. With us they bear the name of "snake-worms," from the snake like appearance and movements of some of the processions.

Those who have access to Figuier's *Insect World* may find therein (pages 46, 47) some interesting details, taken from the writings of M. Guérin–Méneville, respecting migrations of these larvæ observed on the borders of forests in Norway and Hanover, and their conduct upon meeting obstacles, when their ranks are broken, and when the two ends have been brought together; also, some strange superstitions respecting them, entertained by the peasants of Norway and Siberia. No satisfactory explanation has yet been given for the assemblage of such myriads of these footless larvæ and their marches in the brightest sunlight.

The Yellow-Fever Fly.

Another species of *Sciara* has been named in its winged state, "the yellow-fever fly," from its appearance in immense number (in swarms) on different occasions in some of the Southern States, during the prevalence of the epidemic from which it has drawn its name. As appears from an article by Dr. Hagen, in *Psyche*, iii, 1880, p. 111, entitled "The Yellow-fever Fly," no literature relating to these appearances could be found. They rested only on report. From a specimen collected in New Orleans in 1848, and marked as "the yellow-fever fly," which came to the Cambridge Museum, Dr. Hagen identified it as a *Sciara*, but could not refer it to any of the species listed in the Osten Sacken Catalogue of Diptera, and, therefore, accepted it as undescribed.

Prof. Riley, in a notice of the above paper in the *American Naturalist*, xv, 1881, p. 150, quotes the occurrence of another undescribed species of *Sciara*, where the flies came out in millions from the joinings of the floor boards in an upper room of a new addition to a seminary building in Bethlehem, Pa.

The Apple-Midge.

Still another species possessing particular interest from the habitat of its larva differing so greatly from that of most of those of its congeners, is *Sciara mali*, originally described by Dr. Fitch in his *Second Report on the Insects of New York*, as *Molobrus mali*, found by him in its pupal and winged stages in the center of an apple that had been eaten and perforated by the "apple-worm" of the codling-moth. Dr. Fitch was of the opinion that the eggs of this midge are deposited on apples that have been attacked by the apple-worm, and that the larvæ enter the fruit through the perforation in the side made by the worm.

This species is apparently rare. I have never met with it, and I am not aware of any important contribution to its habits or life-history by recent writers. It is not so much as referred to in Osten Sacken's revision of *Characters of the Larvæ of Mycetophilidæ*, in 1886. It will be of interest to know if the larva feeds on the pulp of the fruit or on the excremental or decomposed material associated with the presence of *Carpocapsa pomonella* and *Trypeta pomonella* — the latter the probable burrower of the apple in which the insect was found by Dr. Fitch.

Sciara coprophila n. sp.

The Manure-Fly.

(Ord. Diptera: Fam. Mycetophilidæ)

Examples of the above fly were brought to me on March 20, 1889,* from a gentleman in Albany who was growing mushrooms in his cellar. He believed that the larvæ injured the mushrooms by eating into the stalk near the surface of the bed. Although I have no notes stating the fact—if my memory serves me correctly, some of the larvæ received at this time were carried to their winged state by feeding

* Reference to this was made in the *Fifth Report on the Insects of New York*, 1889, p. 265.

them on the injured mushrooms. If so, it is not improbable that the mushrooms may have decayed before they were eaten by the larvæ. Unfortunately, none of the larvæ were preserved at the time, so that no study may be given them at the present.

Injury to Mushrooms by the Fungus Gnats.

I have not met with any direct statement of injury to mushrooms by *Sciara*, nor is it established that serious injury to cultivated mushrooms is inflicted by any of the large family to which it belongs, although the following named species are among those that are recorded as "feeding on mushrooms" in Europe: *Mycetobia pallipes* Meig., on *Boleti*; *Mycetophila signata* Meig., on *Boletus edulis*; *M. lunata* M., on *Agaricus vitrinus*; *Rymosia fenestralis* M., on *Agaricus melleus*; *Exechia fungorum* Dg., on *Boletus*; *Docosia sciarina* M., on *Boletus scabra* and *B. edulis*; *Boletina*, several species; *Bolitophila cinerea* M.; *B. fusca* M.; *B. disponcta* Loew; *Plesiastina annulata* M.; *Sciophila striata* M., on "mushrooms." A recent English writer on the Diptera,† states: "Some of the fungus gnats [*Mycetophilidæ*] are certainly injurious, as the species that live upon the 'mushroom,' whole frames of this edible fungus being destroyed by these larvæ; but the amount of damage done is small compared to the amount of good which these maggots do in destroying fungi." And again: "The larvæ of these gnats act as 'scavengers; not only do they do away with rotting fungi, but they cause these often injurious productions to putrefy and to become scarce by their destruction."

What the Manure-Fly Is?

Specimens of the fly were submitted to Mr. R. R. Meade, of England, for comparison with European species. He could not identify them with any species known to him, but they approached somewhat nearly to *S. nervosa*.

Probably a Harmless Species.

Some of the flies were also sent to Mr. William Falconer, of Glen Cove, N. Y., with the inquiry if he had ever found them troublesome in his extensive greenhouse experience or in his mushroom growing. He replied that he was familiar with their appearance from having known them for many years — ever since he had been led to study insects and their habits. They always appeared about hotbeds or where there was pretty well-advanced fermenting horse manure, and for this reason he had given them the name of "manure-flies."

† Theobald: *An Account of British Flies*, 1892.

If the winter is comparatively mild, they may be seen for the first in the latter part of February, but ordinarily they do not attract attention until in March. They are in great abundance in the last weeks of March and through April and become comparatively few in May, perhaps by deserting the cellars for outdoor life. He had never had reason to regard them as harmful to mushrooms. At the time of writing (March 25, 1889) there were thousands of the flies in the mushroom cellars, while at the same time the crop of mushrooms was the finest and cleanest that he had ever grown and showing no sign of attack by larvæ of any kind. They are certainly no hindrance to mushroom growing during the winter, for they never appear in the earlier months or until the manure is at least two months old; but they are disagreeable guests, for before the end of April the walls appear as if they had been washed with wet mud, so much dirt and moisture do they gather and leave upon the walls, on which they are constantly leaping from the beds and coursing over. Mr. Falconer did not think it possible that these flies can be identical with those that produce the "maggots" that infest mushrooms in the month of April. In this opinion he was correct, as will appear in subsequent pages.

Remedies Suggested.

If it should be found on closer observation that it is important that the larvæ of these flies should be destroyed, there should be no difficulty in killing them by occasional applications of pure and fresh pyrethrum in water, using it of the strength of one ounce to from four to eight gallons of water, as the larvæ may be deeper beneath or nearer to the surface of the beds. That they multiply with great rapidity is shown by the fact that the fifth day after some surface-feeding larvæ were seen to enter the ground the winged flies therefrom made their appearance.

A method for killing the flies, said by Mr. Falconer to be employed in mushroom cellars in France, might also be used in connection with pyrethrum solution. It is to place small lighted lamps in shallow pans filled with water, with a little kerosene floated on the surface. Vast numbers are attracted to the lights and killed by falling into the kerosene, but still it does not prove wholly effective, as there are always many left.

The Manure-Fly Undescribed.

Of the twenty-three United States Sciaras of the Osten Sacken Catalogue, the "manure-fly" (adopting Mr. Falconer's name for it) can not be referred to any of the Say or Fitch species (11); there is no probability of its being identical with any one of the three Greenland species; and in the absence of types, it would be a loss of time to search for it among the five Walker species. From *S. ochrolabis* Loew -- New York — it would be ruled out by its want of ochreous spots. There would then remain but three species for comparison, viz.: *S. nigra* Wied.— Savannah; *rotondipennis* Macq.— Carolina; and *sciophila* Loew — Dist. Colum. In the improbability of its being one of these, it is herewith described as a new species. The excellent illustrations of it, as also of the two following species, have been made by my assistant, Mr. E. P. Felt.

Its Description.

SCIARA COPROPHILA n. sp. *Larva.*— Length when full grown 8 mm. Head jet black, small, broadly ovate, and more or less retractile into the anterior segment. Body whitish; subcylindrical, tapering slightly toward each end; smooth and indistinctly divided into twelve segments; the dark contents of the convoluted alimentary canal may be seen readily through the semitransparent body-walls; terminal segment usually bent abruptly downward (Fig. 4).

FIG. 4.— Larva of *Sciara coprophila.*

Details of head.— Clypeus subtriangular, emarginate anteriorly, and with a pair of very large punctures, probably setigerous, at the anterior third, and three smaller ones in each anterio-lateral corner; two pairs of the smaller punctures occur on the front close to the clypeus, one at its anterior, the other at the posterior third; a number of very small punctures on the clypeus and close to it are represented by dots in figure 5*e*; several more lateral punctures occur on the epicranium. Labrum; basal portion chitinous, narrow and with a large median tooth; distal portion broad, semimembranous, emarginate anteriorly, and bearing internally three groups of spines on each side of the median line; the anterio-lateral group consists of a slightly curved row of six, the middle group of three closely set, and the posterior group of about three; the anterior and middle groups are represented in figure 5*a*. Antennæ composed of one segment, conical, chitinous; located close to lateral angles of clypeus. Mandibles stout; three large teeth, one smaller internal tooth (Fig. 5*b*). Maxilla composed of a small basal portion and a large distal part; basal portion composed of two pieces; an external piece bearing two punctures along its distal margin, and an inner piece with a prominent internal spine near the basal third; distal portion strongly concave internally, apparently divided longitudinally; inner edge armed with six well-marked teeth and a smaller basal tooth; two large punctures occur at the apical fifth, one on each piece; on the apex of the external piece there is a larger oval puncture, in which lies the rudimentary palpus (Osten Sacken); internal piece with a puncture near middle (Fig. 5*c*, *d*). On ventral surface of head there is a large cordate membranous area, and the sclerites are slightly separated along the median line (Fig. 5*a*).

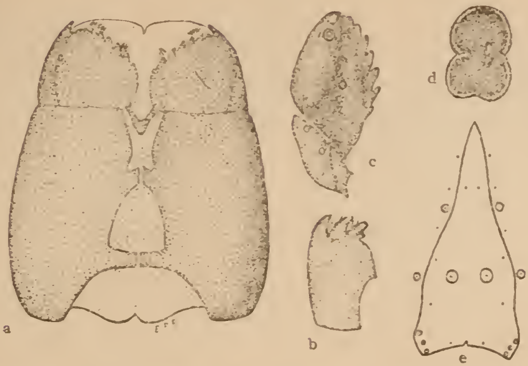


FIG. 5.—*Sciara coprophila*: Details of head of larva; *a*, ventral aspect of head; *b*, mandible; *c*, maxilla; *d*, apical depression in maxilla with contained rudimentary palpus; *e*, outline of clypeus, showing location of punctures. All greatly enlarged.

Pupa.—Length, 2.5 mm. The form of the imago is readily seen; it is a little stouter than in the perfect state. Head and thorax black; abdomen brownish; coxæ yellowish; legs brownish-black. The wings extend to the third abdominal segment; the tarsi to the fifth.

In the earlier portion of the pupa state the eyes only are black and they connect behind the antennæ by a very narrow band; dark-brown patches occur on the base of the antennæ; the rest of the pupa is a variable yellowish-white. As the pupa develops, the antennæ, wing-pads and tarsi darken considerably and the head and thorax darken a little; finally the abdomen begins to darken.

Imago.—Plate I. Head and thorax black; antennæ and abdomen dark-brown; setaceous. Wings hyaline and in certain aspects somewhat irridescent. Coxa dusky-yellow; femur and tibia yellowish-brown; tarsi darker, especially on the terminal segments. Apical portion of the halteres dusky, basal portion yellowish.

Length, 2.5 mm. The general appearance of the female is given in figure 1.

Three ocelli occur, the median one being anterior,—figure 2. The eyes are deeply emarginate and extend to the median line behind the antennæ; facets separated by an unusually thick frame of chitine,—figure 3. Antennæ longer than the head and thorax, composed of 16 segments; the two basal segments are about as broad as long and bear a few stout setæ; the remaining ones are often slightly gibbous with extremities rounded; pediceled distally and invested with numerous fine setæ; width to length as 4 to 7, see figure 6. The ridges represented upon the epistoma in figure 2 are partly internal and the upper portion of the inner ones wholly so, but as they can be easily seen in semitransparency in a mounted preparation, they are, therefore, indicated. The palpi are composed of four segments,—figure 8: basal segment short; second, elongated, capitate distally and bearing a distinct sensory pit; third, similar in form and shorter; fourth, long and slender: setæ on the basal portions of the three distal segments with a more or less verticillate arrangement; on the apical portions the arrangement is more irregular.

Wings hyaline and invested with numerous short hairs. The first longitudinal vein (the first branch of radius) joins costa before the fork of the fourth longitudinal (media). The venation is carefully represented in figure 1. The halteres are long; basal half slender and partially segmented; distal portion spatulate,—figure 4h. The scutum of the mesothorax is produced into a marked dorsal hump, which bears one or more stout setæ,—figures 1, 1a, 4, s′. The scutellum of the mesothorax has a more or less granulated surface. The hind coxa of the male extends to the basal third of the abdomen; in the female the hind coxa extends to about the basal fourth; the hind femur is twice the length of coxa; tibia one-fourth longer than femur; tarsi about equal to femur; middle legs shorter and fore legs still shorter than the hind legs; one apical spine occurs on the fore tibia and two on the middle and hind tibiæ.

The abdomen in both sexes is composed of nine segments; general form conical. The apical portion in the female quite extensile; on the eighth segment, a pair of ventral valves and between them a pair of slender processes; on the ninth segment, a pair of lateral valves, the apical portion of which is nearly circular,—figure 9. The abdomen of the male is shorter and apparently stouter; due to shortness of the terminal segments; the terminal segment bears within the larger jointed appendages a smaller pair of unsegmented, slightly diverging appendages; the apical fourth of these inner appendages is thickened, margin setose; beneath the dorsal plate a slender median organ may be seen arising from a forked base,—figures 11, 11a.

Length of body, 2.5 mm.; of wing, nearly 3 mm. Described from 30 females; 10 males.

Explanation of Plate I.

Fig. 1.—Manure gnat, *Sciara coprophila.*

Fig. 1a.—Scutellar hump of the same, more enlarged.

Fig. 2.—Head of the same: *a*, antenna; *p*, palpus.

Fig. 3.—Portion of the compound eye still more enlarged and showing the relative proportion of chitine to the facets.

Fig. 4.—Lateral aspect of the thorax: *c*, *c*, *c*, insertion of the coxæ of the pro- meso- and meta-thorax; *h*, halter; *S*, spiracle; *s*, scutellar hump; *w*, base of wing.

Fig. 5.—8th, 9th, and 10th segments of the antenna of the greenhouse gnat, *Sciara caldaria.*

Fig. 6.—Ditto of *S. coprophila.*

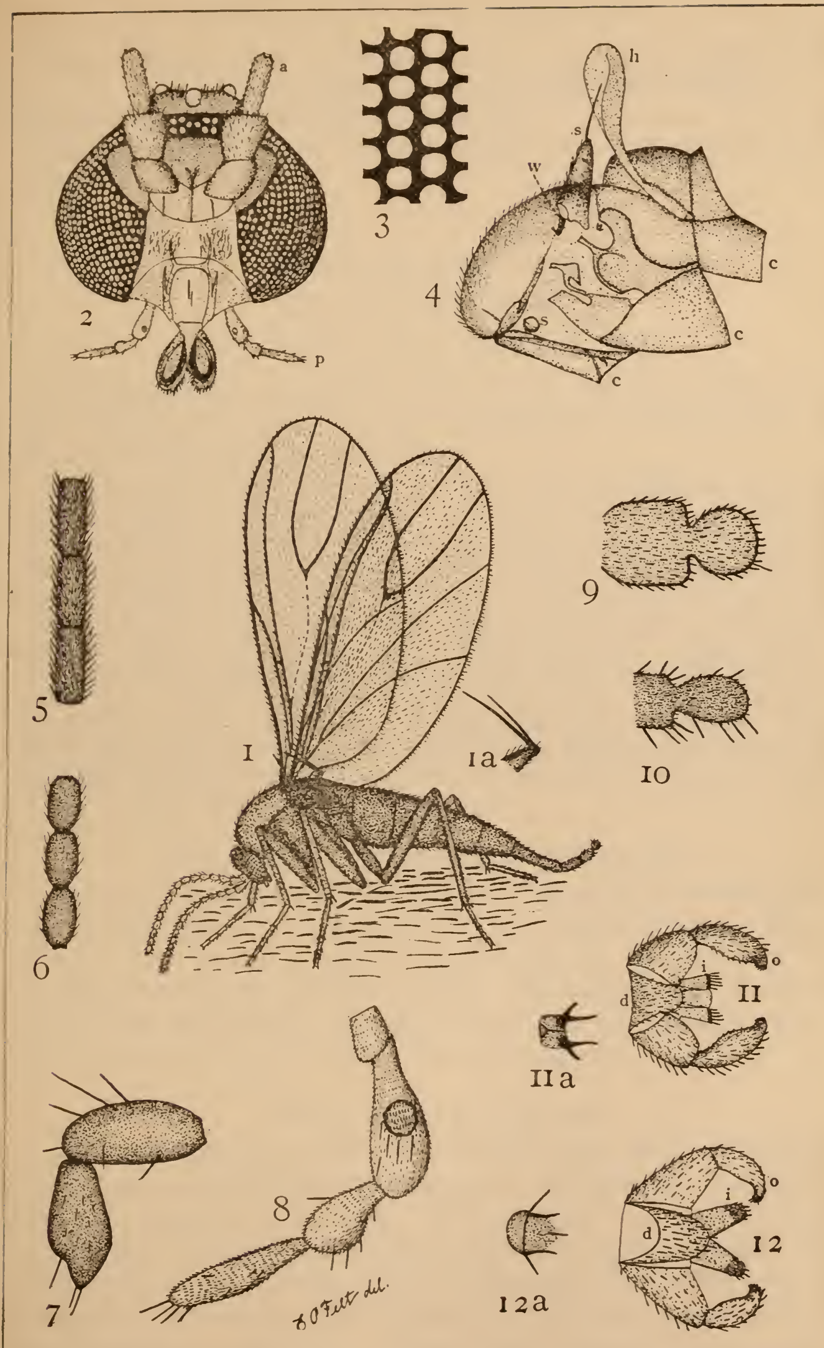
Fig. 7.—Terminal segments of the palpus of *S. caldaria.*

Fig. 8.—Palpus of *S. coprophila*, showing the sensory pit on the second segment.

Fig. 9.—Lateral valve of the female of *S. coprophila.*

Fig. 10.—Ditto of *S. caldaria.*

Fig. 11.—Dorsal aspect of the terminal segment of the male of *S. coprophila:* *d*, dorsal plate; *i*, inner, *o*, outer appendages.



SCIARA.

Fig. 11a.— Dorsal view of the chitinous processes beneath the median dorsal plate of the terminal segment in the male of *S. coprophila*.

Figs. 12, 12a.— Ditto of the male of *S. caldaria*.

Figure 1 is enlarged about twenty diameters; the others are much more enlarged.

Sciara caldaria nov. sp.

The Greenhouse Sciara.

(Ord. Diptera: Fam. Mycetophilidæ.)

A communication from a lady of Boise, Idaho (April 20, 1893), gives the following particulars of some "fungus gnats," believed by her to have been injurious in her greenhouse:

The fly, or flies more properly, for there are thousands of them in my greenhouse, congregate wherever there is the least leaf mold or manure (cow), no matter how old or well-rotted it may be. They lay their eggs in the soil or under the pots or boxes; they seem (some of them) to shed their wings, and produce a white worm which is very difficult to kill. I have fumigated the greenhouse twice a week, used lime and lime-water and kerosene emulsion in the soil — not in a half-way manner, but thoroughly, and still they are just as bad again the next day. I tried dipping the pots in raw kerosene; the next morning on lifting the pots, the little wrigglers ran in all directions. They have done much damage, and I hope, for the benefit of others as well as myself, that you can give an idea of how to rid the house of them. I send to-day a phial with the flies.

Not Known to be Injurious in Greenhouses.

It has not, so far as known to me, been satisfactorily determined if the "fungus gnats" are the occasion of any positive injury in greenhouses. We would be glad to learn from our correspondent the character of the damage which the insect of which she has written has caused her, and also the amount, and any other particulars that may add to our knowledge of its habits and life-history.

General Features of the Fly.

The mature insect is a small fly or midge, closely allied in classification, structure, and general appearance, to the destructive midges that infest our grain and clover crops. It is one-tenth of an inch in length, with a black head, and dark-brown body, rather large and finely haired, transparent wings showing brilliant gold and purple reflections, and having but few veins. The abdomen of the female is narrowed and quite prolonged posteriorly. It is active and restless in its movements, and its long legs serve their purpose in running and leaping.

Its Description.

For the reasons stated for recognizing the manure Sciara as previously undescribed, this also is accepted as new to science and its description herewith given:

SCIARA CALDARIA n. sp. Plate I.— The general features of the imago are much the same as in the manure gnat. It may be distinguished by the greater iridescence of the wings; by the light-brown coxæ; and by the smooth polished scutum of the mesothorax. The proportionate width of the intermediate segments of the antennæ to their length is as 2 to 5; form cylindrical,— figure 5. The two distal segments of the palpi are about one-half as long as broad, and bear several long setæ,— figure 7. The apical portion of the lateral valve of the female is nearly oval,— figure 10. The inner unsegmented appendages of the male widely divergent; the apical third thickened and setose,— figure 12. The median organ beneath the dorsal plate arises from an undivided base,— figure 12a. The other characters, so far as observed, agree with those of the manure gnat. The material at hand was not sufficient to permit of a proper study of the characters afforded by the head.

Length of body, 2.5 mm.; of wing, 3 mm. Described from eight males; two females.

Does Sciara Shed Its Wings?

The statement made by the lady, that some of the flies in her greenhouse shed their wings, would be of so much interest from an entomological view that we would be glad to have it verified, if possible, beyond question. It apparently finds some support in the fact that quite a number of the beautifully iridescent wings of the flies were found in the small quantity of the soil that was sent with the winged insects. I can not think of any end or purpose that could be served by such an unusual proceeding. Where wings are not needed, they are usually withheld. In some insects we have, in the same sex, both winged and wingless forms, and in others the female is wingless. In the genus *Epidapus*, belonging to the *Mycetophilidæ*, in which *Sciara* is included, the "wings and halteres are wholly obsolete" (Theobald), but Prof. Hopkins has recently described and figured a species in which "there are two forms of the males — one with short wings scarcely half the length of the body, and the other with wings as long or longer than the body." Possibly some such wingless forms may have been seen in the Boise greenhouse.

It is well known that among some of the ants, after the colony has taken its "marriage flight" and a return to earth is made for founding new colonies, the wings of the females are torn off, either by themselves or their companions. A sufficient reason for this would seem to be, that as the remainder of their lives is to be entirely devoted to maternal cares and duties within their subterranean abodes, wings would no longer be needed and could only prove an incumbrance to them.

Phora agarici nov. sp.

The Mushroom Phora.

(Ord. DIPTERA: Fam. PHORIDÆ.)

The successful cultivation of mushrooms during the warmer portion of the year -- in May and thereafter through the summer months -- even under the approved methods now quite generally adopted, is regarded as impracticable, owing to the attack and destruction of the plants by the larvæ of small flies that tunnel the stalk and burrow in every direction through the pileus.* This difficulty has long been experienced by mushroom-growers, but no means have been discovered by which it may be surmounted. Many efforts have been made in different directions, but from the peculiar character of the mushroom and its extreme susceptibility to injury from all of the insecticidal preparations that have been experimented with, nothing satisfactory has been accomplished, and further efforts seem hopeless.

In a preceding page, several species of "fungus gnats" (*Mycetophilidæ*) are named, which feed on mushrooms, but it is not believed that in this country, at least, any of those are chargeable with the annual arrest of mushroom culture in the month of April in this latitude, nor is it known that they are among those which infest, to a greater or less extent, *Agaricus campestris* and many other wild forms during the summer months.

A Serious Mushroom Pest.

My attention at different times during preceding years has been called by Mr. William Falconer to the mushroom pest now being considered, as something quite different from the "manure-fly," and which, in our correspondence, he has designated as "the maggot." Mr. Falconer informs me that it has been the common warm-weather pest of the mushroom-grower ever since mushrooms were first cultivated, but in all the literature of practical horticulture — our own and that of Europe — he has never been able to find any indication of its identity.

* It is stated in works on gardening that in deep, dark cellars, mushrooms are not affected in this manner, and that they can be grown throughout the summer with perfect immunity from insect attack. But this is not so. I never saw or knew of an artificially constructed mushroom cellar that was proof against "maggots." In caves away in the bowels of the earth and completely away from natural light, the immunity may possibly be perfect, but of this I know nothing through my own observation or experience. (Wm. Falconer.)

Diseased and Infested Mushrooms.

Under date of May 3, 1889, Mr. Falconer sent for examination some "diseased mushrooms," showing the "black-spot" as brown markings on the surface of the caps which Dr. Farlow had pronounced the work of *Anguillulidæ*. Adhering to the mushrooms by their wings were numbers of the manure Sciara. Rather deep cavities had also been eaten into them by slugs. "But the chief reason," he wrote, "why I send you these, is to show you the crowning evil of mushroom culture, namely the MAGGOTS. By cutting open the mushrooms you may see numerous worm-holes in some of them, both in the caps and stems, and no doubt can discover some of the maggots. They are tiny fellows with a white body and black head, measuring about one-fifth or one-sixth of an inch long, looking to me not much unlike the club-root maggot in cabbage and cauliflower.

The fly was not reared from this sending: possibly no larvæ were found in them, for no examples are contained in the State collection. This is a matter of regret, for if a conspicuous feature of the larva was its "black head" it would indicate a different species from that obtained in a later year in the autumn.*

Two Insects Infesting an Agaricus.

On October 1, 1894, Mr. Falconer sent another package of infested mushrooms which he had gathered in fields: they were "the new mushroom" of *Gardening*, viz., *Agaricus subrufescens* Peck, described in 1893, and an highly esteemed edible species. They were swarming with larvæ, by which, in a brief time, they were completely riddled. A number of the larvæ were preserved in alcohol for the State collection.

FIG. 6.— Puparium of a mushroom-feeding fly.

Although not observed at the time, there were two different larvæ feeding together in the mushrooms, for, after pupation, two distinct forms were found — one more than twice the size of the other, subelliptical in form, concave ventrally, dark brown in color, and with lateral and terminal spinose processes. The puparium is represented in a ventral view in figure 6.

Description of the Phora.

The small puparia disclosed a large number of the flies during the month of October — the length of time after pupation was not noted. They are not referable to any described species so far as known to me,

* Mr. Falconer has probably confounded the black-headed Sciara larvæ with these.

and are, therefore, assumed to be new, and the larva, puparium and imago described as follows:

PHORA AGARICI n. sp. Plate II. *Larva.*— Figure 5. Body nearly cylindrical, composed of 11 segments; length, 3 mm. Whitish, with two minute brown points on the ventral surface of the head. Under a high power the minute, 5-toothed, light-brown mandibles may be demonstrated and also the 3-jointed tubercle-like antennæ on the lateral angles of the head. Dorsum convex; each segment divided into two nearly equal subsegments; hind margin of last segment flattened and produced into ten processes; a median pair; the others equidistant and opposite; posterior six larger. Ventral surface flattened, margined laterally, and segments 2-9 on fore and hind border, segment 10 on fore border only, by transverse ridges.

Puparium.— Figure 6. Light brown; suboval; ends obtusely pointed; length 2.5 mm. Dorsal surface slightly convex; the last six nearly equal segments, and lateral margin, distinct; on the anterior segment, which is about twice the size of the others, there are two slight subdorsal tubercles. Ventral surface very convex; segments and margin not well marked.

Imago.— Figure 1. Body jet black; antennæ fuscous; apical portion of halteres yellowish-white; apical portion of coxæ, front and middle legs yellowish-brown; tarsi brownish; hind legs darker; palpi yellowish. Wings hyaline and with slight iridescence.

Ocellar triangle defined by a suture which extends down the front. Three transverse rows of bristles occur on the front; six in the posterior row, consisting of a median pair and four lateral; middle composed of four nearly equidistant bristles; six equidistant in the anterior row; in front of the median pair of the anterior row there is a small pair; the two pairs point downward, though in some examples the larger pair point upward. Compound eyes bordered behind and below by a single row of bristles; small setæ occur at the angles of the facets (figure 2). Antennæ five-segmented; first short, irregular; second very large, subspherical; third and fourth small, elongated; fifth, basal portion slightly enlarged and equal to fourth; distal portion setaceous, much elongated, plumose (figure 2a). Labium yellowish-brown, usually retracted (figure 3). Terminal segment of palpi long, slightly capitate and bearing several apical bristles; basal segment short, obscurely divided into several subsegments.

Dorsum of thorax thickly pubescent; several long bristles occur near base of wings. Wings hyaline; costal vein less than half the length of the wing; first heavy vein joining costa beyond middle between the humeral cross vein and the apex of the first branch of the second heavy vein; second heavy vein forked near apex; costal margin fringed with stout setæ to tip of second heavy vein; first light vein curved at basal fourth and slightly at apical fourth Halteres spatulate, basal portion segmented (figure 7). Several apical bristles on front and outer portion of coxæ; fore tibia unarmed; middle tibia with very long apical, posterior spine; hind tibia with one long anterior and several short apical, internal spines; anterior edge of middle and posterior edge of hind tibia fringed with a thick row of stout setæ; internally and close to the hind margin of the posterior tibia there is a row of about nine stouter spines on the apical three-fourths; tarsi of middle and hind legs bordered anteriorly and posteriorly by rows of stout spines.

Abdomen broad at base, slightly depressed; apex obtusely pointed, invested with short, scattering setæ. Terminal segment of female with a median process, laterally dilated at base and a pair of suboval appendages near the apex; width to length of median process as 1 to 4; lateral dilation nearly equal to length of median process; subapical appendage one-fourth the length of median process (figure 8). Terminal segment of male with an irregular, dorso-lateral plate, the ventral portion of which is prolonged. Two pairs of organs extend from the plate — an upper straight pair, bearing numerous long setæ on the entire surface, and a lower pair, slightly curved ventrally and bearing several long, usually sharply curved setæ at their tips. Below this armature there is a darker chitinous ring, within which are the essential organs.

Length of body, 1.5 to 2 mm.; of wing, 2 mm. Described from about 75 specimens of both sexes.

Close to the female of *Phora setacea* Ald. as described and figured in the *Canadian Entomologist*, xxiv, 1892, p. 144, fig. 2. This species may be separated by the anterior row of frontal bristles being a nearly straight transverse one, while in *setacea* they are represented as obliquing posteriorly from the median line; the anterior pair of proclivate bristles are also relatively smaller and more nearly in front of the other pair. The coxæ of the female, as well as those of the male, have a number of large sub-apical bristles on the outer side, and the "conical protuberance" on the hind side of the third coxa is about equally developed in both sexes; the fore and middle legs are darker than in *P. setacea*.

None of the marked sexual features indicated by Mr. Aldrich, except those of the genitalia, have been observed in *agarici*. It is probable that the insect described as the male of *setacea* belongs to a distinct species from that of the female.

Peculiar Wing-Pores in Phora.

Mr. E. P. Felt, in his study of this insect in connection with its illustration, etc., has made some interesting observations upon the "wing-pores" which he has detected, and of which he has written as follows:

An additional character which may prove to be of specific value is found in the number and location of certain "pores" or pore-like structures. The pores — four in number — occur in a slightly curved row along the middle line on the under side of the second heavy vein, where it anastomoses with the costal vein; a short stump extends beyond the anastomosis and inclines a little away from the costa.

The pores are less than half their diameter apart, the last one being close to the apex of the stump (figure 10). Each consists of a depression surrounded by a raised circular ring of chitine (figure 11). These pores must not be confounded with the scars on the costal vein left when a bristle is removed; they appear to have no connection with either bristle or setæ. Some twenty-five specimens of *Phora agarici* were examined. In many cases the two wings were compared; in every case where the tip of the second heavy vein was apparent, these structures were found constant in number and position. It requires a mounted preparation and a one-fourth objective to bring them out clearly. Though occurring on the under side of the wing, in this species the veins are sufficiently transparent so that the pores may be seen from the upper side.

Subsequent study has shown that similar pores occur in the genus *Sciara*. They are found along the rudimentary subcostal vein and are much smaller than in *Phora*. In *S. coprophila* there are 10 pores along this vein -- an outer group of three, of which the antepenult is on the inner margin of the vein; the inner seven are nearly equidistant (figure 7a). In *S. caldaria* there are but seven pores -- an outer group of three, with the antepenult as in *S. coprophila;* the inner four equidistant (figure 7b).

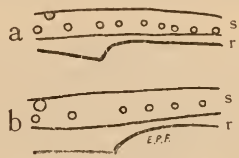


FIG. 7.—Diagram showing pores in veins of *Sciara*: *a*, *S. coprophila*; *b*, *S. caldaria*; *s*, outline of subcosta; *r*, fore margin of radius.

Reference may be made, in connection with the above, to a paper published in 1889 in the *Transactions of the Royal Society of South Africa*, by the late Ezra P. Crawford, entitled "Notes on Certain Pores in the Veins of Some Diptera," and illustrated by several figures. Mr. Crawford found them to "number from five to eight, when present, and their number and position are constant in each species." It is thought that they may be homologous with what Jurine, in *Nouv. Meth. Class. Hymenop. et Dipt.*, 1807, named "bullæ," as observed by him on the wings of certain Hymenoptera.

Infestation of Mushrooms by Phora.

Mr. Falconer has kindly sent, in response to request, the following observations on the occurrence of the Phora larvæ: "They make their appearance in early April, but do not increase to such an extent as to completely ruin the crop until the end of April or the first part of May. In outdoor mushrooms they are to be found from May into October. From August onward they are more numerous in wild mushrooms than at any time in cultivated ones, and they are apparently larger [but slightly so, judging from indication given of comparative sizes], but this may possibly be accounted for by a better food supply. In some

NOTE.—The following information relating to Phora infestation of mushrooms has been kindly communicated to me by Mr. Howard, of the Division of Entomology, at Washington, in reply to an inquiry made: "We have reared *Phora minuta* in considerable numbers from mushrooms received from Geo. Balderston, Colora, Md.: and in Europe, Mr. Coquillett informs me, Scholtz has reared *Phora lutea* Meig. and *Phora flava* Fall. from an agaricus (Schiner, Fauna Austriaca Diptera, II, 1864, p. 343). Leon Dufour reared *P. nigra* Meig. from *Agaricus prunulus* Fries (l. c., 345), and Letzner reared *P. pumila* Meig. from an agaricus (l. c., 345). *Phora bovistæ* Gimmerth. was bred from *Lycoperdon bovista* (l. c., 346).

years and in some localities they are conspicuously more numerous than in others. In gathering a quart of field mushrooms several specimens may be entirely free from any sign of attack, and in others only a few newly-hatched larvæ are at work. Then, again, one may meet with particularly large mushrooms a day or two past their prime which are tunneled like a sponge and are living masses of maggots."

Remedies.

In consideration of the fruitless and long-continued efforts made by mushroom-growers to find an antidote against this insect, and a seeming general conviction that the culture must cease at the advent of warm weather, it may not be worth while to make suggestions for further experimentation. Still, much would be gained if the period of culture could be extended by a month or two. If an insecticide is to be sought, it might naturally be looked for among the vegetable ones. Of these, pyrethrum is certainly one of the most efficient, and the Diptera are known to be particularly sensitive to its influence. The pure, fresh, dry powder blown in the atmosphere with a powder-bellows, or made up into slightly dampened cones for slow burning, would unquestionably kill nearly all, if not all, of the ever-active, leaping and running flies in the apartment. If their eggs have not been previously deposited, their further propagation would be prevented. There seems no reason why a newly-made solution of the powder (largely soluble in water), liberally sprinkled over the soil, should fail to kill the young larvæ at the moderate depth in the bed at which they occur before entering into the base of the stalk, and at the same time be harmless to the plants.

Some Literature of Phora

LATREILLE: Hist. Nat. des Crust.-Ins., xii, 1804 (genus founded).

MACQUART: Hist. Nat. Ins.—Dipt., ii, 1835, pp. 625-631, pl. 24, figs. 1-4 (30 French species characterized).

WESTWOOD: Introduc. Classif. Ins., ii, 1840, pp. 574, 575 (habits), f. 132, 12, 13 (larva and imago).

LOEW: Mon. Dipt. N. Amer., Pt. I, 1862, p. 4 (antennal structure), p. 47 (family characters).

PACKARD: in Amer. Nat., ii, 1868, pp. 196, 197, pl. 4, figs. 1, 2, 3 (*P. incrassata* parasitic in larva of honey-bee in England); the same, in Cotton Insects, 1879, p. 209; Guide Stud. Ins., 1869, p. 127 (parasite of hive-bee), p. 416 (figures of *P. incrassata* as cause of "foul brood"); the same, in Entomol. Begin., 1888, p. 126, f. 146; in Amer. Nat., v, 1871, p. 745, f. 123 (of cave Phora).

SCUDD.-BURG.: in Proc. Bost. Soc. Nat. Hist., xiii, 1870, p. 283, f. 17 of plate (asymmetrical genitalia of *P. microcephala*).

GLOVER: MS. Notes Journ.— Dipt., 1874, pl. 6, figs. 19, 20 (*P. incrassata* imago), pl. 7, f. 37 (larva of *P. dauci*), pl. 9, f. 20 (Phora imago from Mammoth cave), pp. 39, 40 (reference to seven species).

OSTEN SACKEN: Cat. Dipt. N. A., 1878, p. 212 (eight N. A. species listed); in Amer. Entomol., iii, 1880, p. 277 (is Phora parasitic?); the same, in 4th Rept. U. S. Entomolog. Commis., 1885, p. 117.

COMSTOCK: Cotton Ins., 1879, pp. 208-211, fig. 49 (*P. aletiæ* in larva, pupa, and imago described and figured); Man. Stud. Ins., 1895, p. 475 (characters of *Phoridæ*).

HUBBARD: in Amer. Entomol., iii, 1880, p. 39 (Phora in the Mammoth cave), pp. 82, 83 (larva of same described, figured, and compared), p. 228 (*P. aletiæ* a scavenger, not a parasite); the same, in 4th Rept. U. S. Entomolog. Commis., 1885, p. 116 (parasitized by a Chalcid); in id., Notes [112], from Amer. Entomol., p. 228.

RILEY: in Amer. Entomol., iii, 1880, p. 277 (*P. aletiæ* not parasitic), p. 293 (a Chalcid parasite); in Amer. Nat., xvi, 1882, p. 747 (habits of *P. aletiæ*); in 4th Rept. U. S. Entomolog. Commis., 1885, pp. 108, 116, 117 (not parasitic).

BUGNION: in Psyche, iii, 1881, p. 212 (Phora parasitic on *Lina tremulæ*).

SCHWARZ: in 4th Rept. U. S. Entomolog. Commis., 1885, pp. 117-119 (*P. aletiæ* not parasitic).

SCUDDER: in Bull. U. S. Geolog. Surv., No. 31, 1886, p. 86 (eleven amber species recorded by Loew).

BETHUNE: in 16th Rept. Ent. Soc. Ont., 1886, p. 30 (foul brood due to *Phora*).

WILLISTON: Synop. Fam.-Gen. N. A. Dipt., 1888, p. 64.

BRUNETTI: in Entomol. Month. Mag., xxv, 1889, p. 282 (*P. rufipes* a quite general feeder).

NEWSTEAD: in Entomol. Month. Mag., xxvii, 1891, p. 41 (*P. rufipes* in nests of *Vespa Germanica*).

RILEY-HOWARD: in Insect Life, 1892, v, p. 5 (Phora sp., reference).

ALDRICH: in Canad. Entomol., xxiv, 1892, pp. 142-146, 5 figs. (new western species of Phora); in Bull. 30 S. Dak. Agr. Coll. Expt. Stat., 1892, p. 7.

COQUILLET: in Canad. Entomol., xxvii, 1895, pp. 103-107 (synopsis of the genus).

MÉGNIN: Les Parasites Articulés, 1895, p. 471 (*Phora aterrima* in buried human bodies.

EXPLANATION OF PLATE II.

Phora agarici.

Mushroom Phora.

Fig. 1.—Female. The terminal segments are retracted within the body and the base of the abdomen is shrunken (x 20).

Fig. 2.—Dorsal aspect of head; *a*, antenna.

Fig. 3.—Labium and appendages from behind.

Fig. 4.—Palpus, dorsal aspect.

Fig. 5.—Ventral aspect of larva (x 8).

Fig. 6.—Dorsal aspect of pupa (x 8).

Fig. 7.—Halter.

Fig. 8.— Dorsal aspect of the terminal segment of the female: *s*, subapical appendage.

Fig. 9.— Lateral aspect of a portion of the terminal segment of the male: *d*, dorso-lateral plate; *u*, upper, *l*, lower organ.

Fig. 10.— Portion of wing showing location of "pores" at the tip of the second heavy vein; its branch and a portion of costa also shown.

Fig. 11.— A "pore."

All figures greatly enlarged, except where otherwise stated.

Agrilus ruficollis (Fabr.).

The Gouty-Gall Beetle.

(Ord. Coleoptera: Fam. Buprestidæ.)

A severe attack of this insect — known by the name above given from the peculiar swelling in the cane that its larva produces, and also as the "red-necked Agrilus," from its copper-colored thorax contrasting with the brownish-black wing-covers — was reported by Mr. E. Winne, of Delmar, Albany county, N. Y., in the early part of May. He was growing raspberries extensively, and the injuries of this insect threatened the destruction of the crop — so large a proportion of the canes being infested with it. A number of the canes were brought to me, in which the pupæ were found at the time. Several of the beetles subsequently emerged, but they were dead when discovered some weeks thereafter.

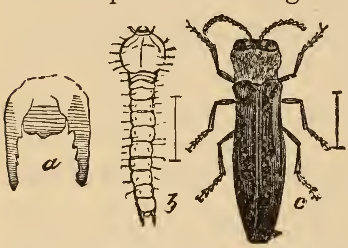


Fig. 8 —The red-necked Agrilus, Agrilus ruficolis: *c*, the beetle; *b*. the larva; *a*, terminal horns of the larva — all enlarged.

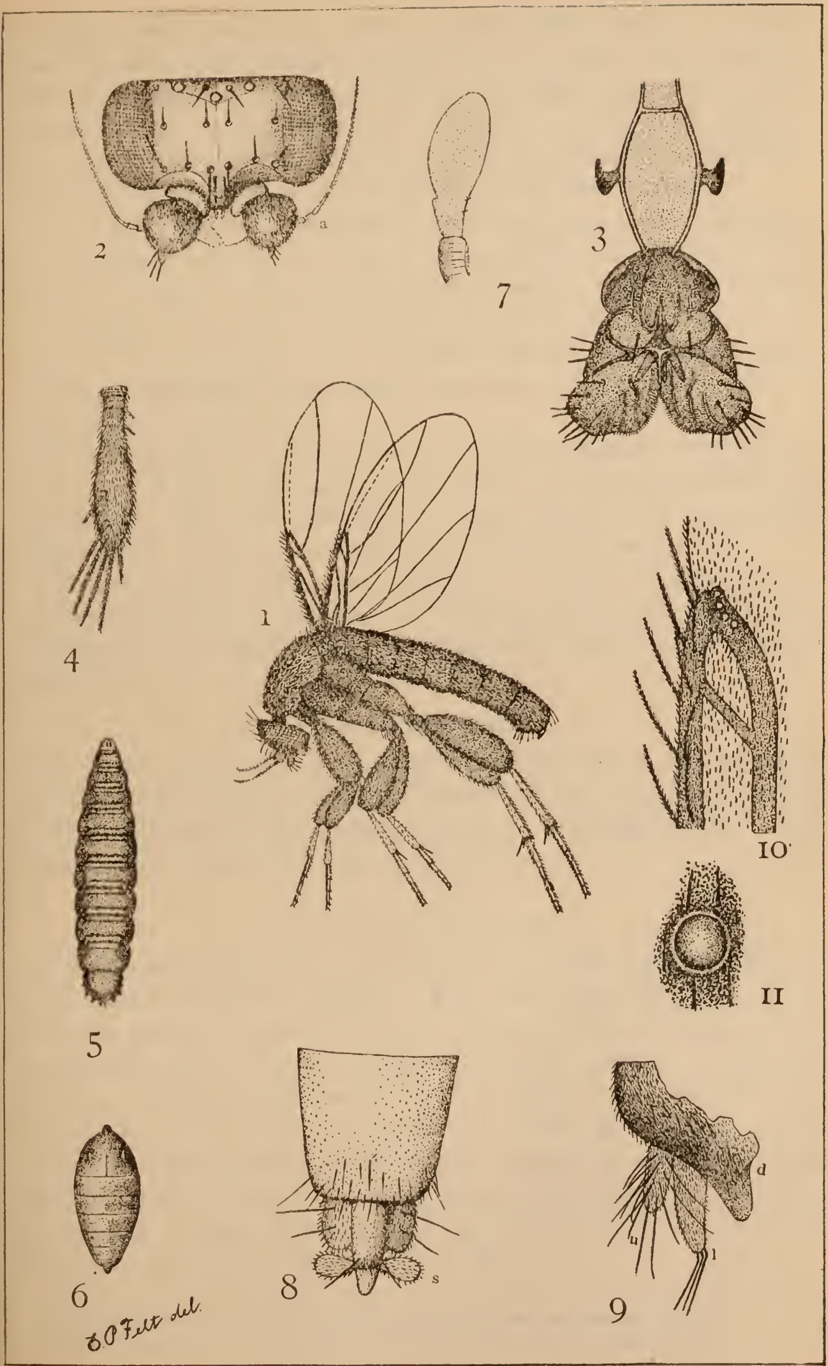
A serious attack of the same insect was also brought to my notice in April by Mr. M. Brooks, of Athens, N. Y.

Remedy.

These gentlemen were informed that the injury from this insect could be, to a large extent, if not entirely, arrested, by cutting off all the canes below the "gouty-gall" produced by the burrowing of the larva in the wood, and burning them, in the early spring before the beetle could mature and escape and deposit eggs for the continuance of the attack.

Operations of the Insect.

According to Walsh–Riley, the beetle makes its appearance early in the summer, but sometimes as late as the fore part of July, and deposits



PHORA.

its eggs shortly thereafter. Prof. Webster states that in a serious attack observed and studied by him of the insect on the dewberry (*Rubus Canadensis*) in Southern Ohio, where the culture of this berry had developed into an important industry, it was learned that the beetles appeared about the middle of May and remained until the last of June or about the time of the ripening of the first berries.*

Dr. J. B. Smith, who represents it as a chief pest of the blackberry in New Jersey, gives for the time of the emergence of the beetle from May 20 to July 10. He is of the opinion that the egg is not inserted in the tissue of the cane as generally stated, but is simply laid at the base of the leaf-stalk or in the bud. See the interesting account by him of the peculiar burrowing operations of the larva as given in *Insect Life*, iv, 1891, p. 28.

Notwithstanding occasional instances of such extensive infestation as above noticed, the beetle seldom falls into the hands of collectors in New York. The only examples (2) taken by me were captured in Schoharie, N. Y., over thirty years ago, probably in my garden.

This insect has been previously noticed in my sixth report, pp. 123–125, where its transformations are briefly given, the gall that it produces figured and some literature cited where fuller details may be found.

Its Distribution.

Dr. Horn, accompanying his detailed description of the beetle in "The Species of Agrilus of Boreal America,"† has given the following as its distribution: From Canada and the New England States southward to Virginia and westward to Missouri.

Respecting Agrilus anxius.

The *Agrilus torpidus* Lec., mentioned in my fifth report as taken in large number from cut poplars at Elk Lake, Essex county, N. Y., in the latter part of August, 1883, had been described by Gory in ?1835 as *Agrilus anxius*: *torpidus*, therefore, becomes a synonym. Its range is said to be from Massachusetts and New Hampshire westward to Colorado. Mr. G. C. Davis has found it producing galls in branches of the willow (*Salix discolor*) in Michigan. The gall is an oval swelling, from which an oval gallery is bored downward, sometimes in the pith, but oftener through the wood, opening outwardly an inch and a half below the gall (*Insect Life*, iv, 1891, p. 66).

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* *Bulletin* 58 *Ohio Agricultural Experiment Station, December* 1894, pp. 29, 30.

† *Transactions of the American Entomological Society*, xviii, 1891, pp. 277–336.

Anomala lucicola (Fabr.).

The Light-loving Grapevine Beetle.

(Ord. COLEOPTERA: Fam. SCARABÆIDÆ.)

FABRICIUS: Supp. Ent. Syst., 1798, p. 132, no. 64–5, *Melolontha mœrens;* no. 66–7, *M. lucicola;* no. 66-7, *M. atrata;* Syst. Eleuth., ii, 1801, p. 174, no. 82, *moerens;* no. 85, *lucicola;* no. 86, *atrata.*

MELSHEIMER: in Proc. Acad. Nat. Sci. Phila., ii, 1846, p. 141 (described as *A. pinicola*).

FITCH: in Count. Gent., xiv, 1859, p. 171 (descriptions of varieties); 3d Rept. Ins. N. Y., 1859, p. 85 (mention); 4th Rept. do., 1859, p. 61 (as *A. pinicola* feeding on pine).

HARRIS: Ins. Inj. Veg., 1862, p. 34 (description, on grapevine).

GLOVER: in Rept. Commis. Pat. for 1861, 1862, p. 602, figs. 39, 40 (features of larva and imago); in Rept. Commis. Agricul. for 1868, 1869, p. 88, fig. 74 (mention).

WALSH: in Pract. Entomol., i, 1866, p. 101 (mention, on grape).

KIRKPATRICK: in Ohio Farmer, Jan. 11, 1868 (injury to grape).

LE BARON: 1st Rept. Ins. Ill., 1871, pp. 54–56 (injury to grape); 4th Rept. do., 1874, p. 89 (mention).

THOMAS: 6th Rept. Ins. Ill., 1877, pp. 105, 106 (description and habits).

SAUNDERS: Ins. Inj. Fruits, 1883, p. 284, fig. 294 (features, habits, remedies).

HORN: in Trans. Amer. Ent. Soc., xi, 1884, pp. 162–3 (description).

LINTNER: in Count. Gent., liii, 1888, p. 565 (features, injuries, remedies); 5th Rept. Ins. N. Y., 1889, p. 305 (abstract of prec.).

HAMILTON: in Insect Life, iv, 1891, p. 132 (*pinicola=lucicola*).

SMITH: in Insect Life, v, 1892, p. 95 (larval development).

WICKHAM: in Canad. Entomol., xxvi, 1894, p. 260 (in Canada: diagnostic characters).

COMSTOCKS: Man. Study Ins., 1895, p. 562 (brief notice).

CHITTENDEN: in Insect Life, vii, 1895, p. 336 (mention).

Several examples of this little Scarabæid, *Anomala lucicola,* were received from Highstown, N. J., on July 13th, taken from grapevines on which they were feeding voraciously.

Exception has been taken to the specific name, meaning *light-loving,* given it nearly a century ago, for although the beetle, like some of the flower beetles, may love to spread its wings in the sunlight, yet its feeding is believed to be done mainly under cover of darkness.

General Features of the Beetle.

It resembles in form the well-known June-bug, *Lachnosterna fusca,* to which it is nearly related, but is of a considerably smaller size, measuring only from three-tenths to four-tenths of an inch in length.

Dr. Fitch, in his *Third Report on the Insects of New York*, has described it as "pale, dull yellow, with the thorax black, except on each side and on the middle of its hind edge; the hind part of the head, the scutel and under side of the body being also black, with the abdomen brown or sometimes dull yellowish."

FIG. 9 — The light-loving grapevine beetle, ANOMALA LUCICOLA. (After Glover.)

The great range in variation in color of the individuals of this species ascribed to it, is in all probability largely sexual. Two males of the examples received were in entire accord with the description of Dr. Fitch above given. The remaining seven were females, and had the thorax yellow and concolorous with the elytra, except a small black spot on each side in front (as has also the male in its yellow margin), and another black spot centrally and more or less distinct, near its hind margin. The wing-covers are narrowly margined with black or brown. The abdomen beneath is yellow.

Description.

As a further aid to identification when detected feeding upon the foliage of the grape, the following is copied from Dr. Horn's "Notes on the Species of Anomala Inhabiting the United States," *loc. cit.*, pp. 157-164.

Form oval, robust; color variable from entirely yellow to entirely black; head moderately densely punctured; clypeus transverse; sides very little divergent, angles rounded, margin in front narrowly reflexed, thorax convex; sides regularly arcuate, gradually narrowed to the point, basal marginal line obliterated, surface rather coarsely but not densely punctured; elytra with moderately deep striæ of rather coarse, closely-placed punctures, the intervals nearly equally convex; pygidium sparsely punctured; body beneath coarsely but sparsely punctured; the pectus very slightly hairy. Length, .35-.40 inch; 9-10 mm.

The front claw of the anterior and middle tarsi is deeply cleft at tip, the two portions nearly equal.

Habits and Destructiveness of the Beetle.

The beetle is noted for its fondness for the foliage of the grape. Dr. LeBaron, in his *First Report on the Insects of Illinois*, has recorded their destructiveness and habits, particularly that of their peculiar flights. They were noticed at about sunset on an evening during the latter part of June, flying close to the ground in a zig-zag manner, as if they were hunting for something, and were in such numbers as to sound like a swarm of bees. Later in the evening they were seen to have settled on some grapevines. If the vines were shaken they would drop readily and "play possum" for a few minutes, and then fly up and commence feeding again. The following morning not a beetle was found on the leaves, but they had eaten one-half of the foliage from two hundred and fifty vines. In searching for them, large numbers were found on the ground under the vines.

Of several vineyards attacked at the same time, only a particular variety, known as Norton's Virginia, was eaten. Their feeding seemed to be confined to the night-time, notwithstanding their specific name of *lucicola.*

Reported Feeding on Pine.

With a single exception all writers on this insect in giving its observed feeding, have reported it on the grape. Dr. Melsheimer has described as *A. pinicola*, beetles "very abundant in Pennsylvania, in July, on the Red or Pitch Pine." Dr. Fitch, *loc. cit.*, mentions the same as "feeding on the leaves of pine in June and July," but probably from no knowledge of his own, as he only knew it in specimens received from the south (? Pennsylvania). Dr. Horn and Dr. Hamilton agree in their reference of Melsheimer's *A. pinicola* to *A. lucicola.*

Remedy.

When the beetles are not very abundant on the grapevines, their feeding may be largely prevented by dusting the foliage with air-slaked lime, but probably the best method of protection would be jarring them from the foliage on cloths stretched on a frame or spread on the ground beneath, and quickly turning them into a vessel of water and kerosene.

Distribution.

The insect is pretty generally distributed over the Northern, Middle, and Eastern States, but does not frequently make its appearance in destructive numbers. For this reason it has not been given special study, and but little seems to be known of its life-history.

From the Fabrician references and synonymy as above given, it would seem that in strict obedience to the rules of priority this insect should be known as *Anomala mœrens*, as in each of the works cited, while the three names appear upon the same page, *mœrens* precedes the other two.

Anomala marginata (Fabr.).

The Margined Anomala.

(Ord. COLEOPTERA: Fam. SCARABÆIDÆ)

FABRICIUS: Ent. Syst. em., i; pars ii, 1792, p. 164 no. 40 (as *Melolontha*).
HORN: in Trans. Amer. Ent. Soc., xi, 1884, pp. 163–164 (description).
BURMEISTER: Handb. Entomol., iv, i, 1894, p. 266.
MUNSON: in Insect Life, i, 1889, p. 220 (operations in Louisiana).
RILEY-HOWARD: in Insect Life, i, 1889, p. 220; in id., v, 1892, p. 45 (identification and remedy).
HOYT: in Insect Life, v, 1892, pp. 43–45; in Count. Gent., lviii, 1893, p. 523 (abundance and injuries in North Carolina).
LINTNER: in Count. Gent., lviii, 1893, p. 523 (distribution, injuries, remedies).

A more destructive species of *Anomala* than the one noticed in the preceding pages is *A. marginata,* if we may judge from the prolonged wail of utter hopelessness from a North Carolina correspondent of the *Country Gentleman,* following a fruitless contest with a horde of the beetles, apparently as irresistible as the rose-bug in New Jersey vineyards. Listen to his cry:

And now we have the *Anomala marginata.* This is the too modest name of a bug, a species of May-beetle, which for "pure cussedness" can give the rose-bug points and come out ahead. It resembles the May-bug, is about half the size and in color is metallic bluish-green. This creature appeared for the first time last summer in this section just as the rose-bug was leaving, and promptly began devouring everything that the other hadn't time to eat. While blessed with the appetite of the rose-bug and the elephant combined, it is not so formal as the former, but brings all its luggage along and remains with us until fall. While the rose-bug has slighted us this summer, the A. M. has come again in millions. It began eating its breakfast about six days ago and hasn't knocked off yet to get ready for lunch. Some of my vines are already quite defoliated. I have found them to some extent on blackberry, raspberry, and rose bushes, but its preference is the grapevine.

I tried hand-picking and shaking them into a vessel with water and kerosene. I had three men working in a plat of thirteen hundred Cynthiana vines for an entire day. In this way they destroyed gallons of them. The next morning they were there in unbroken ranks, not a vacancy visible. I then tried spraying with London purple, a pound to one hundred and fifty gallons of water. If this treatment has caused them any unpleasantness I have yet to discover the fact. One might as well try to convince the Sabbatarians that there are other people in the world who have rights.

If any of your readers having vineyards have been troubled by these pests and have succeeded in getting rid of them I would like to learn their methods. Kerosene emulsion might act as a deterrent, but

I fear that it would spoil the grapes for wine-making. In the meantime, my emotions are too great for utterance. I think that Job makes no mention of ever having contended with the *Anomala marginata.* I would he were here. His opinions expressed in choice Chaldaic might possibly fit the case and give me some relief. J. K. H.

A Southern Species.

Fortunately, *Anomala marginata* rarely occurs in such overwhelming numbers as recorded in the above communication, and then only in the Southern States. It has an extensive distribution from Texas eastward and northward into Tennessee. It has not, so as far as known to me, been taken in the State of New York, although Dr. Hamilton reports it as occasionally seen in southwestern Pennsylvania, and Dr. J. B. Smith, the same in New Jersey, but occurring over most of the State. It is markedly a southern species, as is, indeed, the genus, for of the twelve contained species, only four pertain to the Middle States.

Little Recorded of its Habits.

Very little has been written of this insect,— its habits having received but little attention. The only notices of its injuries found in the many volumes consulted, are these: in *Insect Life*, i, 1888, p. 220, a gentleman writing from Denison, Texas, who had received specimens from Louisiana, states that they come in June and July, and are ravenous feeders on the leaves of the grape, completely skeletonizing them, and also eating out the young buds and tips of the shoots. When disturbed, they drop to the ground and remain motionless for some time, unlike another species associated with them (*A. minuta*), which at once runs to cover.

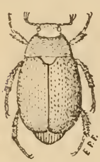


Fig 10.—The margined Anomala, Anomala marginata, natural size. (Original.)

Another notice is in *Insect Life*, v, 1892, from the gentleman whose communication to the *Country Gentleman* has been given herewith. The additional facts mentioned in this later letter are these: It had been noticed in former seasons, but only in isolated examples. In addition to the grape, it had also attacked the foliage of apple and plum—not the pear. The beetles drop to the ground the moment a leaf is touched.

Description.

The beetle is described as follows, by Dr. Horn:

Oval, robust, pale rufescent, disc of thorax and head darker; surface with æneous lustre; head densely punctured; clypeus short, broader at base, margin narrowly reflexed; thorax narrower in front; sides arcuate, base not margined, color brownish, broadly margined at the sides with testaceous; surface coarsely but sparsely punctured; elytra rather deeply striate, with coarse, closely-placed punctures, the second stria composed of a double row of punctures, intervals equally convex; pygidium densely rugulose and pubescent; body beneath sparsely punctured, pectus slightly hairy. Length, .44–.60 inch; 11–15 mm.

Fig. 11.—Middle tarsus and claws of ANOMALA MARGINATA, enlarged. (Original.)

The front claws of the anterior and middle tarsi are cleft at tip, the two portions nearly equal. [The middle tarsus is shown in fig. 11.]

Remedies.

The strong instinct of the beetle, above mentioned, to remain motionless for some time, or to "counterfeit death," as generally phrased, would indicate as the best method of reducing their excessive abundance, that of shaking them on cloths, as recommended for *A. lucicola.* For securing them as they drop, one of the different forms of "collectors" described and figured by Dr. J. B. Smith in his Bulletin on the Rose-Bug (No. 82 of the New Jersey Agricultural Experiment Station), would prove convenient and effective, and decidedly preferable to attempting to gather them into a vessel of water and kerosene.

Dr. Riley has recommended for the attack of this grapevine pest, spraying the vines, upon their appearance, with Paris green and water, at any time before the grapes begin to ripen. A strong kerosene emulsion should also kill the beetles, and if used in June or July, it is hardly possible that it could remain to affect the grapes when converted into wine.

Other Grapevine Anomalas.

In addition to the two species named, at least three others are known to feed upon grape foliage, viz., *A. undulata* Mels., *A. minuta* Burm., and *A. binotata* Gyll.

Diabrotica vittata (Fabr.).

The Striped Cucumber Beetle.

A correspondent has sent the following statement of a supposed protection afforded by a black walnut tree from the attack of the striped cucumber beetle, *Diabrotica vittata* (Fabr.):

My apple orchard joins my garden on the north side and my yard on the east side. Just inside the yard at the junction of these two fences is a black walnut tree, shading that northeast corner of the garden. In this, as far as the walnut shade goes, I can raise all the cucumber and canteloupe plants that I choose to plant, but as soon as I get out of reach of this walnut tree — in one good hour of sunshine they are eaten so suddenly that I almost feel like saying they are swallowed whole by the bugs. All of these plants that I have raised of late have been grown in this corner until old enough to withstand the bugs (just ready to vine), when they are taken up on a large shovel and carried to the places prepared for them. I might think that it was the shade on the east side, but that this walnut tree is a volunteer that came up quite near one of the largest apple trees that I ever saw, which shaded the same ground. This is now old and dying out while the walnut tree takes its place. As the walnut gets larger my plant-bed, to the same extent, is extended in area.

See a brief note in the *Fifth Report on the Insects of New York*, 1889, p. 159, entitled — Beans for repelling the Striped Cucumber Beetle. There are many statements in agricultural journals of the supposed effects of various plants in repelling insect attacks, but they all need verification before they can be accepted.

Dibolia borealis Chev.

A Plantain-Leaf Miner.

(Ord. COLEOPTERA: Fam. CHRYSOMELIDÆ.)

Dibolia borealis CHEVROLAT: Guer. Icon. Règne Anim., 1845, pl. 49 bis., f. 12.
Dibolia œrea MELSHEIMER: in Proc. Acad. Nat. Sci. Phila., iii, 1847, p. 167.
Dibolia œrea Melsh. HENSHAW: List Coleop. N. Amer,, 1885, p. 113, no. 7057.
Dibolia borealis Chev. HENSHAW: 3d Supp. List Coleop. Amer., 1895, p. 29.

Plantain leaves (*Plantago major*) containing larvæ mining them, were received, through favor of Mr. C. L. Shear, of Alcove, N. Y., on June 22d. They were placed in a box where they were overlooked until in the autumn, when two small beetles, dead, were found in the box. They were identified by Dr. John Hamilton as *Dibolia œrea* Mels., now *Dibolia borealis* Chev.

Dr. Hamilton did not know of the mining habits of the larva, but was familiar with the beetle in its abundant occurrence on plantain leaves, at Allegheny, and elsewhere. He called my attention to the following note by S. H. Scudder, in Pscyhe, ii, 1878, p. 154:

Prof. F. H. Storer, of the Bussey Institution, Jamaica Plain, Mass., writes me that in the latter part of May, 1876, it was next to impossible to discover a single leaf of plantain (*Plantago*) that was not completely riddled by beetles (*Dibolia œrea* Melsh.). Several thousand plants from all sorts of situations had passed through his hands, and the only perfect ones that he could find were from particularly cold, sunless places on the north side of buildings.

Habits, Etc., of the Insect.

Prof. P. H. Rolfs has given the following account in *Entomological News*, ii, 1891, p. 13, of the habits and pupation of this insect:

> The habits of this little beetle appear to be familiar, but the following notes on its period of development may be of interest: The larvæ were found abundantly on plantain (*Plantago major*) at La Claire, Iowa, about August 1, 1890. They make an opening in the epidermis of the leaf which they enter, gradually eating their way. Sometimes a larva makes a tunnel, then goes back and starts a branch to it. If the leaf becomes too dry some will leave and enter a fresh one, but in ordinary cases they remain in their leaf until they are ready to pupate. When full-grown they are about three-fourths mm. in length. The period of pupation is fourteen days. Up to the twelfth day the pupa is yellow; on that day a slight coloring of the eyes is noticed, the following day the tarsi become black, and the fourteenth day the beetle appears, becomes entirely black and begins to move about. Eight beetles lived five days without food; after plantain leaves were introduced they ate freely.

A Miner in Turnip Leaves.

Prof. Comstock has noticed this insect in his Report as Entomologist of the U. S. Department of Agriculture for the year 1879. Early in March of that year, turnip leaves being mined by a larva were received from Atlanta, Ga. "The larvæ were found burrowing into the leaf-stems as well as into the turnip itself, the eggs having evidently been deposited near the base of the leaves. It was at first thought that these might be the larvæ of the turnip-flea beetle, as they bore a resemblance to them, but rearing to the perfect state showed them to belong to a closely allied species, *Dibolia ærea*." The larva not having been previously described, Prof. Comstock accompanies the above notice of its feeding habits with its description (page 248 of the *Report of the Department of Agriculture for* 1879).

The Beetle Abroad.

Prof. Herbert Osborn has taken the beetle, in several examples, in sweeping the grass of a lawn in Washington, D. C. (*Insect Life*, vi, 1891, p. 198.)

Of the life-history of this insect little has been recorded. Mr. E. A. Schwarz, of the Entomological Division at Washington, in writing from Vicksburg, Miss., on January 28th, incidentally mentions his having seen during the few preceding warm days *Diabolia ærea* commonly flying about or sitting on fence posts, etc., but had not found it in its winter quarters.

Description of the Beetle.

A description of the beetle by Dr. Horn may be found in his "Synopsis of the Halticini of Boreal America" in the *Transactions of the American Entomological Society*, xvi, 1889, at page 307. It is "oval, slightly oblong, convex, piceous, surface distinctly bronzed, either æneous, slightly cupreous, or bluish. Head shining, indistinctly punctate. Thorax * * * closely punctate with coarse and fine punctures intermixed. Elytra * * * disc convex, with striæ of coarse punctures which are rather closely placed, some of the striæ rather irregular. Body beneath piceous. * * * Length, .12 inch.; 3 mm."

Its Distribution.

Widely distributed over the entire eastern United States and Canada. It has also been received from Nevada. It has also been reported as occurring in Mexico, but it may have been confounded with *D. ovata* Lec.— believed to be a distinct species, although referred by Crotch as a variety of *borealis.*

Otiorhynchus ovatus (Linn.).

The Ovate Snout-Beetle.

(Order Coleoptera : Family Otiorhynchidæ.)

Linnæus: Syst. Nat., i, Pars ii, 1767, p. 615, 69 (original description as *Curculio ovatus*).

Olivier: Entomologie, v, 1807, p. 378, pl. 31, f. 473.

Laboulbene: in Ann. Soc. Ent. France, iii, 1853, i, Bull. 48 (larval notes).

Leconte-Horn: Rhyn. N. Am.; in Proc. Amer. Philosoph. Soc., xv, 1876, p. 61 (description as *ligneus*).

Weed: in Rept. Mich. St. Bd. Agr. for 1883, pp. 425–429 (life-history, as *ligneus;* in Cook's Notes on Injur. Ins.— Ent. Lab. Mich. Agr. Coll. [1884], pp. 6–10, figs. 7–9 (general notice, as *ligneus*); in 14th Rept. Hort. Soc. Mich. for 1884, 1885, pp. 84–88, figs. 7–9 (natural history, description, food, enemies, remedies; as *ligneus*).

—— in Psyche, iv, 1884, p. 233 (injurious to strawberries, as *ligneus*).

Lintner: in Can. Ent., xvi, 1884, p. 182 (infesting a house, as *ligneus*); the same in 15th Ann. Rept. Ent. Soc. Ont., 1885, p. 13; the same in detail, 2nd Rept. Ins. N. Y., 1885, pp. 51–52; 3rd Rept. do., 1887, p. 141 (from beneath carpets); 4th do., 1888, p. 141 (in dwellings, as *ligneus*); 6th do., 1890, pp. 107, 118, 189 (in dwellings and on strawberries; mention); in New Eng. Farmer, June 4, 1890, p. 1 (on strawberries); 7th Rept. Ins. N. Y., 1891, pp. 321, 360 (in dwellings and on strawberries; mention); 9th do., for 1892, 1893, pp. 297, 422, 463 (infesting dwellings; mention).

HENSHAW: List Coleopt. N. Am., 1885, p. 134, no. 1882 (*ovatus* Linn., *ligneus* Lec., erroneous identification).
HAMILTON: in Trans. Am. Ent. Soc., xvi, 1889, p. 153 (distribution); id., xxi, 1894, p. 402 (introduction and distribution).
TOWNSEND: in Psyche, v, 1889, p. 234 (in Michigan).
SCHWARZ: in Insect Life, iii, 1892, p. 37 (in notice of Otiorhynchidæ).
HARRINGTON: in Can. Ent., xxiii, 1891, p. 22 (mention); in 25th Ann. Rept. Ent. Soc. Ont., 1894, p. 49 (common at Sydney, N. S.).
RILEY-HOWARD: in Insect Life, v, 1892, pp. 46–47 (infesting houses; habits).
WEBSTER: in Can. Ent., xxiv, 1892, p. 207 (feeding upon leaves of muskmelon); the same, in Insect Life, v, 1892, p. 99; in do., vi, 1893, p. 186 (in grass).

This curculionid or snout-beetle has been noticed in the Second, Sixth, and Ninth Reports of this series as infesting dwelling-houses. In the first instance a house in Lycoming, Oswego county, N. Y., which had been closed for four years, on being opened in the month of May was found to be harboring an immense number of the beetle, although containing nothing upon which they could feed. They continued into June, the last disappearing about the middle of the month. In the second instance reported they invaded many dwellings in Potsdam, N. Y., in 1889. In the third, they proved a great annoyance to the occupants of a house at Moriches, on Long Island, in the month of August.

As their appearance at Potsdam was merely given incidental mention in the Sixth Report, some further particulars subsequently communicated may be of interest.

Infesting a House in Potsdam, N. Y.

Examples of the beetle were received for identification the latter part of July, 1887, from a lady, with the statement that they had appeared in the house in quantities and seemed particularly to infest woolen goods. The writer was assured that they were harmless to woolens, as both the larva and the beetle fed only on vegetable matter. The following year, in August, the lady wrote that the beetles had appeared in great numbers outside the house, usually coming from their hiding places at about 9 o'clock in the evening. Many were seen upon the outer walls (a stone building). They ate the leaves of the shrubbery, particularly of the rose bushes, of which little was left but the stems. They were also found so abundantly in the gutters on the top of the house that they could be taken up by

FIG. 12.— The ovate snout-beetle, OTIORHYNCHUS OVATUS, with antenna more enlarged. (Original.)

the handful. Many of the rooms of the house abounded with them to the extent that their frequent gathering with a broom was necessary. At the time of writing, August 24th, they were not quite so numerous as they had been about the first of the month. In May of 1889 they again reappeared and gave promise of being more numerous than before. A number of other houses in the vicinity had also become infested.

As a Strawberry Pest.

Very little has been recorded of the life-history of this insect, particularly of that portion which is of the greater economic importance, viz., the larval food-habits. Dr. C. M. Weed had observed the larvæ girdling the crowns of strawberry plants on the grounds of the Michigan Agricultural College, in May and June. The name of the "strawberry crown-girdler" was proposed for it, as, instead of burrowing into and excavating the crown as does the "strawberry crown-borer," *Tyloderma fragariæ* (Riley), "it seems to prefer the outer portion, but in many cases it cuts horizontally through the center of the crown." The mature insect, the beetle, seems to be somewhat of a general feeder, as, according to Miss Clarkson's statement, it was destructive to the foliage of roses and other shrubbery; but no other record of the larval food is known to us than the one above cited.

The Insect Destructive to Cabbage.

During the year, the insect has come to our notice as a serious cabbage pest. Examples of the beetle were received from R. J. Dimon, M. D., of Hastings, Oswego county, N. Y., on August 15th, through Dr. Collier, of the New York Agricultural Experiment Station, for name. Dr. Dimon kindly sent me, under date of October 11th, the following information in regard to its operations.

I have been observing its habits and effects for some time. It commences its attack on the cabbage soon after it is established in the field. The first indications are the turning yellow, then brown, of some of the bottom leaves. The beetles are found on the ground under leaves as soon as the head begins to form. Rotten leaves appear, and sometimes one side of the head rots off entirely. When they do not commence their attack so early, the head forms nicely and nearly attains its growth, when the rot appears and the leaves separate from the heart. The cabbages thus infested are a total loss, and nearly one-half of my field of two thousand plants was ruined in this manner, this year. The injury seems to be done by both the beetle and the grub. I have taken fifty beetles from under a single leaf which had turned brown from their drawing the sap from it; and later, the stalk is found punctured and filled with little white larvæ, about one-third of an inch ong, which destroy the center of the stalk and leave it a foul smeing jelly-like mass. The eggs are deposited just below the first leaves — many in a plant.

Dr. Dimon has been requested to send, another season, examples of the cabbage stalk infested by the larvæ mentioned, that it may be determined beyond question if they are those of *O. ovatus.* The species of Otiorhynchus in their larval stage are root-inhabiting. *O. sulcatus* and *O. picipes* frequently occur in England, as burrowers in mangel-wurzel. Both of these species have been introduced into this country.

While *O. ovatus* is very abundent in New York, none of the other species have been collected by me in the State. *O. sulcatus* is taken rarely.

As the above notes relate only to the economic relations of the insect, a number of references have been given, where further information of it may be found.

Conotrachelus cratægi Walsh.

The Quince Curculio.

(Ord. COLEOPTERA: Fam. CURCULIONIDÆ.)

Conotrachelus cratægi WALSH: in Prairie Farmer, for July 18, 1863, p. 37 (original description).

From an orchard in Geneva, N. Y., two quinces were sent on October 11th, from which eight larvæ of this species were taken — six of the number occurring in one quince. The insect had been very injurious in this orchard in 1893. Spraying with an arsenite, recommended for preventing attack of the plum curculio, had apparently little influence in lessening its injuries, for the trees had been given three sprayings with London purple during the season — one pound to two hundred gallons of water; and yet, a large proportion of the fruit was destroyed. The attack in this and other orchards of the owners had continued for many years, especially in 1887, when of one thousand bushels of quinces grown, one third was more or less affected, as stated in my Fifth Report, 1888.

FIG. 13.—The Quince Curculio, CONOTRACHELUS CRATÆGI; side and back views. (After Riley.)

Fortunately, this is rather a local insect. The injuries in Western New York have not been as serious as in New Jersey, where Dr. Trimble reported in 1870, that in a quince orchard of two hundred and eighty trees, upon a most careful search, he was unable to find a single specimen perfect or clear of one or more blemishes caused by the punctures of this insect. Besides the quince, it had been quite destructive to Lawrence, Seckel, and Duchesse pears.

The quince curculio has not been treated of, in detail, in any of the New York reports. It was not noticed by Dr. Fitch, and was probably unknown to him, at least, as occurring in the State of New York, having been first described by Mr. Walsh in 1863, as found abundantly ("swarming") on wild haws in the West. A brief notice of its feeding habits, transformations, its injuries and remedies for it, is to be found in the *Second Report on the Insects of New York*, 1885. Prof. Riley has given an extended account of it in his *Third Report on the Insects of Missouri.* The literature relating to it is quite limited.

The Seventeen-Year Locust in the State of New York in 1894.

(Ord. HEMIPTERA: Subord. HOMOPTERA: Fam. CICADIDÆ.)

The "Hudson river valley brood" of this interesting insect (*Cicada septendecim*), which was previously seen in the year 1877, made its return at its expected time — during the latter part of May, continuing during the month of June and gradually disappearing in the early part of July. It is the largest in number and the most extended in its range of any of the six New York broods. This alone would render its visit of more than ordinary interest, but in addition thereto the interest always attaching to it was largely increased by the discovery in a number of places in the State of curiously formed clayey structures built by the pupal insect upon the surface of the ground to a height of two or three inches, in continuation of the underground burrows, frequently in many thousands and occasionally in hundreds of thousands. Why they were exceptional, and were in some places found intermingled with the ordinary open burrows, and what cause led the pupæ to construct them — notwithstanding the study that has been given them and the explanations that have been offered — these and other questions connected with them still remain to be satisfactorily answered through future observations and study.

That the occasion might be improved in obtaining information of the precise territory occupied by this brood, of its building operations, and of other matters relating to it, the following was prepared as a circular and largely distributed throughout the Hudson river counties, and was also, by request, copied in many of the local papers of the several counties:

UNIVERSITY OF THE STATE OF NEW YORK,
OFFICE OF THE STATE ENTOMOLOGIST.

THE PERIODICAL CICADA, OR THE "SEVENTEEN-YEAR LOCUST."

Perhaps no known insect has more interest connected with it than the one above named. The life-period of none other approaches it in length. Although its remarkably long life is doubted by many, yet no scientific fact has been better established than that from the time its eggs are deposited in the slits made in the twigs of trees, to that in which the perfect insect is developed from the eggs and appears abroad, soon to deposit its eggs, seventeen years (less about one month) will have intervened.

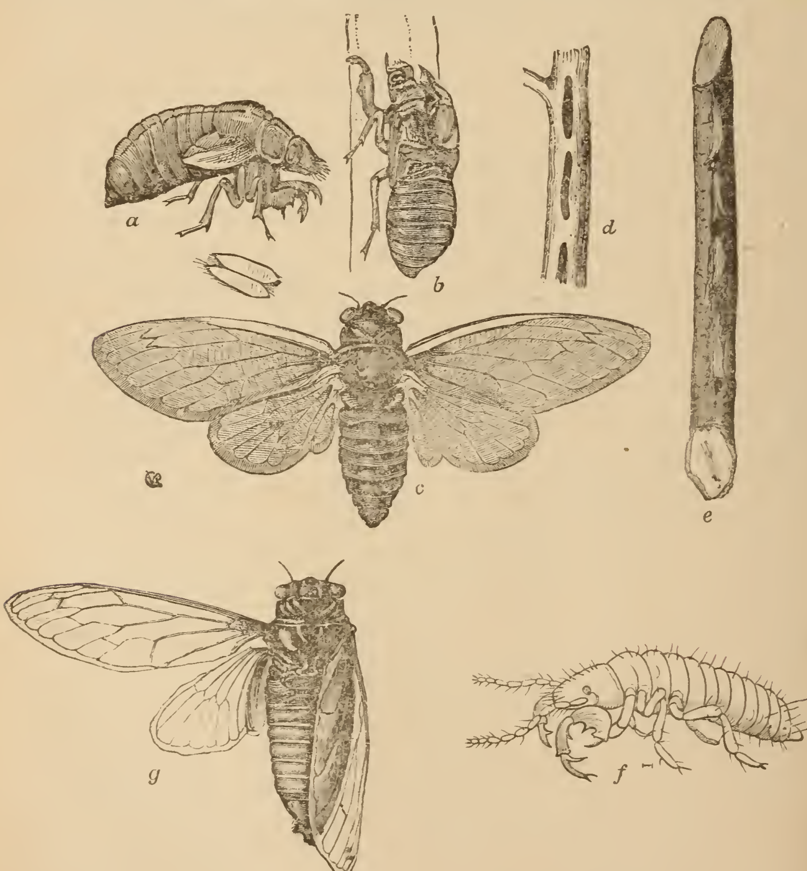
In some localities in the United States the periodical Cicada (usually but improperly known as the seventeen-year locust) appears at shorter intervals than this — in four or six or other number of years; but these are of other broods which extend over certain localities of greater or less extent, but each one always true to its appointed time of seventeen years. The only exception to this is, that in some of the Southern States, a race occurs, indistinguishable in appearance from the others, but the several broods of which appear every thirteen years.

In the State of New York, six distinct broods of the seventeen-year cicada are known. The one that is with us at the present time, and of which the first insects made their appearance about the 25th of May, has been designated as the Hudson river valley brood. Dr. Fitch, who was the first to indicate its boundary, states, in his *First Report on the Insects of New York:* "Its northern limit is in the vicinity of Schuylerville and Fort Miller [Saratoga and Washington counties], and thence reaches south along both sides of the Hudson to its mouth, where it extends east at least to New Haven in Connecticut, and west across the north part of New Jersey and into Pennsylvania."

How far inward in each direction from the river this brood extends is not known, nor whether in any instance it reaches the outer limits of any of the twelve eastern river counties. Definite knowledge of its range would be of interest and of use, and would aid in mapping the infested region. Such a map, made from sufficient data, would serve to show in subsequent returns, whether the successive broods are lessening, both in the number of insects and in the territory occupied by them, as is generally believed.

Most persons who can recall a "locust year," are familiar with the appearance of the insect in its pupal and winged stages; but as aid to its recognition by those not acquainted with it, the following figures are given:

At *a* the *pupa* is shown. This is the form that the larva assumes as it approaches maturity in its sixteenth or seventeenth year, and is that in which it comes out of the ground in May or June and climbs up and fastens itself by its sharp claws to the trunk of a tree, shrub, fence or some other convenient upright object. In a short time the pupa-case (the outer horny covering of the pupa) splits on its back and the mature insect (in a white color at first) comes out of it, leaving it as seen at *b*. When the wings have expanded and dried and the insect has changed to its natural colors of red eyes and red veins



of the wings, it is ready for flight, as represented at *c*. At *d* is intended to be shown the slits bored into the twigs for its eggs (two eggs enlarged are figured underneath the pupa), but their peculiar appearance, as made by repeated thrusts of the ovipositor, is more correctly given at *e*. A greatly magnified figure of the young cicada (the larva) just as it hatches from the egg and drops from the tree to enter the ground and feed on the sap of the rootlets is given at *f*. Figure *g* is another representation of the winged insect, in which one of the wings has its natural position when at rest.

The pupa comes from the ground through a smooth round hole extending some distance downward, of the diameter of the tip of a man's little finger.

A remarkable departure from this usual habit has come to our notice this year at a locality in New Baltimore, N. Y., sixteen miles south of Albany, where, at least as early as the last week in April, the pupæ had brought up from apparently a considerable depth, masses of a soft clay-like material and moulded it above ground into rudely conical or cylindric structures, for their temporary occupancy, it is supposed. The ground was almost covered with them. In places twenty-five could be counted to the square foot. They inclined at a considerable angle from the perpendicular and measured from two to three and a half inches in height. The chamber within was uniform in diameter with the hole in the ground. Figures *h* and *i*, taken from photographs on wood made for the *Country Gentleman*, are of about two-thirds the natural size. The pupa, when its full time has come, breaks a round opening through the upper part of the chamber for its escape.

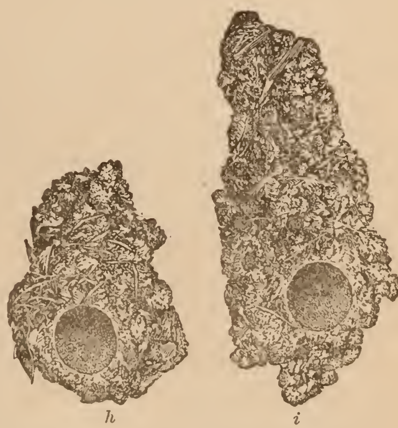


FIG. 15.—Clay buildings of the seventeen-year cicada.

It is not known when they were built or how they were made. Why they were constructed by all of the insects in this locality and not elsewhere is a mystery full of interest and for which no satisfactory conjecture can be offered. Only two other instances of their occurrence in former years have been given by writers, and only one specimen up to the present is known in any collection — in that of the National Museum at Washington, deposited there about twenty-five years ago.

The purpose of the present circular is to obtain all the information of this interesting insect that can be secured during the remainder of its brief stay with us. It will disappear gradually during the early part of July without, it is believed, having been the occasion of any special harm. Unlike the devastating locusts, its injuries are seldom serious except to young fruit-trees and in nurseries.

Replies are requested from all whom this circular may reach to as many of the questions proposed below as can be conveniently given. Any other notes of interest would be acceptable. Even a few words on a postal card giving locality or abundance or other item might prove of special value.

1. At what place was the Cicada seen? Locate it so that it can be indicated on a map.

2. When was it first seen — in May, or not until early June?

3. What was its comparative abundance — few, many, very abundant, or "millions"?

4. How abundant compared with the 1877 appearance?

5. Were holes seen in the ground from whence they came? Statements sometimes represent the ground as "honey-combed" by them.

6. Were any of the clay or mud above ground houses seen? Ground burned over in the early spring might be examined for them.

7. When were their peculiar noises or "screeching" first heard?

8. When were their first egg-deposits in the twigs seen?

9. Do the slitted twigs show wilted leaves and break, and later fall to the ground?

10. Has any particular injury been done to fruit-trees or grape-vines?

11. In what trees, shrubs, or plants have the egg-deposits been seen?

12. Is any instance of its "stinging" a person known? A painful or harmful sting from it is not credited.

13. Does the English sparrow feed on it, and if so, to what extent?

14. What birds or mammals have been seen to eat it?

15. What insect attack on it has been observed?

16. Do many of the old males, when the body is broken open, show a dry, powdery, brownish fungus attack?

17. Of the two distinct forms of the Cicada — variety *Cassinii* being about two-thirds the size of the other and the rings of its body beneath being without the orange border — are many of *Cassinii* seen? Or, a number of specimens taken as they come to hand, might be sent to me for identification.

18. Has the noise or cry of the insect (made only by the male) been heard later than July 1st?

19. How late in July were any of the insects seen?

20. Has it failed to appear in any locality where it occurred in 1877 ?

In answer to any of the above, the question may be indicated by the number prefixed to it.

J. A. Lintner,
State Entomologist.

Albany, *June* 13, 1894.

Nearly a thousand copies of the above circular were distributed, but, with the usual result that attends such inquiries, comparatively few replies were received — less than one hundred. It is strange that when so simple a task is asked for as a few words upon a postal card, that so few persons are disposed to comply with the request, but negligently withhold what might be an important contribution to science.

The answers returned to question 1, gave insufficient data for the preparation of the map proposed, to show the portions of the Hudson river counties occupied by the insect, but much interesting and valuable information upon other points was obtained which will be put in form for as early publication as is possible.

A number of photographs were secured of the pupal buildings thickly dotting the ground at the New Baltimore locality, and of others, illustrating various forms and conditions from specimens placed in the State Museum Collection, from other localities in the State where the buildings were also found.

Psylla pyricola (Foerster).

The Pear-Tree Psylla.

(Ord. Hemiptera: Subord. Homoptera: Fam. Psyllidæ.)

In writing of the distribution of *Psylla pyricola*, in the preceding report (Ninth, for 1892), it was stated that the insect had been studied in Central New York by Mr. M. V. Slingerland, at Ithaca, Tompkins county, but " in Western New York it must occur sparingly if at all," for reasons stated.

Its Occurrence in Western New York.

Since then, two notices of its presence in western counties have come to my knowledge. Mr. Sherman Williams, of Bluff Point, Yates county, has written that about one hundred of his pear-trees, twelve years old, showed attack in 1891, of what he now recognizes as the pear-tree Psylla. The blossoms dropped and the blackened leaves covered with the "honey-dew" drew numbers of wasps to feed upon the sweet substance. None of the trees were killed but many presented an unhealthy appearance. The attack was not renewed in 1892.

Mr. John H. Brown, of Mt. Morris, Livingston county, sends the information that he has had the Psylla with him during the past ten years. The blackened leaves and the honey-dew indicated the attack. It had been more severe during the two years past, in which time it had killed a hundred of his trees.

In Eastern New York.

In Eastern New York the Psylla was reported as unusually abundant and injurious in orchards of Mr. M. Brooks, in Athens, Greene county, in 1893, preferring the Bartlett and Anjou to the other varieties. It does not appear to have been numerous in most of the localities where reported in former years.

Remarkable Abundance of Aphides or Plant-Lice in 1893.

(Ord. HEMIPTERA: Subord. HOMOPTERA: Fam. APHIDIDÆ.)

The early spring did not bring to notice, either through personal observation or that of my correspondents, the usual number of injurious insects. The earliest to claim attention were the aphides, or plant-lice -- more or less abundant every year, but in some seasons becoming very numerous and correspondingly destructive.

The opening of the apple-tree buds in early May was attended with such an unusual abundance of the apple-tree aphis, *Aphis mali* Fabr., as to excite apprehension of their effect upon the coming fruit crop. Many letters were sent to me in relation to them. The necessity of preventing their increase by spraying was urged on my correspondents, unless a heavy and continued rain should occur before they would be sheltered by the leaves -- say within ten days or a fortnight after their hatching. Mr. C. C. Risley, Chairman of the Executive Committee of the Hop Growers' Association, of New York, writing under date of May 9th, stated that hop-growers were reporting large numbers of plant-lice on the buds and blossoms of fruit-trees and on rose-bushes, recalling the conditions existing in the spring of 1886, in which year the hop crop of the State of New York was almost wholly destroyed by the hop-vine aphis. This year the fruit-trees seemed even more infested than they were at that time. He especially wished to know what significance, if any, this might have with respect to hop injuries the present year.

Answer was made that the past winter had apparently been very favorable for the protection and preservation of aphis eggs, and unless the young, recently hatched or now hatching, could be speedily destroyed by a heavy rainfall, which, at this stage of their existence, is so fatal to them, we would, in all probability, find the present year characterized by an abundance of aphides equal to that of 1886. It was, therefore, recommended that, if natural causes did not intervene to prevent this multiplication, the hop-growers, on the first appearance of the insect in their yards, should proceed to kill them by proper spraying before they could produce new generations and extend over the entire yards. Directions for spraying with kerosene emulsion — perhaps the best insecticide for use against this insect — and how to make the emulsion, accompanied the letter.

In response to a request from the editor of the *American Farmer*, for information for the benefit of its readers in regard to the multiplication of plant-lice as reported from New York, the following communication was made and published in the issue of that journal for June 1, 1893:

"The remarkable abundance of these destructive little pests on the opening buds and tender leaves of fruit-trees in the State of New York this spring is exciting a great deal of interest and considerable apprehension among fruit-growers. The apple-tree has been particularly infested, the insect occurring on it, the *Aphis mali*, being one that multiplies under favoring conditions in excessive numbers, entirely covering twigs and standing one on another, and sucking out all the sap until the parts attacked are blighted.

"From some portions of the State, reports have reached me of the opening buds of apple-trees being literally covered with these plant-lice, or aphides as they are scientifically known. As the reports have come from eastern, central, and northern counties, it would appear as if the condition was general throughout the State. Whether it also extends into adjoining and other States is as yet unknown to me.

"To inquiries made of the probable effect of this attack on the coming fruit crops, I have replied that it was unusually severe, and apparently exceeded anything that we had experienced since the year 1886, when the superabundance of plant-lice of different species inflicted serious losses, and the hop-vine aphis almost destroyed the hop crop of the State of New York. It was, therefore, desirable that fruit-growers should spray their trees at once with kerosene emulsion, strong soap suds, or tobacco water, and not wait until the aphides have greatly multiplied and found shelter within the curled leaves where the insecticide could not reach them. A long, cold rain following in a week or ten days the appearance of the insect, would probably be quite as beneficial as the spraying recommended, if we could judge from observations in preceding years, but, of course, this providential aid could not be counted upon.

"Since then we have had throughout the State heavy rains, continuing with more or less intermission, amounting to from two to three inches of fall. It was not a cold rain, however, and judging from a few reports since received (I have not been able to make personal observations), it failed to prove very efficient in the desired direction, for the apple aphis is said to be about as abundant as before.

"Our hop-growers also are feeling considerable anxiety, for the same conditions that favor an unusual number of the apple aphis would naturally tend to the multiplication of the hop-vine aphis, as was so markedly illustrated in 1886.

"The hop-growers have, therefore, been advised to keep close watch for the first appearance of the hop aphis on the upper leaves of the outer rows of their hop yards. They will probably be seen there about the last of May or the first of June as full-grown, winged females, which have just flown from neighboring plum-trees, where the winter had been passed in the egg and the early spring as wingless females. If these, the mothers and progenitors of a number of successive broods through the summer, are killed at this time by proper spraying with suitable insecticides — in the proportion that they are destroyed, will subsequent injury to the crop be prevented.

"It is said that in England the hop-growers do not attempt to grow a hop crop without their regular 'hop washings,' which we call spraying."

[Mr. C. C. Risley, under date of June 5th, reported that the aphis was at that time to be found in several of the yards in the vicinity of Waterville, not only on the outer rows, but also in the central part of the fields — an unusual occurrence for so early in the season. Soon after (June 7th), Mr. Risley sent, as illustrating the abundance of the aphis, a small hop-vine leaf of not more than one-fourth of an inch in area, having upon it twenty-five of the winged migrants from plum trees. Still later, Mr. Turnboul, of Glen, estimated that, assuming an average in former years of twenty-five of the winged migrants on a large leaf, the average number this year would be two hundred and fifty.]

Reports of unusual abundance of aphides on fruit-trees came from the following counties, indicating that they were not confined to any particular part of the State: Westchester (on apple and cherry in June), Dutchess, Schoharie (buds literally covered in June), Schenectady, Chenango (on apples and pears in May), Oneida and Onondaga in May, Madison, Oswego, and Chautauqua.

Of the hop vine aphis, *Phorodon humuli*, the most severe injury seems to have been caused in the southern part of Dutchess county, where hop yards were entirely stripped, save here and there a blackened, perforated leaf of a new shoot. Nothing was done to stop the ravages of the insect; so quickly did it do its work that it was almost done before it was discovered. The crop is an entire failure (*New York State Weather Crop Bulletin*, July 8, 1893). In Madison county the destruction of the crop was threatened in early July, but a more favorable condition was reported later. Spraying was resorted to in several of the counties — in Franklin and others — with gratifying results (*Report of the Entomologist to the Regents of the University of the State of New York for the year* 1893).

Are Aphides Eaten by Spiders?

Mr. Charles A. Green has sent, with inquiry of its correctness, the following published statement of D. C. Keller: "Spiders protect fruit-trees from aphides. I have fed spiders in captivity, and have found aphides to be their natural food."

That spiders feed on aphides has never come under my observation, nor do I remember any record of such habit.

The utility of spiders in the destruction of aphides could alone be established by reliable observations made under natural conditions. The fact of spiders in captivity, in the absence of other food, feeding on plant-lice would be of no economic importance. We would expect them to do so, as well as to prey upon any other small insects furnished them.

It is not possible that plant-lice can be the natural food of spiders, or the fact would have been observed and reported over and over again during the close studies that have been made of these pests of our gardens and orchards and grain fields. They find their natural enemies in the lady-bugs and their larvæ (*Coccinellidæ*), and in species of the lace-winged fly (*Chrysopa*). If the plant-lice abounded on forest trees, then their natural enemies would be sure to find them out promptly, and not leave them to be discovered and destroyed by spiders.

We may safely conclude that spiders are of inappreciable service to us in the war we are compelled to wage against the aphides. We would gladly welcome them as allies in this contest, if there was any evidence of their service. That some of them may feed at times on some of the smaller Hemiptera would appear from the following:

In the *Entomologist*, London, for July, 1894, Prof. T. D. A. Cockerell, of the New Mexico Agricultural Experiment Station, has recorded his finding a little Attid spider in some numbers on a grapevine in Las Cruces, N. M., to the foliage of which a small leaf-hopper of the genus *Typhlocyba* was quite injurious. Although the spider was not observed actually preying upon the leaf-hopper, Prof. Cockerell entertained no doubt that it fed upon it.

The *Attidæ* are known as "jumping spiders." They spin no web, but capture their prey by leaping upon it, either from ambush or by approaching under cover until sufficiently near for the leap.

The *Typhlocibina* belong to the Hemiptera, and some of the species do not exceed the *Aphididæ* in size.

Pentatoma juniperina (Linn.).

The Juniper Plant-bug.

(Ord. Hemiptera: Subord. Heteroptera: Fam. Pentatomidæ.)

Linnæus: Systema Naturæ, i, pars ii, 1767, p. 722, no. 48 (original description as *Cimex juniperinus*).

Amyot-Serville: Hist. Nat. des Insectes — Hémiptères, 1843, p. 132 (brief description).

Glover: "Manuscript Notes from My Journal. Order Hemiptera," 1876, pl. 7, f. 21, p. 57 (listed).

Provancher: Petite Fauna Entomologique du Canada — Hémiptères, iii, 1886, pp. 41–2, pl. i, f. 4 (as *Lioderma ligata*).

Saunders: Hemiptera Heteroptera of the British Islands, 1892, pp. 28–29 (description).

Van Duzee: List of Hemiptera of Buffalo and Vicinity; in Bull. Buff. Soc. Nat. Hist., v, 1894, p. 171 (food-plants).

A correspondent at Brockport, N. Y., has sent me (June 14) several examples of a plant-bug which he states had nearly destroyed his crop of peaches in 1892, by puncturing them and sucking their juices until they became rough and pithy and entirely worthless.

What the Insect Is.

The insect is one of the numerous species of "plant-bugs," as they are commonly called (sometimes also known as "stink-bugs," from their disgusting odor), which take their food by suction, and are quite injurious to many crops. This is a large green form, measuring one-half inch long by three-tenths of an inch broad. It is suboval in outline, being destitute of the prominent prothoracic lateral angles characterizing most of the family of *Pentatomidæ*, to which it belongs. Fig. 16 represents it in about twice its natural size. It is an European species and was described by Linnæus in his *Systema Naturæ*, as *Cimex juniperinus*. It is now known as *Pentatoma juniperina*.*

FIG. 16 — Juniper plant-bug, PENTATOMA JUNIPERINA. (Original.)

Its Description.

The following description of it is from "The Hemiptera Heteroptera of the British Islands," by Edward Saunders:

Convex, bright olive-green, margin of pronotum and of the base of the elytra pale. Head punctured, antennæ darker toward the apex; pronotum very closely punctured, its lateral margins narrowly raised and ochreous, slightly rounded, posterior angles simple; scutellum and elytra closely punctured, the former slightly wrinkled transversely and with the apex pale, the latter with the lateral margins at the base narrowly rufescent; legs concolorous with the upper surface. Length 12–13 mm.

Three localities in England named: on Junipers. (Rare.)

Its Occurrence in Europe.

Amyot et Serville describe it briefly,† giving its European synonymy with its distribution as follows: "It inhabits particularly the north of Europe: it is extremely rare in the vicinity of Paris. M. Rambur and Carreno have taken it on the juniper at Fontainebleau."

American Distribution.

Nothing seems to have been published of the habits of this insect in this country, and even its name has been seldom recorded. Yet it appears to have a wide distribution, Mr. Uhler having had it from Colorado. Mr. E. P. Van Duzee lists it as "occasional on various trees and bushes, especially on willows and junipers, from May to

* Determined by Mr. P. R. Uhler — not given in his Check-list of the Hemiptera-Heteroptera, of 1886.

† *Histoire Naturelle des Insectes.— Hémiptères*, 1843, page 132.

October: young in July and August." Provancher has figured "Pentatoma juniperina *Linn.*" in explanation of a plate, but in the text refers to it as *Lioderma ligata* Say—"a very common species found everywhere in fields and gardens," further remarking of it: "Confounded by several authors with *Pentatoma juniperina* of Linné, but differing from it in several of its characters." Mr. Glover, in his "Manuscript Notes from my Journal — order Hemiptera," 1876, pl. 7. fig. 21, has given a fairly good figure of it.

Habits of the Family.

The *Pentatomidæ* are both phytophagous and carnivorous, sucking the juices of the leaves and twigs of shrubs and trees, and of caterpillars and other insects which they puncture with their beak and speedily kill by extracting their fluids.

Remedy, if Abundant.

P. juniperina is probably too rare a species to become a serious fruit pest. Its numbers at Brockport must have been an exceptional occurrence. In such instances, probably an effective method of dealing with it would be to jar them from the branches while young and before the fruit has attained a large size upon sheets spread underneath, from which they may be shaken into vessels of water and kerosene.

Leptocoris trivittatus (Say).

The Box-elder Plant-bug.

(Ord. HEMIPTERA: Subord. HETEROPTERA: Fam. COREIDÆ.)

SAY: in Journ. Acad. Nat. Sci. Phila., iv, 1825, p. 322 (original description, as *Lygæus trivittatus*); Compl. Writ., Lec. Edit., ii, 1883, p. 246.

STAL: Enum. Hemipt., i, 1870, p. 226 (in Missouri, Mexico).

UHLER: List Hemipt. West Miss. Riv. (Separata), 1876, p. 35; the same, in Bull. U. S. G.-G. Surv. Terr., i, no. 5, 1876, p. 301 (distribution); in id., iii, no. 2, 1877, p. 408 (in Arizona, Colorado, and Utah); Ch. List Hemipt. N. A., 1886, p. 13, no. 606.

GLOVER: MS. Notes Journ.— Hemipt., 1876, p. 43, pl. 4, fig. 24 (cites Say).

POPENOE: in Am. Ent., iii, 1880, p. 162 (habits and appearance); in Industrialist, v, no. 47, 1880 (habits and remedies); id., vi, no. 31, 1881 (habits); in 3rd Bien. Rept. Kans. St. Bd. Agr. for 1881–82, 1883, pp. 612-613 (general account, as *Lygæus trivittatus*); in 1st Ann. Rept. Kans. Expt. Sta. for 1888, 1889, pp. 220-225 (extended account with plate); the same, in Industrialist, xiv, 1889, p. 101.

DISTANT: in Biologia Centrali-Americana: Rhynchota, 1882, p. 172 (North America, Mexico).

RILEY: in Bull. 12 Div. Entomol.—U. S. Dept. Agr., 1886, p. 41, pl. 1, fig. 5 (injuring apples in Utah; remedies).

LINTNER: in Count. Gent., lii, 1887, p. 69 (description, habits, remedies; brief); 4th Rept. Ins. N. Y., 1888, pp. 156-158, fig. 64 (description, food habits, distribution, etc.), p. 193 (abstract of notice); in Count. Gent., lix, 1894, p. 699 (in Iowa, and remarks on), p. 841 (in N. Dakota); in id., lx, 1895, p. 786 (in Eastern Iowa).

BRUNER: in Nebraska Farmer, Nov. 8, 1888 (brief notice; the same, in Bull. 5 Nebr. Agr. Expt. Sta., 1889, pp. 36-37, fig. 19); Bull. 14 do., 1890, pp. 126-130, figs. 87, 88, (habits, description from Popenoe, enemies).

GILLETTE: in Prairie Farmer, lxi, 1889, p. 833 (in So. Dakota; brief notice).

RILEY-HOWARD: in Insect Life, i, 1889, p. 325 (in Utah and Nebr.); in do., iii, 1890, p. 72-73 (on box-elder in Kans.); in do., iv, 1892, p. 273 (injurious to fruits in the State of Washington); in do., vi, 1894, p. 328 (in houses in Wash. State).

KELLOGG: Com. Inj. Ins. Kans., 1892, pp. 99, 100 (life-history, description, habits, Kansas notes).

WEED: Insects and Insecticides, 1891, pp. 145-147, fig. 78 (food-plants, habits, remedies).

OSBORN: in Proc. Iowa Acad. Sci., i, 1892, p. 122 (in list of Iowa Hemiptera, as *Leptocorisa*).

FLETCHER: in Naturaliste Canadian, xxi, 1894, p. 192 (common in Manitoba and the Northwest).

GILLETTE-BAKER: Bull. 31 Col. Agr. Expt. Stat., 1895, p. 21 (localities, etc.).

COCKERELL: Bull. 15 New Mex. Agr. Expt. Stat., Jan., 1895, p. 75 (in the Middle Valley of New Mexico).

LUGGER: 1st Rept. Entomol. Minn. Agr. Expt. St., 1896, pp. 108-111, pl. 13 (habits, etc., as *Leptocorisa trivittata*).

Although this insect is not a member of the insect fauna of the State of New York — if we may judge from the progress that it is making in this direction, steadily, although not as rapidly as that of another southern allied form, *Murgantia histrionica* — not many years will elapse before its unwelcome presence will be announced in the Middle and Eastern States.

Its Northward Spread.

At the time of the notice of this insect in my 4th Report above cited, it had not been recorded north of Missouri. In 1891 it was reported from the State of Washington, in Columbia and Garfield counties, in the southeastern corner of the State, near Idaho, in latitude 46°, where it had appeared the preceding year, and was now destroying large quantities of plums, peaches, apples, and some grapes. The same year Prof. Osborn catalogued it among the Hemiptera of Iowa, as common in the western part of the State. Soon thereafter it had increased to such extent as to appear in myriads in some localities and command popular attention, as appears from the following extract from a communication to the *Country Gentleman* of September 27, 1894, written from Shenandoah, a city in the southwestern part of the State:

While rambling along the city sidewalks I noticed an insect the like of which I never saw before. It was in all stages of existence and of all sizes. The immature bug was of a lively red color, while the mature form was from one-half to three-fourths of an inch in length. Its wing-cases were divided into two equal sections by lines; the forward portion was heart-shaped, and the bug in shape reminded me of the potato-bug (Cantharides). The fore-half was a dusty black color, the after-half deep black. In the brief space of time that I had for investigation I found that it fed on fruit, especially plums, which it tapped, sucking the juice. It is also a cannibal, for I saw them eating one another. The smaller ones will bite a person on provocation. They are quick in their movements, hiding at once on the approach of man. I was told that it was supposed to have been brought from the West in fruit four years ago. It is a pest, having increased at an alarming rate. I should like very much to know what it is, and whether it is likely to become a dangerous nuisance. So far as yet known, its area is limited.

Although no examples were sent for identification, from the characters given by the correspondent, there could be no question of its being the box-elder plant-bug. When mature and provided with wings, it is one-half inch long by two-tenths inch broad, flattened above, and of an elongate-oval form. The terminal leathery portion of the wing-covers are red-bordered on their outer and hind margins. Its thorax is red on its outer sides, with a narrower central longitudinal line of the same color. The lower side of the body is red, in places. Its original description by Say, is given in the *Fourth Rept. Ins. N. Y.*, cited.

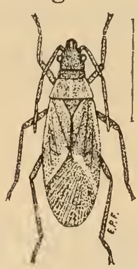


FIG. 17.—The box-elder plant-bug, LEPTOCORIS TRIVITTATUS. (Original.)

Not Entirely a Plant-Bug.

The statement above made that this bug is cannibalistic is interesting, as probably the first time that it has been observed. It is not at all probable, however, that its feeding upon one another is practised to any great extent, for if such was its established habit, its immense assemblages without the visible presence of a food-supply (as in the instance to be given below), would not be so frequently seen. That it will, also, inflict a wound under provocation, is also of interest. That it will bite even without provocation, has been stated of it, as in *Insect Life*, vi, p. 328: "We have previously heard unsubstantiated rumors that the insect will enter beds and bite human beings," when in its adult stage it had sought the warmth and shelter of dwellings (Riley-Howard). One of these rumors is probably the following, from a gentleman in Columbia county, Washington: "These bugs are a tolerable make-shift for bed-bugs when young, crawling into beds and biting quite sharply" (*Insect Life*, iv, p. 273).

The proboscis of this insect, while certainly a formidable weapon, is not correctly represented in the figure given in my 4th Report. It is there shown in an extended position, which it is doubtful if it ever assumes (at rest it is folded appressed to the body beneath), and of a length equal to one-half of the insect, including the wing-covers, while its true length scarcely exceeds the one-third.

Its Abundance in North Dakota.

The present year (1894), the insect has been found in such immense numbers in North Dakota as to excite unusual interest. A gentleman writing October 29th, from Jamestown, N. D. (N. Lat. 47°), on the Northern Pacific Railroad, gives several particulars which add to our knowledge of its life-history and habits which are worthy of transcription.

A strange insect has made its appearance in this locality in large numbers, and has been the occasion of much speculation as to its character, habits, and name. It has been seen for many weeks past in myriads in certain localities, and is now met with, as it has made its presence felt for weeks past, in stores, offices, barber-shops, hotels, and on the trees and walks. Where it came from and where and when it will go, are yet unanswered questions. Prof. Waldron, of the State Experiment Station at Fargo, says that it is closely allied to the chinch-bug. * * * He is of the opinion that these bugs came from South America, where most of their allies live.

The insects were first noticed in this portion of the State about the middle of August, at Spiritwood Lake. The bugs were seen in all stages of growth — from the red-coated young to the black-winged adults — hanging in clusters from the limbs and in large numbers on the trunks of the trees. The next instance known of their presence was on September 20th, when thousands of the young were found in the timber at the junction of the Pipestone and James rivers, in this city. Nearly a dozen patches of the young, varying from four or five feet to sixty feet in diameter, were discovered. The wingless larvæ, crimson in color, were several feet deep and formed a writhing mass. A few fully developed bugs were noticed among the young. Thousands were seen on the brush, logs, trees, and stones. The insects, while in the larval state, remained in this locality for about two weeks, and then suddenly disappeared.

The description given in continuation of the above established the identity of "North Dakota's New Bug" with the *Leptocoris trivittatus.*

Its Problematic Food-supply.

No other account that we have had of it has represented it as occurring in such remarkable numbers, massing in such innumerable multitudes and entering buildings of various kinds. It is evidently gregarious, as we are told of its hanging in clusters like bees from the limbs of trees; but the cause of its assembling in so large companies and swarming in stores and other business places cannot be explained. In both cases the food that the young would require for their development would not be procurable, and speedy death would therefore seem to be the natural result of placing them in such positions. As the insect is one of the Hemiptera (belonging to a family next in classification to that in which the notorious chinch-bug has place), it must find its food by means of its piercing and sucking beak in the sap of shrubs, trees, and fruit.

The insect has been given the name of the box-elder plant-bug, from its having been usually found upon that tree, *Negundo aceroides*, one of the common names of which is the ash-leaved maple; but it does not appear to be known if it actually breeds upon it or merely resorts to it for food.

It Reaches the Mississippi River.

In October, 1895 (delayed publication permits this mention), examples of the insect were received by me from McGregor, Iowa, with the statement that they had become so numerous in that vicinity as to be a nuisance to housekeepers, flying or crawling into every open space. This occurrence is an interesting feature in the distribution of the *Leptocoris*, since from the location of McGregor, on the west shore of the Mississippi river, it is highly probable that the insect, through flight or commercial transportation, has already reached the opposite shore and entered Wisconsin and Illinois.

Its Present Known Distribution.

While at first known only as a southern insect, it has now become a western one, since it presumably occurs in each State and Territory west of the Mississippi river, ranging from the river to the Pacific ocean, through Missouri, Kansas, Colorado, Utah, Arizona and California. To the southward, it has been found in New Mexico, and outside of the United States — in Mexico. Northward, it is known in Iowa, Nebraska, North Dakota and Washington. Intermediate States would cover the entire western region.

According to Mr. Fletcher, as quoted by l'Abbé V. A. Huard (*loc. cit.*), "It is very common in all Manitoba and the North-West, on the *Negundo aceroides.* I have found it in abundance at Regina and in the environs of Winnipeg."

Probable Eastern Spread.

It is strange that with its adaptability to such varied degrees of temperatures — from North Dakota and Washington to Mexico — and other even more dissimilar conditions, that it has not extended its range, so far as known, to the eastward of the Mississippi river. Its favorite food-plant — the box-elder — and the only one on which it has been said to breed, is widely distributed over most of the eastern half of the United States.

Its more specific distribution, given by Sargent, is herewith quoted, as of interest in connection with possible future spread of the insect:

Acer Negundo is one of the most widely distributed, and in some parts of the country one of the commonest trees of the North American forest. It occurs on the banks of the Winooski river and of Lake Champlain in Vermont, on the shores of Cayuga lake in New York, in Eastern Pennsylvania, and ranges to Hernando county in Florida, and northwestward to Dog's Head lake in Winnipeg and along the southern branch of the Saskatchewan to the eastern base of the Rocky Mountains; in the United States it is found as far west as the eastern slopes of the Rocky Mountains in Montana, the Wahsatch Mountains in Utah, Western Texas, New Mexico, and Eastern Arizona, extending south along the mountain ranges of Northeastern Mexico. It is comparatively rare in all the region east of the Appalachian Mountains and is much more common in the basin of the Mississippi, being the most abundant and reaching its greatest size in the valleys of the streams which flow into the lower Ohio river. (*Sargent's Silva of North America*, ii, 1891, p. 112.)

Accepting the popular belief that the insect breeds on the box-elder* and that it is or was originally its preferred food-plant, then we may expect that within a few years, perhaps five, it will have reached in Illinois the region drained by the streams flowing into the lower Ohio river, where the Negundo finds its best conditions for growth and multiplication, soon thereafter to extend over the entire drainage area of the river, computed at 214,000 square miles, and thence gradually over a large portion of the eastern United States.

From the fondness that this insect has recently shown for ripe fruit, and not always waiting for the ripening, it is hoped that eastern fruit-growers may long be spared from the foreshadowed spread of this pernicious fruit pest and its injuries.

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* Mr. A. L. Siler, of Rouch, Utah, in sending examples of the insect to Prof. Riley, in 1885, stated that they were bred on the box-elder shade-trees.

Habits of the Insect.

Prof. Popenoe, of the State Agricultural College of Kansas, has been a close observer of this insect, and was the first writer to call popular attention to it. The account given by him in 1889, in the *Industrialist*, of its habits is apparently so complete that it will be read with interest whenever and wherever the insect displays its gregarious tendency. The article is accompanied by figures illustrating its early stages, and contains recommendations for its destruction, etc., but only the portion relating to its habits is herewith quoted:

The species has been known in this locality for over ten years as a tree pest, appearing at times in great numbers upon the box-elder, and occasionally attacking the ash. During the winter the adults are hidden in sheltered nooks and corners everywhere, but are especially abundant in crevices of stone walls and the angles of stone buildings, on the south sides of which they appear, singly and in clusters, every warm day during the season. As soon as the increasing warmth of spring allows they leave these shelters and seek the trees attacked by them. From the time of their scattering in the spring until the appearance of the first adults after midsummer they are much less conspicuous, and are not likely to be noticed except upon search directly for them. It is at this time, however, that their eggs are laid, and the numerous young are hatching and beginning their work on the trees. After midsummer their gregarious tendency is again manifested in the flocking of the bugs of all sizes and in great numbers in lines up and down the trunks and branches of the trees. Not infrequently they may be seen crowded in a broad line extending from the ground to the secondary branches, the company including larvæ of all sizes, pupæ, and fully matured individuals. This habit persists more or less completely until October and November, or until the trees are bare. During the warm days of Indian summer the bugs fly everywhere, flocking to the warm sides of buildings and entering houses where, though otherwise harmless, they become troublesome through their abundance and through their propensity to fall clumsily into pails of water, crocks of milk and other articles of food left uncovered.

They are principally found, as stated, upon box-elder trees, but observation shows them to be much more general in their selection of food-plants. They feed also on the ash, and I have observed them in abundance sucking the sap from the Ampelopsis clinging to the south side of a stone building. Into the greenhouse many make their way during the autumnal flight, and such are specially fortunate; for they find there not only the desired warm shelter, but abundance of food as well. They are not slow to test the qualities of the juices of the plants growing in the house, and we have seen them with beaks inserted in the stems of geraniums, cactuses, lilies, Coleus, Ageratum and other plants.

Remedies.

Attack from Hemiptera (suctorial insects) are particularly to be dreaded, as they cannot be reached by the arsenites, of which are several of our best insecticides. Kerosene emulsion would probably be the best application that could be employed when the bugs occur on trees. When assembled on the ground in patches or large areas, as reported from North Dakota, kerosene mixed with water by brisk stirring or, better still, unmixed, could be effectively used for their speedy destruction Hot water, when convenient, would be a simple remedy. Any one of these applications would be more effective upon the insect in its early stages, before the development of wings has given a degree of protection.

The Grasshopper Plague in Western New York.

(Ord. ORTHOPTERA: Fam. ACRIDIDÆ.)

The injuries from grasshoppers (locusts) in the State of New York noticed in the brief undistributed report for 1893, which were so severe as to have been characterized as a "grasshopper plague," have been followed by similar injuries in 1894. The following notice of it, given to the *Country Gentleman* of October 12, 1893, and in part included in the report above named, will apply, in the main, to the visitation of the present year.

The Rocky Mountain Locust.

It is fortunate for the agricultural interests of the Eastern United States that it is exempt from the ravages of the destructive grasshopper of the West, *Melanoplus spretus*, or the "Rocky Mountain locust," as it is familiarly called, which in years gone by brought fearful losses, suffering, starvation, and death to many families and communities in Kansas, Nebraska, and Iowa. In these three States, with Missouri added, the loss to crops in the year 1874 was estimated at one hundred millions of dollars. It is probable that severe injuries by this particular species will never occur east of the Mississippi river. Its permanent breeding grounds lie far to the westward; and, as in its most extended migrations it has not crossed the Mississippi, there is no fear that it will do so hereafter, now that, thanks to the labors of the United States Entomological Commission, its eastward migrations and its ravages have been virtually brought under control.

In the eastern portion of the United States -- of the more than one hundred species of locust (commonly called grasshoppers) that are known to science, there are, strictly speaking, no migratory ones. The reason of this is obvious; there are no arid regions of elevated, treeless plains within this limit, of the character of the breeding grounds of the *M. spretus*, the sparse vegetation of which compels the immense broods to take flight as soon as winged, often for hundreds of miles into adjoining States in search of food.

Destructive Locusts of the Eastern United States.

Our two most common species are the *Melanoplus femur-rubrum* (DeGeer) and *Melanoplus atlanis* (Riley) — each having a wide range, extending from Florida into British America and occurring on the Pacific coast. Of the two, the former, known to many under the common name of the "red-legged grasshopper"— is the more frequently met with while feeding in our pastures and meadows; the latter, *M. atlanis*, which has been designated by Dr. Riley as "the lesser migratory locust," is, at times and in localities, the more destructive, for, as indicated in its popular name, when so abundant as to have devoured everything edible, it takes wing and flies for miles to new feeding-grounds. It has been particularly abundant and destructive in the New England States. Dr. Harris, in his Treatise on the Insects of New England, records of what was undoubtedly this species: "At times, particularly before their final disappearance, they collect in clouds, rise high in the atmosphere, and take extensive flights. I was authentically informed that some persons employed in raising the steeple of the church at Williamstown were, while standing near the vane, covered by them, and saw, at the same time, vast swarms of them flying over their heads." In Williamson's History of Maine, quoted by Dr. Harris, it is stated: "In 1743 and 1756 they covered the whole country, and threatened to devour everything green. Indeed, so great was the alarm they occasioned among the people that days of fasting and prayer were appointed."

In recent times they have committed great ravages in the Merrimac valley in New Hampshire, during the years 1872–1885, and again in 1889, when sixty bushels of the grasshoppers were collected and destroyed from one oat field of three and a half acres, under the stimulus of a State bounty of $1 per bushel. In collecting them, the sheet-iron coal-oil pan, known as the "hopperdozer," employed in the Western States against the Rocky Mountain locust, was used.

So serious were the losses sustained that the farmers of the Merrimac valley made application to the United States Department of Agriculture at Washington for such aid as might bring them relief. Dr. Riley was commissioned to make examination, and ascertain what could be done in practically dealing with the pest. His report was published in the Annual Report of the Department for the year 1883 (pp. 170–180, pl. 2), and as it contains a full discussion of the history, characters, range and life-history, natural enemies of, and remedies (5 pp.) for, the species, it will amply repay perusal, especially by those who may hereafter be called to contend with this voracious insect.

Our Two Most Injurious Species.

Melanoplus femur-rubrum, the red-legged grasshopper, although not known ever to become migratory, from its being the more abundant of the two, is probably chargeable with a greater aggregate amount of injury to gardens, fruit-trees, and crops than the *M. atlanis.* Both of these species belong to the same genus with the Rocky Mountain locust, and resemble it closely in life-history and habits. The three are so much alike in appearance that a close inspection by an ordinary observer would only show that *M. spretus* of the West is the better

FIG. 18 — The Rocky Mountain Locust, M. SPRETUS.

fitted for long flight by its considerably longer wings. *M. atlanis* was confounded with *M. femur-rubrum* until within less than twenty years

FIG. 19 — The Red-Legged Locust, M. FEMUR-RUBRUM.

ago; it is hardly separable except by comparison of the last segment of the abdomen. Until lately, and up to the present by some writers, the above three species and their associates have had place in the genus *Caloptenus.*

Operations in New York.

The present year (1894) has been a favorable one for grasshopper multiplication, from the dry weather that has prevailed over a large extent of the country — in one locality in Illinois "not a drop of rain having fallen in three months."

It is very unusual that occasion arises for complaints of grasshopper injuries to crops in the State of New York, but this year, in its western counties, they have, for the first time in several years, proved to be a veritable plague. About the middle of July, even while *M. femur-rubrum* was yet in its wingless larval stage, their abundance, and damage caused by them, began to arouse apprehension and alarm. From that time up to the last of August their destructiveness continued to increase, until certain crops were entirely ruined, and of others only a small portion escaped. Fortunately, after a heavy rainfall on the 28th and 29th of August, amounting to over five inches* in some localities, a material diminution in their number was observed.

They appear to have been particularly injurious in the more western counties. Mr. J. A. McCullom, of Niagara county, writing toward the latter part of August, states that most of the crops have been destroyed entirely by the ravenous insects or so damaged as to be worthless. From Erie county it is reported: "Grasshoppers have settled down on this section of Western New York and eaten every green thing in sight. The loss will be very large. Acres on acres which a short time ago were fresh and green with ripening crops are now barren wastes of leafless stalks and branches. At first but little attention was paid to the flying and hopping pests, but as they increased in number hourly, the farmers became alarmed and steps were taken to drive them away. A strong mixture of salt and water was used, but had little effect."

In Chautauqua county fields of oats were stripped of their grain early in August and "garden truck" wholly destroyed, while in Cattaraugus and Allegany counties they were very numerous at the same time. In Wyoming county, after consuming the corn, they began to eat the leaves of the fruit-trees. In Genesee county they were reported as "eating every green thing." In Orleans county "they had never been seen in such numbers before."

Along the southern range of counties they were quite destructive in Steuben (many oat crops were cut prematurely for fodder in order to save it), in Chemung and Tioga. In Central New York they inflicted much damage in Madison county and northeasterly toward the lake shore in Oswego county, where, among others, the cabbage crop suffered severely. In the northern part of the State, as in Franklin county, they were less destructive, but pastures and meadows were reported as suffering from them. Even in the Adirondack Mountains of Essex county they were observed by me in July and August in far greater abundance than I had ever before known them to occur in that region. In walking through the meadows hundreds were continually

* At the stations of the N. Y. State Weather Bureau at Sacketts Harbor and at Watertown in Jefferson county, the rainfall at this time was 5.25 inches and 5.51 inches.

being driven up before me, but no complaint was made of injuries sustained, although they must have been of considerable importance.

Species Chargeable with the Injuries.

As usual in the State of New York a large proportion of the injury committed on the crops this season is chargeable to *M. femur-rubrum* and *M. atlanis*, but in their destructive work they had nearly a score of active assistants in other members of their family, which were also unusually abundant, among which were *Melanoplus femoratus, Circotettix verruculosa, Camnula pellucida, Dissosteira carolina* and *Chimarocephala viridifasciata.*

The Present Condition.

With the crops of the year for the most part harvested, comparatively little is being reported at the present of grasshopper injuries; but as the creatures are still existing in force and will continue until the coming of heavy frosts, much apprehension is being entertained that in the absence of other as desirable food they will turn their attention to the winter grain and entirely destroy it. There is reason for this fear and in all probability it will be a consideration with farmers, where the insects still abound, in their usual fall sowing of rye and wheat.

Will the Insects Abound the Coming Year?

This question, of deep interest to many, cannot be definitely answered. When the *M. atlanis* apparently became domiciled in the Merrimac valley in 1872, it continued to ravage the region for several successive years, as before stated, but this may not be accepted as the rule. Annual recurrences of a grasshopper scourge — as with that of the chinch-bug in Illinois and other of the Western States — is dependent largely on seasonal conditions, particularly the occurrence of drouths, on the number of its parasites and predaceous enemies, and on fungus attacks. Each female of *M. femur-rubrum* and *M. atlanis* that survives in a healthful condition until their lives are ended by the frosts of October, will have deposited in the soil about one hundred eggs. Quite a large proportion of these eggs will doubtless be destroyed during the winter or before the time for their hatching in the coming month of May. Those that hatch will be exposed to many enemies and dangers — perhaps so many and potent that any unusual abundance will be prevented. It can only be said, from present knowledge, that in the event of severe drouths again prevailing during the coming summer, the ravages of this year will probably be repeated, and more disastrously, unless measures shall be taken for their prevention.

To Prevent the Ravages.

The investigations of the Rocky Mountain locust, by the commissioners appointed by Congress to study its life-history and methods for its control, have given us several means by which the injuries of any of our locusts, when occurring abundantly, may be greatly reduced.

1. *Destruction of the eggs.*— The eggs are deposited in masses of about one hundred, cemented in a "pod," in holes bored by the female, at a depth of about an inch in the ground. Experiment has shown that most of these will be destroyed by harrowing the ground to a moderate depth in the autumn, or in mild winter weather. Rather bare places along roadsides, and even in roadways, seem to be preferred for oviposition.

2. *Plowing under.*— Plowing the infested land in the spring, as the grasshoppers are about hatching, to a depth of from four to six inches, and following this with rolling, has proved a very satisfactory method of killing the young hoppers and those about ready to emerge.

3. *The use of the hopperdozer.*—Whenever the young insects appear in sufficient numbers to warrant it, the "hopperdozer" — a long sheet-iron pan containing tar or kerosene for catching and killing them, as it is drawn over the field — may be effectually used. For its construction and manner of use in the Western States, and in the Merrimac valley of New Hampshire, see the Annual Reports of the U. S. Department of Agriculture.

4. *The bran-mash poison.*—When the above methods have not accomplished their purpose, or all active measures have been neglected until the insects have become winged, the poisoned bait may be resorted to, with every prospect, if we may judge from the testimony borne, of its successful working. The bran-mash recommended by Mr. Coquillett, after its use on the devastating locusts in San Joaquin valley, California, may be made in the following manner: To a washtub or half-barrel about three-fourths full of dry bran, add about five pounds of arsenic and mix thoroughly with a spade or shovel. Dissolve five pounds of sugar in a pail of water, pour it on the bran and arsenic, and stir thoroughly, adding more water until the mash is entirely saturated.

The mash may be distributed in spoonfuls throughout the field, in such quantity as is eaten by the grasshoppers. Mr. Coquillett used a teaspoonful for each tree, shrub, grapevine, or plant infested, at a cost of less than 50 cents for each acre of orchard or vineyard, and as a result, hardly a living locust could be found a day or two thereafter, while the ground was literally covered with their dead bodies.

To those who have been sufferers from the locusts in New York this year — in the event of a prospect of a recurrence of the visitation another season — it would be well if they write to the Department of Agriculture at Washington, asking to be furnished, if possible, with Bulletin 25 of the Division of Entomology, entitled, "Destructive Locusts," by C. V. Riley, Ph. D. Its more complete title is: "A Popular Consideration of a Few of the More Injurious Locusts (or 'Grasshoppers') of the United States, together with the Best Means of Destroying Them." Several of the facts embodied in the above communication have been taken from this publication.

Julus cæruleocinctus Wood.

With Associated Potato-Scab.

(Class Myriopoda: Ord. Chilognatha: Fam. Julidæ.)

From being nearly allied to insects and at times similarly destructive to important crops, the millepeds, or "thousand-legged worms," and their operations are frequently brought to the notice of the entomologist.

Boring into Potato Stems.

Mr. D. J. Garth, of Scarsdale, Westchester county, N. Y., has sent a potato plant dug on June 3d, in which most of the stems had been eaten by *Julus cæruleocinctus* from the surface of the ground downward six inches to the seed tuber, burrowing into which were a number of this milleped.

Fig. 20. — Thousand-legged worm, Julus cæruleocinctus Wood.

A similar attack is published in the *Rural New Yorker* for June 22, 1889 (page 416), where the stems were found fallen over and either dead, wilted, or wilting. Investigation showed that a thousand legged worm was the cause. "In some instances the vine was girdled; in others from one to four of these milleps were found eating into the stems; in others they had bored into and up the stem. The vines at length rot about the infested part or become so weakened that they fall over and die. They are attacked always just beneath the soil or from one inch to an inch and a half below. It is learned that potato vines in certain parts of Monmouth county, N. J., are similarly affected."

In all probability the above was also the work of *Julus cæruleocinctus*, the most common species in the State of New York.

Infesting Scabby Potatoes.

Mr. Garth has also sent at another time some "scabby" potatoes, containing in cavities several of the same *Julus*. The potatoes had been grown in an orchard about ten years old, which had been in grass for several years and was broken up the preceding year. The soil was good and in lieu of barnyard manure, ground bone and muriate of potash was used for fertilizing. Mr. Garth desired to know the name of the worms and if injurious to crops, how they could be destroyed; and also the cause of the scab.

A Common Pest of Potatoes.

In reply the name was given with the statement that it was a well-known potato pest, frequently found occupying and feeding in cavities of potatoes, as in those received. My "third report" (*Report to the Regents of the University for the Year* 1886) contains a four-page notice of it, in which some serious attacks are recorded, as in one instance where fully one-half of a potato crop in Cooperstown, N. Y., was destroyed. In other of my reports it is charged with eating the interior of corn lying on the ground, roots of geraniums, of cabbage, stems of lilies, etc. As it often occurs in association with scabby potatoes, it has commonly been thought to be one of the causes of the scab, others being other species of millepeds, wire-worms, earth-worms, grubs and mites. The truth, however, is that the diseased potatoes merely offer an attractive feeding-ground to the various forms above named.

Potato Scab Caused by a Fungus.

Dr. Roland Thaxter, in his reports as mycologist to the Connecticut Agricultural Station, has, it is thought, shown beyond all question that the "scab" observed by him and prevalent in this portion of the United States is caused by the attack of a fungus, which he has described and named as *Oospora scabies*.*

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* *Report of the Connecticut Agricultural Experiment Station* for 1891–1892, p. 159.

One Form of the Scab may be Caused by Bacteria.

It was believed a few years ago that Prof. Bolley, now of the North Dakota Agricultural Experiment Station, had demonstrated that at least one form of potato scab was produced by bacteria, but later studies favor the idea that the bacteria observed merely accompanied the fungus disease, and that it rarely, if ever, becomes parasitic under mature conditions.

A Potato Scab Caused by Fungus Gnats.

Quite recently the studies of Prof. A. D. Hopkins, Entomologist of the West Virginia Experiment Station, on the connection of species of *Sciara* (small flies) with scabby potatoes and the potato rot, have resulted in his showing that one form of scab may be caused by species of these flies, commonly known as "fungus gnats." He concludes a paper* on the subject read before the Entomological Society of Washington in these words:

While I admit that one or more forms of the so-called potato scab may be due to the action of fungi and that the true potato rot is a fungous disease, I am confident that there are forms heretofore recognized as scab and rot which are not due to fungous disease, but are the direct result of the attack of insects belonging to the family *Mycetophilidæ* and to the genera *Sciara* and *Epidapus*.

The species that he found especially instrumental in producing the potato scab blemish was a new and interesting, *Epidapus* which he has described, named and figured as *Epidapus scabies*. The fly is so minute, being only from 1 to 2 mm. in length, that it would escape observation in ordinary examination of potatoes affected with the scab.

How to Prevent Potato Scab.

Replying to the important inquiry of how to prevent the scab, Dr. Thaxter, while not able from the results of his experiments to indicate any remedy for it, has named the following as preventive measures: 1. The seed must be free from scab. 2. Land where scab has prevailed must not be planted to potatoes. 3. Scabby potatoes should not be fed to live stock unless they have been first thoroughly cooked. 4. Use any other fertilizer in preference to barnyard manure. 5. If a crop is found to be infested with scab, dig it as soon as possible in order to stay its increase.

The following treatment, it is claimed, will almost insure a crop against the scab, if planted in soil not already infested. It is known

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* *Notes on the Habits of Certain Mycetophilids, with Descriptions of Epidapus scabies* sp. nov.

as "the corrosive sublimate treatment" and was proposed by Prof. Bolley, in 1891, in *Bulletin No.* 4 *of the North Dakota Agricultural Experiment Station*, on "Potato Scab and Possibilities of Prevention." The directions are: Dissolve two ounces of finely pulverized corrosive sublimate in two gallons of hot water and let it stand over night or until all dissolved. Pour it into a barrel containing thirteen gallons of water and allow it to stand for four or five hours, stirring it several times thoroughly. Selecting as fair seed potatoes as possible, wash all the dirt from them and immerse as many as you can in the solution for one hour and a half. Pour off the solution, which may be used several times if needed. After the potatoes are dry, cut and plant as usual, or they may be cut before the treatment if preferred. The corrosive sublimate is a strong *poison* and should be used with care. The solution named is the same as used in surgery and will not injure unless taken into the stomach.

Remedies for Thousand-Legged Worms.

The injuries of the *Julidæ* have long been known and borne without the discovery of any simple remedy or preventive. Where they are very abundant the ground might be treated in the autumn with a liberal coating of gas-lime if obtainable. Salt freely applied broadcast or dropped over each hill after planting should make the tuber or the stalk distasteful to the worm, as it does the roots of young corn to the white grub. Application of soot and water has been recommended by English writers, but it would be difficult to procure it in sufficient quantity for use in large fields. Dr. Smith, Entomologist of New Jersey, has had excellent results in treating infested crops with potash and with kainit. Of the latter he states: "Where potato ground is infested with wire-worm (*Julus*), a heavy dressing with kainit will bring relief;" and of potash — "it is effective against * * * the wire-worms (*Julus*) on potatoes."* Although the quotations leave us in doubt whether wire-worms or *Julidæ* were experimented with, the applications should be equally successful with either, as their habits are much alike. Kainit was found to be the more valuable as an insecticide, especially against wire-worms.

In a communication on "The Thousand-legged Worm," by Dr. Fitch, to the *Country Gentleman* of July 14, 1859, p. 27, it is stated that thousands of a species of *Julus* (not determined) had been destroyed by hot water after they had been drawn to shelter beneath boards laid on the walks in the evening. The boards might prove more effective

* *Annual Report New Jersey Agricultural Station* for the Year 1890, 1891, page 436.

if slices of potatoes or of other vegetables of which they are known to be fond, were placed beneath them to serve as baits.

Curtis in his *Farm Insects*, page 207, among other remedies, recommends strewing old cabbage leaves over a field, in the same way as when slugs are troublesome, and employing children to turn them over and collect the millepeds secreted beneath.

Miss Ormerod states that a species of *Julus*, *J. guttatus*, has a special fondness for mangolds, and where slices had been placed for bait, she had seen them swarming, when removed, with the millepeds crawling over them in all directions. Cotton-cake had also been found to attract them from special crops. "A strong solution of common salt or of nitrate of soda rapidly killed the spotted millepede."

Mites Attacking Mushrooms.

(Class Arachnida: Ord. Acarina: Fam. ?Trombididæ.)

A mushroom-grower, writing from Newburgh, N. Y., who has three thousand square feet of mushroom beds in cellars, asks for a remedy for "the millions of small, reddish crawling lice which attack each 'pin head' as soon as it shows through the soil."

Prolificacy of Mites.

No examples were sent, but with hardly a doubt the little reddish creatures were mites, belonging to the Order of *Acarina*, as no other living forms (unless *Anguillulidæ*) would occur "in millions" in connection with mushrooms, except the minute and rapidly multiplying acarids. Thus, in an instance recorded by Murray — in a barn on the Imperial farm at Vincennes, where Australian potatoes had been stored, such an immense number of mites had been developed in less than eight days that the soil of the ground was completely covered with a bed of the *Tyroglyphus*, looking like an animated dust, of a gray color, and composed of myriads of millions of these little animals.

An European Mushroom Mite.

It would be of interest to know the particular species that has attacked the pin-head mushrooms of the above inquiry, as it might aid in prescribing the proper remedy. In Europe, *Rhizoglyphus rostroserratus* is very destructive to the cultivated mushrooms, particularly to the common *Agaricus campestris* grown in the vicinity of Paris, but this is described as of a feeble, gray, rusty color; it produces, or is associated with, a moist black rot, which in less than forty-eight hours reduces the mushrooms to a state of black and deliquescent putrescence.

Probably Bryobia pratensis.

It is not improbable that the mites of the Newburg cellar may be the *Bryobia pratensis*, known sometimes as "the clover-mite" from its being often found upon that plant, although frequently met with on other vegetation. It is a common species in the State of New York and many of the other States, and reports are received, from time to time, of its occurrence in dwelling-houses, in conservatories, in roadways and elsewhere. (See account and illustration in the sixth and seventh reports of this series.)

Remedies for Mites.

The best remedy that we have for mites is sulphur. An application, by means of a powder-bellows, of the flour of sulphur over the mushroom bed when the "pin-heads" make their appearance, ought not to interfere with their edibility. The experiment might also be made of sublimating sulphur by placing it on the steam pipes, or by burning brimstone. The last-named method has been made very convenient for use under almost any conditions, in the sulphur candles of about a pound weight each, which have lately been put in market for disinfectant purposes, and may be purchased in most drug stores. It is possible, too, that the vapor of bisulphide of carbon might be employed for killing the mites. A small quantity — an ounce or two of the liquid — may be placed in an open vessel near the ceiling so that the vapor in descending might diffuse itself over the ground area. The cellar should be closed, and no lamp or light or fire of any kind brought in which might ignite the inflammable vapor.

Caution in Use of Insecticides.

It would be well, before using either the sulphur or the bisulphide of carbon as above suggested, to consult Mr. William Falconer, of Glen Cove, L. I., who is intimately acquainted with mushroom culture in all its phases and an authority on the subject, and his opinion asked as to the possibility of injury to the mushrooms, either in their development or for the table, from the use of the substances named. If it shall be found that they may safely be used, we will have in them convenient and effective methods of ridding mushroom beds not only of mites, but of the larvæ of a small fly and other insect forms that are frequently so detrimental to mushroom culture as to arrest it completely at certain seasons.

Mites Infesting Potatoes.

(Ord. ACARINA: Fams. ACARIDÆ, GAMASIDÆ.)

Some "scabby" potatoes received from Westchester county, N. Y., had large cavities eaten into them, which were nearly filled with "thousand-legged worms," *Julus cœruleocinctus*. Associated with them were hundreds of mites occupying, and apparently feeding in, the cavities excavated by the millepeds. Examples of the mites were sent to Prof. H. Osborn, of the Iowa Agricultural College, who is studying these creatures, for his identification. He returned answer as follows:

Food-habits of Rhizoglyphus.

"The specimens I take to be a species of *Rhizoglyphus*, near or identical with the *R.* (*Tyroglyphus*) *phylloxeræ* of Planchon and Riley, the habits of which were recorded as very similar to this — feeding upon the vegetable tissues of the roots infested with *Phylloxeræ*.

"I have seen examples apparently identical with this, in large numbers, in various vegetables and roots that were injured by insects or in a partial state of decay, and I surmise that they feed mainly, if not entirely, on decaying vegetable matter, although Riley reported them as, when full-grown, preying upon the *Phylloxeræ*" (*Sixth Report on the Insects of Missouri*, 1874, p. 53).

Associated with Potato Scab.

This mite is identical in appearance with a species of which a photograph was sent me a few years ago by a correspondent in Eastern New York, who claimed, and was very confident, that he had made the discovery that it was the cause of the "potato scab." From this it may be inferred that it is not infrequently an attendant on the scab disease.

Other Mites in Potatoes.

In *Third Report on Insects of New York* I have recorded the appearance of two species of mites in cavities of potatoes associated with *Julus cœruleocinctus*, one of which was *Uropoda Americana* Riley — an occasional parasite of *Julus*, and the other a vegetarian, apparently undescribed, and for which, if it proved to be new, I proposed the name of *Gamasus obovatus*.*

* *Third Report on the Insects of New York* — "Report to the Regents for the Year 1886," 1887, pp. 133, 134.

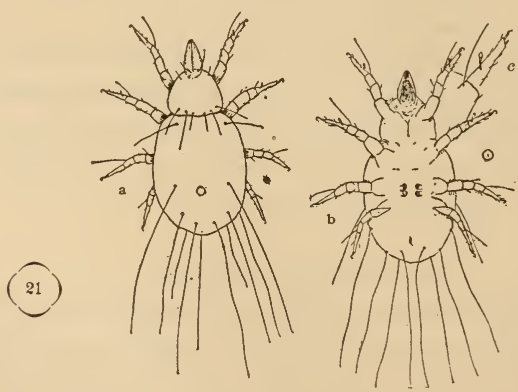
Tyroglyphus Lintneri Osborn.

A Mushroom-Infesting Mite.

(Ord. ACARINA: Fam. ACARIDÆ.)

In December, 1892, some mushrooms were sent to me from Jamesport, Suffolk county, Long Island, suffering from an attack of mites. The mites abounded in blackened cavities in both the pileus and stalk. They were white, shining, and long-haired, and were apparently an undescribed species of *Rhizoglyphus.* When submitted to Prof. Herbert Osborn for examination, he found the mite to approach nearly to *Tyroglyphus phylloxeræ* Riley, but to differ from it in several structural details, and has described it under the name of *Tyroglyphus Lintneri,* in *Science,* xxii, 1893, p. 360, with figures. For convenience of reference, the description and figures and accompanying remarks are herewith given:

Some time ago I received from Prof. J. A. Lintner specimens of a mite which had been found infesting mushrooms quite seriously, and from its habits and the statements concerning its numbers, it is likely to prove a very important pest of this crop. From the literature which is available, it does not appear to be described, and is certainly different from the species described as infesting mushrooms in Europe. It approaches more nearly to the *Tyroglyphus phylloxeræ* of Riley, but is quite different in many structural details. Since it is likely to prove of importance, it seems desirable to describe it, even though it may possibly prove identical with some of the described European forms.



Tyroglyphus Lintneri n. sp. *a,* dorsal view; *b,* ventral view; *c,* tarsus more enlarged—length shown in circle to right. (From nature, by H. Osborn.)

Description.

Tyroglyphus Lintneri n. sp. The mandibles are large, chelate, strongly toothed, the palpi terminating with a strong hook. The tarsi hooked with no sucker visible, the last segment long, slender, spiny at tip and on the two anterior pairs bearing a clavate appendage. The hairs are very long, those on the posterior part of the body equal to or greater than the length of the body, and their origin marked by chitinous rings, six located on the posterior portion of the anterior division of the body and standing quite erect, ten on the posterior portion, two at anterior angles, two behind the middle, and others near the margin on the posterior third of the body; abdominal suckers, four, located between the abdominal legs.

This species differs from *T. phylloxeræ* Riley, particularly in the greater length of the tarsal joints, greater curvature of tarsal claw, and the much greater length of the hairs — those at the end of the abdomen being as long or longer than the body, while those of *phylloxeræ*, Riley describes as about one-third the diameter of the body. It is also larger than specimens I have determined as *phylloxeræ*, and the second pair of legs is further back on the body than shown in Riley's figure.

Prof. Osborn found the above species different from the *Tyroglyphus* which I had sent to him occurring in cavities in potatoes (see page 451).

Phytoptus pyri (Scheuten).

Pear-Leaf Blister-Mite.

(Class Arachnida: Ord. Acarina: Fam. Phytoptidæ.)

Scheuten: in Wiegman's Archiv., 1857, p. 104 (original description as *Typhlodromus pyri*).

Packard: Guide Study Ins., 1869, p. 666 (brief notice, as *T. pyri*).

Glover: in Rept. Comm. Agricul. for 1872, 1874, p. 113, fig. 2 (brief notice, as *T. pyri*).

Murray: Econom. Entomol.— Aptera [1877], p. 358 (brief account).

Burrill: in Gard. Monthly and Horticul., xxii, January, 1880 (general account).

Riley: in Am. Ent., iii, 1880, p. 26 (review of Burrill's account), p. 74 (reference to Glover's account, as *T. pyri*).

Garman: in Rept. Ins. Ill., xii, 1883, pp. 125, 134, 140, figs. 24, 25 (Burrill quoted).

Osborn: Bull. no. 2 Iowa Agr. Coll., 1884, p. 56 (brief account).

Crawford: Rept. on Fusicladiums, etc., in Australia, 1886, p. 46 (general account).

Osborn-Underwood: in Canad. Entomol., xviii, 1886, p. 12 (listed).

Gillette: in Rept. Mich. Hort. Soc. for 1886, 1887, p. 87 (mention).

Webster: in Insect Life, i, 1889, p. 363 (mention); in id., v, 1892, p. 105 (abundant in Ohio); the same, in 23d Ann. Rept. Ent. Soc. Ont., 1892, p. 40; also in Canad. Entomol., xxiv, 1892, p. 207.

COMSTOCK-SLINGERLAND: Bull. 23 Cornell Agr. Expt. Stat., 1890, pp. 103-107, figs. 1-4 (detailed account).

LINTNER: in Count. Gent., lv, Oct., 1890, p. 781 (general account); 7th Rept. Ins. N. Y. for 1890, 1891, p. 365 (summary of preceding account); in Insect Life, v, 1892, p. 105 (abundance in Eastern N. Y.); the same, in 23d Ann. Rept. Ent. Soc. Ont., 1892, p. 40; also in Canad. Entomol., xxiv, 1892, p. 207; in Count. Gent., lvii, 1892, p. 504 (remedies); 9th Rept. Ins. N. Y. for 1892, 1893, p. 442 (reference to Count. Gent.); in Count. Gent., lix, 1894, p. 468 (general account).

FRENCH: Destr. Insects Victoria, 1891, Part 1, p. 119 (general account, col. plate).

RILEY-HOWARD: in Insect Life, iii, 1891, p. 308 (reference); in do., v, 1892, p. 1 (reference); in do., vii, 1894, p. 278 (on Pacific Coast).

WEED: Insects and Insecticides, 1891, p. 68 (general account).

FLETCHER: in Exper. Farms Repts. for 1891, 1892, pp. 198-200, figs. 5, 6 (general account); in 24th Ann. Rept. Fruit-Growers Assoc. of Ont. for 1892, 1893, p. 113; in Ann. Rept. for 1892, p. 146 (mention).

COBB: in Agr. Gazette N. So. Wales, iii, 1892, pp. 287, 288, fig. 11 (general notice).

SLINGERLAND: in Insect Life, v, 1892, p. 104 (general account); same in brief in 23d Ann. Rept. Ent. Soc. Ont., 1892, p. 40; also in Can. Ent., xxiv, 1892, p. 207; in Count. Gent., lvii, 1892, p. 629, c. 2 (remedy); in Bull. 61 Cornell Agricul. Expt. Stat., Dec., 1893, pp. 317-328, figs. 1-5; the same in 6th Ann. Rept. id. for 1893, 1894, pp. 321-330, fig. 1-4 (life-history, remedy, bibliography, etc.); in Canad. Entomol., xxvii, 1895, p. 330, in foot-note (Nalepa writes *Phytoptus pyri* n. sp.).

SMITH: in Insect Life, v, 1892, p. 105 (remedies); the same in 23d Ann. Rept. Ent. Soc. Ont., 1892, p. 40; also in Canad. Entomol., xxiv, 1892, p. 207).

MCCARTHY: Bull. 92 N. Car. Agr. Expt. Stat., 1893, p. 99 (brief notice).

BETHUNE: in 23d Ann. Rept. Ent. Soc. Ont. for 1892, 1893, p. 9 (spread in Ontario and Maritime provinces).

ORMEROD: 17th Rept. Inj. Ins. for 1893, 1894, pp. 84-88 (general account); 18th Rept. id. for 1894, 1895, pp. 86-92 (general account).

ALDRICH: in Insect Life, vii, 1894 p. 202 (in Idaho).

WASHBURN: in Bull. 33 Oregon Agr. Expt. Stat., 1894, pp. 9-12, 2 figures (attack and remedies).

COMSTOCKS: Man. Stud. Insects, 1895, pp. 44-45, figs. 52-54 (mite and galls illustrated).

The injury caused to the leaves of pear-trees by this mite has long been known to fruit-growers in this country, but its true cause was not understood, until detected by Prof. Burrill, and, in 1882, recognized as identical with the *Phytoptus pyri* of Europe. The nature of the attack had been known for a number of years earlier, in Europe.

The mite as occupant of the galls had been seen by Dr. Thomas Taylor, microscopist of the U. S. Department of Agriculture, in 1872, as appears from Glover's Report for that year, in which he states:

"In May, many leaves of the pear-tree were observed to be covered by dark-brown blotches somewhat like a fungoid growth, but upon examination by Mr. Taylor, microscopist of the department, these blotches were found to be inhabited by myriads of small mites almost invisible to the naked eye. These mites appear to run all over the leaves, but especially to burrow in the brown patches, which appear to be entirely eaten out by them. Their bodies are long, cylindrical, yellowish-white, with only two pairs of legs placed very far forward toward the head, and they move with considerable agility. They are also marked with a multitude of rings, and have two long hairs or bristles and two shorter ones on the end of the abdomen."

A figure of the mite accompanies the above, and comparison is made with the *Typhlodromus pyri* Scheuten, figured by Dr. Packard on plate 10 of his Guide.

Nature of the Attack.

In the early spring, as the buds are unfolding, the leaves may be seen to be studded with small red spots or blotches which, on close examination, show themselves on each side, but more conspicuously on the upper, as slightly thickened areas of the leaf. They soon present a fuzzy appearance when seen under a lens, resembling a particular form of fungus, for which they had been for many years mistaken, it not being then known that they were galls produced by a mite. On the under side of the leaf, a small opening may be seen in each gall through which the mites emerge at their maturity. The galls, at first red, or red on one side and green on the other, soon change to blackish or brown upon the destruction of the cells and tissues of the affected spot. If a section is made of a gall, the two surfaces are seen to be separated by a cavity of disorganized tissue. When the attack is severe, and the galls numerous, they coalesce into patches of various sizes until they cover large areas of the leaf, when the normal action being arrested, the leaf dies and falls to the ground.

The attack at its commencement is usually slight, but under ordinary conditions it spreads rapidly and proves quite injurious if allowed to continue through the season and for successive years. It seems to be extending from orchard to orchard, and is becoming quite widely distributed, not only in New York but throughout the States generally.

How the Attack may be Recognized.

The attack can be recognized by comparison with the features given above and in other publications on it. Its identification must usually depend upon the characters shown in the galls or blisters. The mite producing them, even when traveling on the surface of the leaf, is invisible to the naked eye, and can only be seen with the aid of a high magnifying power. Using an achromatic triplet, when some infested leaves sent to me were carefully examined, three or four of the four-legged, long, white mites could be distinctly seen moving rather rapidly over the surface.

Is the Kieffer Pear Particularly Liable to Attack.

A gentleman writing to the *Country Gentleman* from Haddonfield, N. J., in 1894, makes the following statement:

Enclosed are leaves from Kieffer pear-trees planted in the spring of 1893, and two years old when planted. The trees are vigorous and green, but some of the leaves are shriveled and marked in blotches of a reddish brown, as the inclosed show. Other leaves on the same branch are healthy. Will you inform me what the trouble is, and how to remedy it? I have two thousand trees of this age and, as far as I can see, the Kieffers are the only ones affected.

Another gentleman, writing from Charlotte, N. C, sends leaves of four-year-old LeConte pear-trees which show a severe attack of the blister galls.

Another correspondent, from Carlton, N. Y., has written: "Find inclosed Bartlett pear twigs and leaves. Can you inform me what the disease is and what causes it, and if there is a remedy for it? There is a dwarf Duchess planted by the side of the Bartlett that does not seem to be affected with this mildew or rust, or whatever it is."

It will probably be found that the mite will attack all or most of the varieties of pear without special preference, such as the pear-midge has shown for the Lawrence pear.

Its infestation of a single tree in an orchard may be the result of its having been accidentally carried to it by the wind or upon a bird or insect, as the San José Scale insect is known to be conveyed. Should the mites fall to the ground with the leaves, they would not probably survive the winter; and it is hardly possible that they would travel from one tree to another unless by contact of interlocking branches.

Characters of the Phytoptidæ.

The *Phytoptidæ*, the family to which the pear-leaf blister-mite belongs, are popularly known as gall-mites from the deformities that they occasion on the leaves of the plants that they infest. Not all, however, produce galls, some of them living within the buds and arresting their development, while others occasion a singular growth of curled or twisted hairs on the under side of the leaves in which they live. The galls that they produce are of various forms and sizes, but they frequently appear as rounded swellings or pouches on the upper surface of the leaf, with a slit-like opening below, through which the mites may pass in and out. They are to be found upon several of our trees and shrubs and plants, as the maple, ash, the elms, oaks, linden, willows, pear, grapevine, arbor vitæ, verbena, etc.

The artificers and occupants of these galls are very peculiar creatures. They are exceedingly minute — most of them disclosing hardly any form to the naked eye. Some of them are "so small and transparent (as the *Phytoptus* of the ash), that it cannot be seen in the gall at all, and it is only by washing out the galls and searching for them in the water in which they have been washed that it can be known that there have been living creatures there." Under the microscope they show extraordinary structure. Mites, as a rule, possess four pairs of legs, while these have but two pairs, and for this reason they were for a long time regarded as the undeveloped larvæ of other species of *Acarina*. Their legs are five-jointed, and terminate in a single curved claw and an associated feathered organ. They have a tubular rostrum and a pair of feeble maxillæ, enabling them to feed both by biting and suction; their cylindrical, long, transversely multi-ringed abdomen ends in a sucker capable of being extended and withdrawn.

The *Phytoptidæ* have recently been separated into subfamilies by Dr. Alfred Nalepa, of the Royal and Imperial College, Vienna, as published in the Reports of the Proceedings of the Imperial Academy of Science, of Vienna. His writings have not been seen by me, but quoting from Miss Ormerod's 17th Report, 1894, the main distinctions on which divisions are based, are "on such points as the body being cylindrical, as is generally the case with the genus *Phytoptus*, or the abdomen being the largest immediately behind the thoracic shield, or other variations of form; also on the abdomen being similarly ringed throughout, or the rings broader on the back and narrower below, or other variations."

The Pear Phytoptus — P. pyri.

Through the kind permission of Dr. Nalepa, one of the excellent figures with which he has illustrated the mite and its operations, is herewith reproduced.

The fruit-grower will need no further detail of the appearance of the mite to serve for its recognition, than has already been given. The

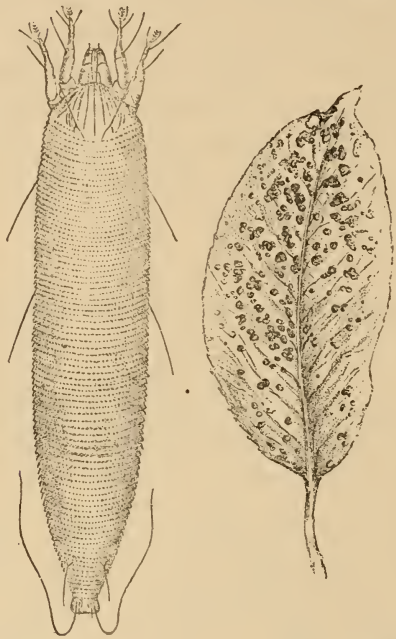


FIG. 22.—The pear-tree blister-mite, PHYTOPTUS PYRI, largely magnified; and a leaf showing the blister galls, natural size.

entomological student, in the absence of Dr. Nalepa's paper, may be glad to have the following abridgment of Dr. Nalepa's description, as given by Miss Ormerod, in her 17th Report:

Body cylindrical, 0.2 mm. long, about 5–6 times as long as broad. Thoracic shield very small, semicircular. * * * The proboscis is strong, slightly curved, directed forward, and 0.025 mm. long. The legs are rather weak and short. The holding-claw ("haftklaue") is very small, exceedingly slender, and four-branched. (This is sometimes described as a "feather-bristle.") * * * The abdomen is uniformly ringed (about eight rings), and rather finely punctured.

Remedies.

Most of the mites can be destroyed by applications of sulphur in some form, as the simple flour of sulphur thrown upon the foliage when wet with dew; sulphur, soap, and water mixed; combined with an alkali in the proportion of one pound of sulphur and two pounds of fresh lime boiled in four gallons of water; or, four ounces of sulphuret of lime, purchased at the druggist's, and two ounces of soft soap, stirred into one gallon of water. The Bordeaux mixture and other similar prepaiations which are now being extensively employed for fungoid diseases should be efficient in killing various species of mites.

But as the *Phytoptidæ* are usually concealed within their galls, they are but slightly amenable to sulphur or other insecticides. Their attacks are ordinarily, for a considerable time at least, quite local, being confined to a single tree, or even to a limb.

If taken at the very commencement of the attack no better remedy can be found than to pick off all of the infested leaves, or remove the infested branches, from time to time, whenever the presence of the blister galls is noticed, and burn them. When there are no conveniences for spraying, trees more generally affected should be heavily pruned in spring or winter for burning.

The best method, however, where proper spraying can be done, for arresting an established attack of this most troublesome pest, has recently been published by Mr. M. V. Slingerland of Cornell University, in an excellent paper on the "Pear-Leaf Blister," contained in Bulletin 61 of the Cornell Agricultural Experiment Station, December, 1893. Careful experiments carried over two seasons have shown Mr. Slingerland that the insect "can be nearly exterminated in a badly infested orchard by a single thorough spraying of the trees in winter with kerosene emulsion diluted with from five to seven parts of water."

This is a valuable discovery, for there need not, hereafter, be any difficulty in arresting attacks which, hitherto, we have been entirely unable to control.

A Peach-Tree Phytoptus — P. ?persicæ.

Dr. Thomas Taylor, of Washington, has given me verbally, the following information: In the year 1872, soon after he had discovered the pear-leaf blister-mite, now known as *Phytoptus pyri*, in association with its galls, and had called Mr. Glover's attention to it (see page 455 of this report), he observed, also, immense numbers of a similar mite, but of only one-half the size, whitening the leaves of a peach-tree, in Washington, and running rapidly over the surface of the leaves. It had but four legs, and in all other particulars gave evidence of being a *Phytoptus*.

Dr. Taylor has not seen the mite from that time to the present. No published record of its observation was made by him or by Mr. Glover to whom it was shown, nor does it appear to have been noticed by any one else in this country.

It is probably identical with *Phytoptus persicæ*, noticed briefly by Murray, in his *Economic Entomology—Aptera*, p. 354, where it is represented as whitening the leaves of peach-trees, at times, in Montreuil, near Paris, as noticed by M. Guérin-Méneville, in 1851, in *Ann. Soc. Ent. France.* The white dust covering the trees gave to the attack the name of "the miller" (le meunier).

A Plum-Tree Phytoptus.

Mr. Slingerland has recently had brought to his notice, a mite inhabiting small, subspherical excrescences encircling the base of buds and shoots of plum twigs received from Industry, Pa. Dr. Riley, several years ago, had examples of probably the same mite sent to him from plum-trees in New York and in Ohio. Mr. Slingerland, in the *Canadian Entomologist*, for December, 1895, has referred the mite to *Phytoptus phlœocoptes* Nalepa, and given a figure of the mite and infested twigs.

Undoubtedly a large number of these gall-mites will be discovered in the United States. Professor Garman has indicated fourteen species of Phytoptus, of which ten (the other four undescribed) are given in the *Preliminary List of N. A. Acarina*, 1886, of Osborn and Underwood. A large number of Phytoptus galls have been observed. So long ago as in 1885, Dr. Hagen, in a paper contained in the February issue of the *Canadian Entomologist*, states, that there are fifty-one American Phytoptus galls in the collection of the Museum of Comparative Zoölogy, and that sixty-eight are known from North America, belonging to forty-two species of plants, thirty-three genera and twenty-three families.

APPENDIX.

(A)

THE SCORPION-FLIES.

By E. P. Felt, D. Sc.

(Read in abstract before the American Association for the Advancement of Science, September 3, 1895, at Springfield, Mass.)

The scorpion-flies are to be found more commonly in damp, waste places, where little of value grows and, consequently, their powers for either good or evil are limited by the surroundings. In the larval state they are most probably predaceous and may aid in keeping some of the smaller injurious insects in check. In the imago state the evidence of the predaceous habits of *Panorpa*, the typical scorpion-fly, is not so clear as one might desire, yet there is nothing to prove it injurious.

The scorpion-flies, together with the closely-related genus *Bittacus* and a few other allied forms, were long included in the old order Neuroptera. Within recent years some authors have assigned these insects to a separate order, the Mecoptera, which is placed between the now more limited order Neuroptera and the Lepidoptera. The Mecoptera

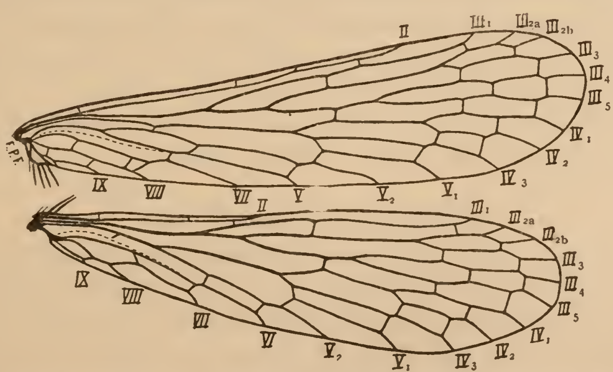


Fig. 23.—Venation of Panorpa rufescens. The homology of the veins was determined by Prof. J. H. Comstock

are distinguished by possessing four numerously veined membraneous wings (Fig. 23); the head is prolonged into a beak; metamorphosis complete. The enlarged forceps-like appendages of the male *Panorpa* has led to the popular name of Scorpion-fly for members of this genus (Pls. iii, iv, fig. 12), and it appears that some authors include the genus *Bittacus* under the term "scorpion-flies," though the male appendages have no likeness to those of a scorpion. This is due, most probably, to the lack of a more appropriate common name. Up till 1863 almost nothing was known concerning the life-history of these insects, but, thanks to the most excellent work of Brauer,* the student of the order need no longer labor in the dark. I have failed to find any important contribution to our knowledge of the habits of these insects since his time, and nothing in this line appears to have been done upon the American species.

The breeding and field observations upon which this paper is based were carried on under the direction of the Entomological Department of Cornell University.

Panorpa rufescens Ramb.

This was the most common species of *Panorpa* in the vicinity of Ithaca, N. Y., during the summer of 1895. In 1894 *P. maculosa* Hagen was extremely abundant in the ravines along the shores of Lake Canandaigua, N. Y. These species resemble each other so closely that in the working out of the life-history of one it is quite likely that we have obtained a very good idea of that of the other. They are found in moist woods during July and August, especially along streams and where nettles abound. The markings upon the wings in both species vary considerably not only in extent but also in depth of color, and there is some variation in the smaller veins. The scorpion-flies seem to be no favorites with collectors. This may be due to an indefinable, uncanny appearance, which leads the entomologist to look for more agreeable specimens; or it may be due to the unprepossessing qualities of the mounted insect — it shrivels so badly that it cannot be made to look nicely. Though quite common, these insects are rarely listed.

Appearance and General Habits.

The perfect insect may be seen resting upon a leaf eyeing the intruder critically or else flitting to a safer position. The elevated fore part of the body, the gracefully curved, erect antennæ and the large eyes, together with the long beak (Pl. iv, figs. 4, 5), give this insect a wary look. Though apparently watchful, they are easily taken in a net. When held in the hand, they show their indignation by

* In *Verhandl. der k. k. zool. bot. Gesellschaft*, xiii, 1863, p. 310, Taf. 13, 14.

biting at the confining fingers and exuding from the mouth, grasshopper-like, a dark-colored fluid. The males bear the seventh and following segments of the abdomen curved over the fifth and sixth, so that the enlarged, forceps-like genitalia not infrequently touch the dorsal spine of the sixth abdominal segment (Pl. iv, fig. 12).

The males use the genital armor as a weapon; they can pinch harder with the large harpe (Pl iii, fig. 12 h.) than with the mandibles. The mobile, extensile abdomen enables them to use this weapon quite effectively. European species (*P. germanica* or *P. communis*) are said to "dart out a long, slender tube toward the disturbing object. Through this tube a little drop of malodorous, whitish fluid is forced, which is undoubtedly repugnant to its enemies."* At least fifty of these insects were handled while alive, and yet nothing of the kind was observed in our species.

A Peculiar Organ.

Several times two scorpion-flies were seen standing side by side and facing in nearly opposite directions — the tip of the long beak of one nearly resting upon the abdomen of the other about midway of its length. No importance was attached to this seemingly accidental position at the time. Later studies of the male revealed a curious organ at this point. Near the anterior margin of the fourth abdominal segment there is a median tuberculate process or globular elevation bearing a large, conical, spine, which points in an anterio-dorsal direction (Pl. iv, fig. 6). The large spine appears to be the opening of some kind of a gland. The posterior margin of the preceding segment is produced backward as a bilobed extension thickly set with stout setæ. This process has the appearance of a separate sclerite and is probably protective in function, as it not infrequently nearly conceals the organ on the fourth segment. In *P. maculosa* this organ is more fully developed. No trace of it has been found in the female. From the above it would seem probable that this organ secreted a volatile oil attractive to the female.

The male of *Panorpa nematogaster* McLachl. from Java "possesses a curious appendage to the third joint" of the abdomen.† As the third segment of McLachlan is what I have found to be really the fourth, it is possible that this "curious appendage homologous with the similarly located organ occurring in our native species. As a description of this interesting appendage of *Panorpa nematogaster* is not

* PACKARD: *in Kingsley's Standard Natural History*, ii, *Crustacea and Insects*, 1884, p. 161.
† SCUDDER: in *Bull. 2, U. S. Geol. Geograph. Surv.*, iv, 1878, p. 54[illegible].

accessible at the time of writing, it is impossible to do more than suggest a possible homology between the organs.

Is Panorpa Predaceous?

If one cares to watch these insects, they usually may be seen sitting upon the upper side of a leaf. From time to time the wings are slowly elevated and the abdomen caused to vibrate rapidly a few times. This is most probably a respiratory movement. Occasionally one or two may be found feeding upon a dead fly or a dead larva. They seem to bite the tissues for the sole purpose of liberating the body fluids, so that feeding is a combination of biting and sucking. They appear to pay no attention to living, intact insects, although they do not hesitate to suck the fluids from a wounded caterpillar. Some small *Halisidota* and *Datana* larvæ were placed in cages with *Panorpa*, but in no instance were they injured. One of these larvæ crawled against the leg of a female; she simply moved out of the way and finally flew off. But when an injured larva was placed in the cage, it was quickly pounced upon and the fluids sucked from the wound. They do not hesitate to feed upon the dead of their own species, and they will also feed greedily upon raw flesh. A number of individuals were kept in cages and fed upon meat, which was renewed every morning. Within ten minutes after the change, most of them would be feeding eagerly. There was no tearing and pulling; the tip of the long beak would be thrust into the most juicy parts with evident delight. Cooked meat was given them once, but it was not relished so well, probably from being too dry. The next morning several appeared sick. One female lived upon nothing but meat for eighteen days. She was kept in a tumbler with a little sand in the bottom and muslin stretched over the top. The sand frequently got pretty dry — she might have lived longer had the conditions been more natural. From the foregoing it would seem that *Panorpa* does not prey on living animals, although Kirby and Spence record the following:* "Terrible as is the dragon-fly in the insect world in general, putting to flight and devouring whole hosts of butterflies, May-flies, and others of its tribes, it instills no terror into the stout heart of the scorpion-fly (*Panorpa communis*), though much its inferior in size and strength. Lyonnet saw one attack a dragon-fly of ten times its own bigness, bring it to the ground, pierce it repeatedly with its proboscis; and had he not by his eagerness parted them, he doubts not it would have destroyed this

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* *Entomology*, vol., ii, p. 253. 1828.

tyrant of the insect creation." This statement has been referred to in a number of more recent works on entomology, and may be considered the accepted character of the insect. A French writer has observed the same species "eating *portions* of fishes which had been placed on a sunny bank."* Prof. Davis of the Michigan Agricultural College has recorded a species of *Panorpa* as "very common in the fields and noticed to attack the cotton-worm."† In response to a special inquiry, Prof. Davis kindly writes: "As to the *Panorpa* sp. reported by me, can only say that I do not now recall the instance under consideration. What I saw may possibly and quite probably was eating on an injured caterpillar and I felt warranted in classing it with the ones I did." It is possible that *Panorpa* does attack and kill its own prey, but there appears to be no undoubted proof of this at present, unless the account of Kirby and Spence is credited — it does not seem possible that it could be true of our species, at least. The wounded and dead cotton-worms would readily explain the presence of *Panorpa* there, as referred to above. From an economic standpoint, it makes quite a difference whether *Panorpa* preys upon living, uninjured insects or not. Our species were under close observation, indoors and outside, for six weeks, yet they were not seen to touch a living, uninjured animal of any kind and they were seen a number of times in nature feeding upon partially decayed insects: neither the mandibles or the maxillæ of this insect are well adapted to piercing. This is quite different from the closely allied genus *Bittacus*, which will touch nothing but living prey, so far as observed, and its mouth parts are well adapted for piercing. The two genera agree in taking very little or no solid food in the imago state.

Egg-laying Habits.

A number of Panorpas were kept in a roomy cage with several potted plants set in moist sand. The sides of the cage were of glass or wire screen and permitted ready observation. At various times in the afternoon females were seen walking slowly about and exploring every crevice in the sand with the long, mobile abdomen. Occasionally one would back down into a crevice till nearly out of sight. Frequently these explorations would continue some twenty minutes — the same ground being gone over several times. Finally a female would remain fixed with her abdomen thrust into a crevice. Later investigation usually revealed an irregular mass of yellowish-white eggs one to two centimeters below the surface; twenty-four to twenty-nine being the number counted in each of several clusters. The ovaries were found to

* *Psyche*. vol., iii, 1886, p. 212.
† In *Bull*. 15, *Ark. Agr. Expt. Station*, 1890, p. 10.

consist of about twenty-five tubes, in each of which there were seven to eight ova. In the enlarged end of each tube there was a well-developed ovum; the next was smaller and less developed; the size and degree of development of the ova decreased toward the small end of the tube (Pl. iv, fig. 11). Observation showed that from twenty-five to thirty eggs are laid at one time — presumably one from each tube; dissection would indicate that more than one lot of eggs are deposited, and this is supported by the extended imago existence, which lasts several weeks. If the seven or eight ova of each tube mature during this time, a single female is capable of depositing between one hundred and fifty and two hundred eggs. Examination of two other females resulted in the finding of twenty-three well formed eggs in one and twenty-six in the other. In these notes no allowance was made for those destroyed before they could be counted, of which there were several in each instance. They adhere together slightly on account of the small amount of a viscid fluid covering them. There was nothing to show that the female excavates a nidus; she appears to depend upon finding a suitable hiding place. The appendages of her abdomen are so slender that they could hardly be used for excavation. In at least two cases the eggs were laid in irregular, diffuse masses on the surface of the sand, there being no crevice. One lot was deposited partly under a piece of meat, but in most no attention appeared to be paid to the future wants of the larvæ.

Eggs and Young Larva.

If the eggs were allowed to lie upon a dry surface they quickly dried and shriveled up. Two from a lot which subsequently hatched were placed upon a glass slip. Within thirty minutes they had shrunken to a noticeable extent, and within three hours they had shriveled up completely. The shell is thin and must be quite porous.

The Egg.— (Pl. iv, fig. 10.) Elliptical oval; long diameter .625 mm.; short diameter .6 mm. The egg is pale yellow when first laid, turning in a day or two to sooty-yellow. The shell is finely marked with subhexagonal depressions; in the center of each depression there is a circular elevation.

Several clusters were dug up immediately after being laid, placed in vials and covered with about half an inch of moist sand. Most of the time the vials were kept tightly corked. If moisture gathered abundantly on the sides of the vial the cork was removed and some of the moisture allowed to evaporate. The eggs hatched in from six to seven days — they were laid in the afternoon and the larvæ were found on the morning of the sixth or seventh day.

Young larva. — When first hatched the larva is whitish, with a light brown head. The head soon darkens and the body becomes a gray color. The general appearance of the larva is that of a caterpillar (Pl. iii, fig. 1), though there is a strange look about it — the antennæ and eyes are unusually prominent. Each antenna is composed of four segments; the fourth is long and slender; the third is longer, much stouter and bears a special sense organ (Pl. iii, fig. 5 *s*). Each eye is composed of a group of about twenty ocelli. A well-marked thoracic shield occurs upon the first thoracic, and an irregular slightly chitinized area upon the dorsum of each of the remaining body segments. The most striking feature of the young larva is the row of annulated, pilose spines each side of the median line on the abdominal segments, except on the tenth, which bears a single median process. The spines on the eighth, ninth, and tenth segments persist through all the larval stages; those of the others become rudimentary after the first stage. Small setæ with rudimentary ones at their base occur on the body segments; their relative position and number are shown in Pl. iii, figs. 10, 11. Spiracles occur, as in caterpillars, on the first thoracic and on the eight anterior abdominal segments; they have a peculiar radiate structure (Pl. iii, fig. 7). The abdominal segments bearing spiracles have each a pair of rudimentary prolegs, the anterior pair being the most reduced. On the last segment there is the peculiar, retractile, four-branched anal-fork of Brauer (Pl. iii, fig. 19).

Rapid Growth of Larva.

The larva grows rapidly during its early stages. The first stage lasts five days; at the end of this time the thoracic segments become thickened considerably; the thoracic shield and the dorsal portion of the old head-case split along the median line (one was preserved in just this condition), and through this rent the larva leaves its old skin in much the same way as many caterpillars. Dull, apparently dead larvæ were repeatedly seen; in many cases this condition was most likely incident to molting. At the end of the first stage the reduction of the annulated spines on abdominal segments one to seven to mere rudiments, renders the recognition of this period easy (Pl. iii, fig. 1*a*). Between the other stages there are less marked differences. The segmentation of the body is plainer and there is also an increase in width of the head. The ratio between the width of the head in the first and second stages was calculated, and from this was estimated, by Dyar's rule,* the width of the

* Dyar: *Psyche*, v, p. 420. 1890.

head in the succeeding stages. The ratio was found to be 1.178. From time to time larvæ were taken from the cage, measured, and the results tabulated. A definite increase in the width of the head was attributed to molting. Considering that the larvæ measured came from several lots of eggs laid at different times, the figures given below are remarkably constant. Occasionally a larva would be found with a width of head intermediate, but most of the time they were easily referred to one stage or the other. In the earlier stages there was greater constancy, as one might expect.

WIDTH OF HEAD.

STAGE.	Measured.	Calculated.	Differences	Proportionate error.*
	mm.	mm.	mm.	
1	0.5625	....	....	....
2	0.6625	....	....	....
3	0.7750	0.7800	.0050	.0066
4	0.9375	0.9194	.0181	.0193
5	1.0625	1.0830	.0205	.0183
6	1.3255	1.2760	.0495	.0373
7	1.5000	1.4950	.0050	.0033

If this ratio be constant, seven stages were recognized within two weeks after the first larva was found. It was probably several days old when found, and there may have been older larvæ in the cage. There could have been none more than six days old at the time, because it takes six days for the eggs to hatch, and the insects had been in the cage but twelve days. It is hardly likely that oviposition occurred during the first few days. The seventh stage was reached within twenty, and possibly, within sixteen days after the larva emerged from the egg. In another cage, one reached the sixth stage within twelve days after it emerged from the egg. That is, it molted six times in seven or eight days. This result was obtained with larvæ of known age, and the time of the first molt was also known. The seventh stage was attained by one larva August 14. Up till August 22 the cage, from which this was taken, was under the closest supervision, a constant watch being kept for a possible eighth stage. August 22 a portion of this cage was thoroughly examined and some twenty larvæ removed; but none were larger than those taken earlier. A close watch was kept on a smaller lot of larvæ until September 11, but no later stage was discovered. It would, therefore, appear that the seventh stage might be the limit of growth. As the larvæ reached

* Obtained by dividing the difference by actual width.

this stage, they became less active, and not rarely portions of the head and thorax became incrusted with a thin layer of very fine particles of sand. Several thus incrusted died, but not so many as to convince one that this incrustation was the cause. Unfortunately all perished at this time.

Habits of the Larvæ.

Throughout their different stages, the larvæ usually harmonize with their surroundings so closely that it is difficult to detect them. Frequently a slight motion of the earth is the first indication of their presence. They burrow in the earth, and remain underground much of the time. Many burrows ran less than one inch below the surface, although a few extended to a depth of three or four inches. The larvæ may be fed readily upon raw meat placed upon the surface of the ground. Some time after placing the meat in the cage, they may be found under it, frequently in a more or less cell-like depression. When in such a position they rarely try to escape, but trust to their protective resemblances, and remain motionless. Around the edge of the piece of meat and also under it, the mouths of burrows may be seen and in them the heads of larvæ; when in such positions they dodge back quickly at the least disturbance. Unless the meat is moved very cautiously the burrows will appear empty; but if quiet is maintained for a few moments, the heads will soon be seen. The burrows opening under the meat frequently come to the surface a little distance away, and it is quite easy to drive a larva out of its back-door. Not infrequently they have been observed to emerge from a burrow for their feeding. This usually occurred in the afternoon. On one of these occasions a little fellow was watched through a simple lens. It was interesting to see him bite off a piece of meat and swallow it with every evidence of satisfaction. The antennæ were moved back and forth in a most appreciative way. As the larvæ increase in size, more burrows open upon the surface and they are seen lying at their mouths. One time two were seen out of adjacent burrows. The larger seized the smaller in the back and tried to drag it down into its burrow. The smaller was unable to escape, and when it was pulled away with forceps, the body-wall was ruptured. At another time a smaller active larva was seen to attack a larger inactive one, which, unable to resist, was bitten so severely that the segment swelled considerably, but was not ruptured. In a day or two the larger died and was fed upon by its former persecutor. In several cages there was a marked decrease in the number of larvæ. The foregoing incidents throw light on the mystery. The weaker probably fell a prey to the rapacity of the stronger. The larvæ will feed readily upon recently killed caterpillars. Packard (*loc. cit.*, p. 162) states that the food of the larva is dead animals.

On another occasion a larva was seen moving particles of earth from the mouth of its burrow, seizing them with its mandibles and placing them on one side. The larvæ burrow slowly; they do not excavate the earth but compress it by a series of muscular contractions. They cannot travel readily over moist sand, because particles adhere to the legs and interfere with their movement. This is especially true of the anal-fork, which frequently becomes filled with a mass of sand. If the larvæ have a firm surface as a piece of paper or glass their rate of locomotion will compare favorably with that of many caterpillars. The method of progression sometimes resembles that of a geometer. The thoracic legs and the anal-fork are the principal organs of locomotion, the latter being capable of supporting the entire body, and upon a hard surface it is used in much the same way as the anal prolegs of a caterpillar. The rudimentary prolegs seem of little use. When seized the larva opens its tiny jaws in a very suggestive way. If dropped into water it quickly sinks and straightens out apparently dead, but soon revives when removed.

As the larvæ were kept under nearly natural conditions, it is quite likely that they live in much the same way in nature. They burrow in the ground or wander over the surface and live upon what they can find. The special sense organ on the antenna probably enables them to locate the coveted food readily. One afternoon the haunts of *Panorpa* were visited. Several vials were sunk with their mouths just at the surface of the ground, and bits of meat were placed in them. Later in the day a *Panorpa* larva was found in one of the vials. Not only do they wander in search of food, but it is also quite likely that they lie in wait at the mouths of their burrows and capture whatever may fall within their power.

Length of Larval Existence.

For the remainder of the life-history of this species I can do no better than quote McLachlan's translation of Brauer's observations upon an European species:*

" They are full grown in thirty days, and then burrow deeper into the ground, excavate an oval cell in a small lump of earth, and remain as larvæ for several months before assuming the pupa state. In this condition they shrivel to one-half of their previous length, the underside increases in thickness, and the end of the body is somewhat curved

* *In Trans. Lond. Ent. Soc.*, 1868, *p.* 213.

against the back. If taken out they move slowly and have no power to walk. The bristles on the last three segments are then partly broken off."

It is probable that *P. rufescens* completes its round of life in nearly the same manner, though, as shown in the preceding, its growth is more rapid.

Pupa of European Species.

The pupa of an European species of *Panorpa*, as figured and described by Westwood,* is inactive. The limbs are laid along the breast and the antennæ along the sides. The head is less elongated than in the imago. The pupa was found an inch below the surface in moist earth at the foot of an alder stump.

Bittacus strigosus Hagen.

The general appearance of this insect is quite different from that of *Panorpa*. Its body is more slender and the sides more flattened. Were it not for the long beak, which is much more pointed and especially adapted for piercing, the relationship between the two genera would scarcely be suspected. Upon closer examination, however, the affinity becomes clearer. For example, the venation of the wings in the two

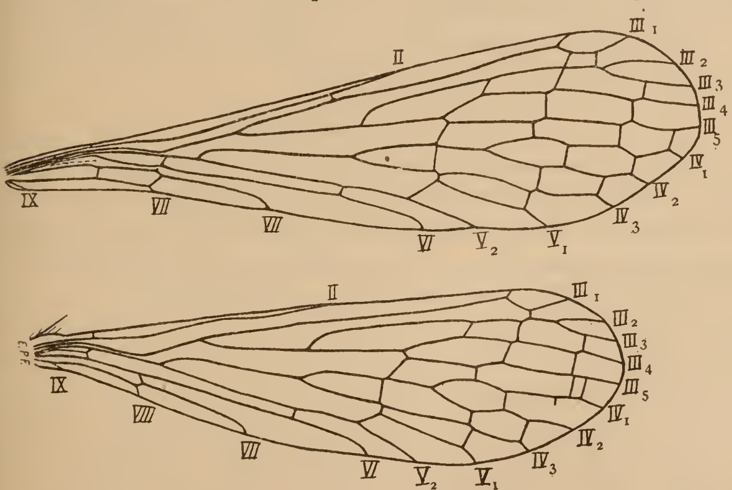

FIG. 24.—Venation of BITTACUS STRIGOSUS. The homology of the veins was determined by Prof. J. H. Comstock.

genera is very similar (Fig. 24). The minute mouth-parts and other organs also show the relationship existing between them.

* *Introduct. Class. Insects*, vol. ii, pp. 52, 53, figs. 65, 18. 1840.

Habitat and Appearance.

The moist shady swamps are the delight of this insect. In such places they may be seen flitting from branch to branch, during July and early August, rarely retaining one position more than ten minutes. Their manner of flight and general appearance resembles that of the Tipulæ which abound in the same places, but they never alight *upon* a leaf or branch of any kind; they suspend themselves by the long slender fore limbs (Pl. iv, fig. 1), not infrequently using the middle pair of limbs also.* The limbs of *Bittacus* are totally unfitted for supporting the owner in the position most insects assume when at rest. On a flat surface it is nearly helpless; its long legs become entangled, or if several are in a bottle, a snarled mass of legs with here and there a body is the result — it cannot even stand on its legs. In their suspended position the fore limbs are bent so as to elevate the head above the fore femora, thus affording an uninterrupted view. The head is extended forward, while the slender beak inclines a little from the horizontal. The diverging antennæ curve gracefully backwards. The wings droop beside the body and cover the abdomen. One leg or the two of the middle pair not used in supporting the insect, extend at an oblique angle from the body. The hind femora are nearly vertical, the tibiæ incline forward, while the tarsi hang in a peculiar drooping curve. The general appearance of the insect in this position is not very unlike a bit of dried, dangling foliage.

Method of Capturing Prey.

The position appears restful and one might almost think the insect asleep. It is very far from that, as many a small insect could testify, were it still alive. The small fly that ventures within reach of the long, dangling legs imperils its life. In a second those well-armed tarsi (Pl. iv, fig. 2) seize the unfortunate, the fourth and fifth segments of the tarsus shutting together like the jaws of a trap (shown at *a*) — the teeth upon their apposing surfaces (shown at *b* and *c*); and also the large spines on the second and third segments, especially of the hind leg (shown in outline at *d* and *e*). The struggle is usually short; two, three, or four of those long legs lay hold of the captive and soon bring it within reach of the sharp beak. It is only a minute's work to pierce a soft part of the body and suck the victim's blood, when the lifeless remains are dropped to the ground and the insatiate insect is ready for the next. If a large

* Baron Osten-Sacken has contributed an interesting observation upon the habits of *B. apterus*. The insect is not rare in open grassy places in parts of California and it "replaces the want of wings by a great dexterity in climbing, swinging itself, monkey-like, from halm to halm, often suspended only by the front tarsi." One was observed devouring a Tipula.— C. V. Riley, in *Am. Nat.*, July, 1882, pp. 596-597.

fly is seized, *Bittacus* would sooner be torn from its support than relinquish its hold upon the prey. One was seen in the field just after she had seized a rather large fly; twice she was torn from the supporting stem and forced to fly a short distance, still holding her prey. After quite a struggle the fly was killed. *Bittacus* will touch nothing but living insects, so far as known. One female killed four house-flies in a day; on another she killed three. In nature they undoubtedly destroy large numbers of insects; flies seemed to be preferred, though some small Capsidæ, Coleoptera, and Hymenoptera were killed by confined individuals. As they are such voracious feeders and by no means rare, since hundreds were seen flitting in the woods inhabited by them, the genus may be ranked among the beneficial insects. It appears to be rather local and, therefore, of little importance in an economic way. In the woods where they abounded the conditions seemed favorable for the multiplication of mosquitoes, yet they were not abundant; possibly their numbers were reduced by the bloodthirsty *Bittacus.*

Habits of European Species.

The following is Dr. Packard's (*loc. cit.*, p. 162) rendering of Brauer's account of an European species: "The imagines, or adult flies, live in a sort of a chamber covered in by leaves, grasses, nettles, etc., forming an airy abode or vivarium. Here they feed upon such flies as enter their habitation. The flies die after laying their eggs in the soil, and the earth at the bottom of the chamber dries up, but in the following April, when the soil is again wet by the spring rains, the larvæ hatch out. And now a remarkable fact has been noticed by Brauer. He has observed that if the marshy or wet ground where the female *Bittaci* customarily lay their eggs does not dry up, no females appear until the second year following; so that the eggs lie over unhatched two years. The first condition of their hatching is a complete drying of the earth in which the eggs lie; the second condition is a succeeding thorough wetting of the ground in spring. If the ground remains dry from want of snow in the winter or of rain in the spring, and there follows in the next summer a very thorough wetting of the soil, then the time of appearance of the adult will be retarded three or four months."

In this country no vivarium or chamber has been found as yet. The insects were observed for hours in their native haunts, where they were seen to rise in numbers from low bushes and ferns upon the approach of an intruder, yet they were rarely seen within three inches of the ground. In this connection it would be interesting to learn how this airy chamber or vivarium was constructed. On the ground, as before stated, the insects appear nearly helpless. When suspended from the branches they could easily pull leaves, etc., together, but they appear to have no means of fastening them in place. This interesting habit does not seem to be common to any American species yet observed.

A Remarkable Organ.

Arising between the large appendages of the tenth abdominal segment of the male there is a most remarkable median organ; it is a long, slender filament of chitine coiled up like the proboscis of a butterfly (Pl. iii, fig. 14 *f*). It is also represented partly extended in figure 15 *f*. When stretched out it would quickly spring back to its original position upon being released. This was observed upon males that had been dead some forty hours and also upon alcoholic specimens. The insect can uncoil this filament. It appears like the rudiment of a once important organ.

Egg-laying Habits.

The perfect state lasts a number of days and possibly a month or more. Owing to their requiring living food, it was difficult to keep the insects alive when in confinement. A female of *B. pilicornis* Westw. was kept five days; during that period she killed eight house-flies, and there were times when she would have been glad of more. The first day of confinement she laid one egg and several each day thereafter; before dying, thirty were deposited. This species was less abundant at Ithaca and appeared much less vigorous than *B. strigosus*. Several examples of *B. strigosus* with well-distended abdomens were dissected; they were found to contain fourteen, sixteen, and nineteen eggs, respectively, yet the abdomens were apparently as large as that of *B. pilicornis*, which laid thirty eggs. From the above it would seem that the eggs develop and are produced a few at a time during the greater part of the adult existence. These insects die very soon if deprived of food, most of them living but a day after capture unless well supplied with small insects. So far as observed, oviposition consists simply of extruding the egg and allowing it to drop at random. It has a hard shell and a tough inner membrane, differing in this respect from that of *Panorpa*.

The egg.— Subcuboidal; long diameter, .8125 mm.: short diameter, .6875 mm. Color, dark brown. Shell hard, tuberculate. It appears like the "frass" of a caterpillar (Pl. iv., fig. 9).

Larval and Pupal Stages of European Species.

In all probability our American species winter in the egg state. The larvæ have not been seen by me. The following is abridged from Packard's (*loc. cit.*, pp. 163, 164) rendering of Brauer's observations upon European species. The larvæ of *Bittacus* do not burrow in the ground as do those of *Panorpa*, but remain on the surface and secrete themselves under leaves, etc.; like Panorpa, the larvæ feed readily upon meat. They differ from that of *Panorpa* in the possession of "two rows of dorsal spiny tubercles which end in long stiff filaments, and which extend from behind the head to the tail." They are reddish-gray in color and their hairs resemble particles of earth or bits of vegetation and thus aid in concealing the possessor. "At the least disturbance they assume an erect position, throwing the body into the shape of an S, or they roll up spirally like a saw-fly larva and fall into the cracks in the ground." They pupate in a cell one or two inches below the surface, in which the larvæ remain ten days before pupation. The pupa state lasts fourteen days.

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Explanation of Plate III.

Panorpa rufescens.

Larva.

Fig. 1.—Lateral aspect of first stage: 1*a*, rudimentary annulated spine of 7th abdominal segment in 2d stage; 1*b*, the annulated spine of 8th abdominal segment in do; 1*c*, abnormal bifiurcate spine of 10th abdominal segment.

Fig. 2.—Ventral aspect of head: *e*, eye; *p*, maxillary palpus.

Fig. 3.—Dorsal aspect of head: *a*, antenna; *e*, eye.

Fig. 4.—One of the eyes, showing distribution of ocelli.

Fig. 5.—Antenna, showing special sense organ at *s*.

Fig. 6.—Mandible.

Fig. 7.—Thoracic spiracle in first stage.

Fig. 10.—Arrangement of setæ on 3d thoracic segment; diagrammatic.

Fig. 11.—The same of the 1st abdominal segment.

Fig. 19.—Anal-fork extended, latero-caudal aspect.

Fig. 21.—Portion of the maxilla; *p*, palpus.

Imago.

Fig. 8.—Lateral aspect of 9th abdominal segment of male: *v*, valve.

Fig. 12.—Ventral aspect of 10th abdominal segment of male: *h*, harpe; *u*, uncus; *l*, lower limb of uncus; *i*, inner harpe.

Fig. 9.—Internal aspect of ventral portion of 9th abdominal segment of female.

Fig. 16.—Dorsal aspect of 9th and 10th segments of female abdomen: *a*, segmented appendage.

Fig. 17.—Lateral aspect of 8th, 9th, and 10th segments of female abdomen: *a*, segmented appendage.

Bittacus strigosus.

Imago.

Fig. 20.—Internal aspect of right valve.

Fig. 13.—Cephalo-lateral aspect of 9th abdominal segment: *h*, harpe; *u*, uncus.

Fig. 14.—The same of 10th abdominal segment: *i*, inner harpe; *f*, chitinous filament.

Fig. 15.—Chitinous filament partially uncoiled: *i*, inner harpe; *f*, filament.

Fig. 18.—Dorsal aspect of 9th and 10th abdominal segments of female: *a*, unsegmented appendage.

All the drawings, except figures 19 and 21, were made with the aid of the camera lucida. All the figures are greatly enlarged.

Explanation of Plate IV.

Fig. 1.—Natural position of *Bittacus strigosus*. Drawn from a photograph of the living insect (enlarged).

Fig. 2.—Fore tarsus of *B. strigosus*: *a*, 4th and 5th segments apposed; *b*, teeth of 5th enlarged; *c*, do. of 4th; *d*, armature of 3d on middle legs; *e*, the same of 2d and 3d segments of hind legs.

Fig. 3.—Fore leg of *Panorpa rufescens*.

Fig. 4.—Lateral aspect of the head of *P. rufescens*.

Fig. 5.—Front of same.

Fig. 6.—Portions of the fourth and fifth abdominal segments of *P. rufescens*, showing the dorsal abdominal organ of the male.

Fig. 7.—Terminal antennal segment of *B. strigosus*.

Fig. 8.—Three antennal segments, 8th, 9th and 10th, of *P. rufescens*.

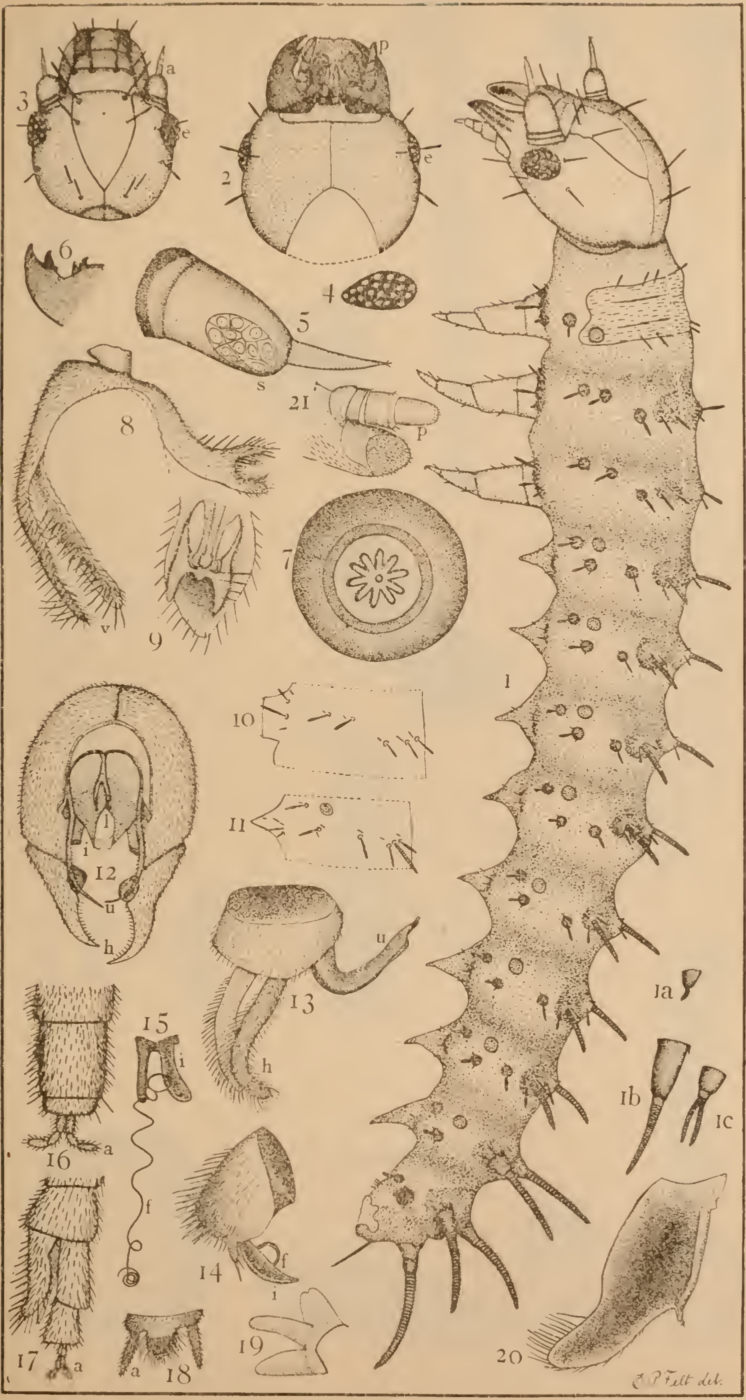
Fig. 9.—Egg of *B. strigosus*.

Fig. 10.—Egg of *P. rufescens*.

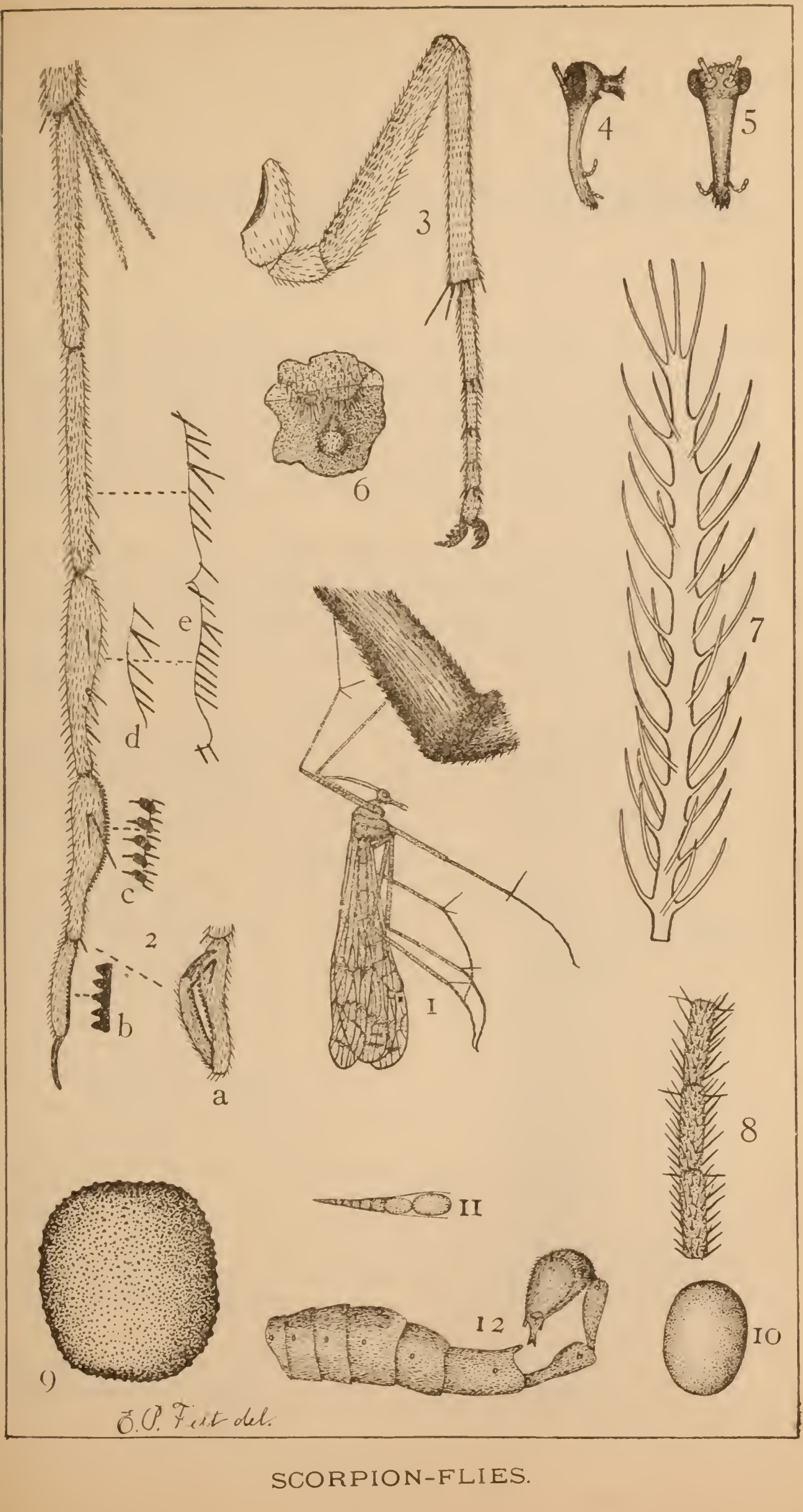
Fig. 11.—A single ovarian tube of *P. rufescens*.

Fig. 12.—Lateral aspect of male abdomen of *P. rufescens*.

Figures 4, 5, 9, 10, 12 were drawn by aid of the camera lucida; the others, to scale. Figures 2, 3, 6, 7, 8, 9, 10, 11 greatly enlarged; figures 4, 5, 12 moderately enlarged.



SCORPION-FLIES.



SCORPION-FLIES.

(B.)

LIST OF DATES OF COLLECTIONS OF LEPIDOPTERA (HETEROCERA).

The time of appearance of insects in their perfect stage is an important and essential part of their life-history. It is of special importance in the injurious species, in enabling us often to guard against the deposit of their eggs, or to destroy the larvæ at their earliest appearance before serious injury has been committed by them.

The following list is from unpublished memoranda made in the year 1874 of species taken either in Albany or Schenectady, New York. Similar lists for the years 1869, 1870, 1872 and 1875 may be found in Nos. 1, 2, 3 and 4 of my "Entomological Contributions."

SPHINGIDÆ

Philampelus Pandorus (*Hübn.*)	August 18.
Philampelus Achemon (*Drury*)	August 25.
Ampelophaga Myron (*Cram.*)	June 24.
Ceratomia Amyntor (*Hübn.*)	July 10; Sept. 22.

BOMBYCIDÆ

Alypia octomaculata (*Fabr.*)	June 9.
Eudryas grata (*Fabr.*)	June 27.
Euphanessa mendica (*Walk.*)	July 7, 8, 12, 13, 17, 21.
Arctia parthenice (*Kirby*)	August 23.
Pyrrharctia isabella (*Sm.-Abb.*)	June 28.
Spilosoma virginica (*Fabr.*)	June 12.
Euchætes egle (*Drury*)	June 24.
Halisidota tessellaris (*Sm.-Abb.*)	July 21.
Orgyia leucostigma (*Sm.-Abb.*)	July 9, 15.
Heterocampa marthesia (*Cram.*)	July 14.
Attacus Cecropia (*Linn.*)	June 26.
Actias luna (*Linn.*)	June 18.
Telea Polyphemus (*Cram.*)	June 26.
Hyperchiria Io (*Fabr.*)	July 1, 3.
Eacles imperialis (*Drury*)	July 8; August 24.
Clisiocampa Americana *Harris*	June 30.

NOCTUIDÆ

Pseudothyatira expultrix *Grote*	July 1, 5.
Acronycta morula *Gr.-Rob*	June 30.

Acronycta funeralis *Gr.-Rob*	August 8.
Acronycta hamamelis *Guen.*	June 14.
Acronycta dissecta *Gr.-Rob*	June 24.
Agrotis badicollis *Grote*	August 24.
Agrotis prasina (*Fabr.*)	August 22.
Agrotis c-nigrum (*Linn.*)	July 5, 8.
Agrotis plecta (*Linn.*)	June 6, 30.
Agrotis haruspica *Grote*	July 21.
Agrotis clandestina (*Harris*)	June 24.
Agrotis subgothica (*Haw.*)	August 22, 31.
Agrotis tricosa *Lintn*	August 11, 29, 31.
Agrotis herilis *Grote*	July 3, 12.
Mamestra meditata *Grote*	September 30.
Mamestra grandis (*Boisd.*)	June 15.
Mamestra trifolii (*Rott.*)	June 6.
Mamestra adjuncta (*Boisd.*)	June 3; July 17.
Mamestra renigera (*Steph.*).	August 20.
Hadena passer (*Guen.*)	June 17; July 1.
Hadena finitima (*Guen.*)	June 13.
Hadena lateritia (*Hufn.*)	August 22, 25.
Hadena devastatrix (*Brace*)	August 28.
Hadena arctica (*Boisd.*)	June 13; July 1, 5, 21.
Hadena fractilinea *Grote*	August 22; Sept. 20.
Hyppa xylinoides (*Guen.*)	June 7; August 22.
Euplexia lucipara (*Linn.*)	July 17.
Nephelodes violans *Guen*	August 29.
Helotropha reniformis *Grote*	August 10, 25.
Hydrœcia sera *Gr.-Rob*	July 6, 17.
Hydrœcia nictitans (*Linn.*)	July 21.
Leucania albilinea (*Hübn.*)	August 10, 17, 21.
Leucania unipuncta (*Haw.*)	July 5, 8.
Leucania pseudargyria *Guen*	June 13, 21, 31.
Ufeus satyricus *Grote*	April 25.
Adipsophanes miscellus *Grote*	August 9.
Crambodes talidiformis *Guen*	June 22; July 20.
Caradrina miranda *Grote.*	August 16.
Caradrina multifera *Walk.*	September 5.
Orthosia bicolorago (*Guen.*)	October 14, 18.
Morrisonia confusor (*Hübn.*)	May 13.
Cucullia asteroides *Guen*	August 23.
Plusia ærea (*Hübn.*)	July 21; August 23.
Plusia æroides *Grote*	July 21.
Plusia precationis *Guen*	July 26.
Erastria synochitis *Gr.-Rob*	July 9.
Erastria muscosula *Guen*	July 10.
Erastria apicosa (*Haw.*)	July 17.
Catocala nubilis (*Hübn.*)	July 14.
Parallelia bistriaris (*Hübn.*)	June 26, 30.
Pityolita pedipalalis (*Guen.*)	June 21.
Renia discoloralis *Guen*	Aug. 3.

Geometridæ

Prochœrodes transversata (*Drury*)	Aug. 6, 7, 11.
Tetracis crocallata *Guen*	June 13.
Tetracis lorata (*Grote*)	June 13.
Angerona crocatoria (*Fabr.*)	July 10.
Acidalia enucleata *Guen*	July 20.
Stegania pustularia *Guen*	July 7.
Hæmatopis grataria (*Fabr.*)	June 22.
Hemerophila unitaria *Her.-Sch*	July 3.
Heterophleps triguttata *Her.-Sch*	June 22; July 21; Aug. 22
Petrophora diversilineata *Hübn*	July 1.
Plemyria fluviata *Hübn*	July 21.

Pyralidæ

Desmia maculalis *Westw*	Aug. 1, 9.
Botis marculenta *Gr.-Rob*	July 21.
Botis acutella *Walker*	June 11.
Botis ferrugalis *Hübn*	Aug. 7.
Botis unifascialis *Pack*	June 1, 3.
Botis theseusalis *Walk*	June 27, 28.
Botis adipaloides *Gr.-Rob*	July 12.
Evergestis straminalis *Hübn*	Aug. 20, 22, 23.
Cordylopeza nigrinodes *Zeller*	July 21.
Pyralis farinalis *Linn*	June 3, 4; July 5, 8.
Pyralis costalis *Fabr*	July 7, 8.

Tortricidæ

Cacœcia purpurana (*Clem.*)	July 10.
Cacœcia cerasivorana (*Fitch*)	July 19.
Cacœcia argyrospila (*Walk.*)	June 2, 22, 26.
Lozotænia afflictana (*Walk.*)	May 21.
Ptycholoma persicana (*Clem.*)	June 9.
Pandemis limitata (*Rob.*)	July 10.
Tortrix fumiferana *Clem*	July 7.
Cenopis reticulatana (*Clem.*)	July 22.
Cenopis Pettittana (*Rob.*)	July 1.
Amphisa discopunctana (*Clem.*)	June 30.
Exartema permundana *Clem*	July 10.
Exartema exoleta *Zeller*	July 14.
Penthina nimbatana (*Clem.*)	June 23.
Penthina chionosema *Zeller*	June 18.
Sericoris instrutana *Clem*	June 22.
Sericoris campestrana *Zeller*	June 19.
Tmetocera ocellana (*Schiff.*)	June 26.
Phoxopteris semiovana *Zeller*	May 29.
Carpocapsa pomonella (*Linn*)	May 28.

(C)

LIST OF PUBLICATIONS OF THE ENTOMOLOGIST.

The following is a list of the principal publications of the Entomologist during the years 1893 and 1894 (100), giving title, place, and date, and a summary of contents of each.

How to Prevent the Ravages of the Cabbage-Maggot. (Gardening, for February 1, 1893, i, p. 155, figs. 1–3 — 92 cm.)

As the effectiveness of remedies are often influenced by soil and other conditions, the following are noticed and commended: Tobacco; lime; burdock decoction; tansy decoction; kerosene emulsion; night-soil; soot; hellebore; liquid manure. More effective than any of these as a preventive — the tarred-paper protectors designed by Prof. E. S. Goff are described and illustrated, with method of making, and mention of results obtained from their use.

A Destructive Elm-Tree Bark-Borer. (Garden and Forest, for February 15, 1893, vi, p. 76 — 29 cm.)

The white elm, *Ulmus Americana*, in New York and other Northern States is being injured and killed by the burrowing in the inner bark and sap-wood of the longicorn beetle, *Saperda tridentata* Oliv. A coating, containing carbolic acid and Paris green to deter from oviposition and to kill the larvæ in entering the bark, is recommended. A better remedy would be to remove the outer bark until the burrows are reached, and then apply kerosene emulsion to kill the grubs or pupæ. The experiment of M. Robert, in France, is related, of killing the Scolytus in elms by removing all of the outer bark in two thousand elms, and in removing strips of the bark two inches wide from the ground to the boughs. The four insects operating on our elms and threatening their destruction are noticed. Fears expressed lest the elm is a doomed tree.

Plant-Lice. (Country Gentleman, for March 9, 1893, lviii, p. 186, c. 3 — 12 cm.)

Inquiry is made, from Nassau, N. Y., of means for destroying lice on roots of vegetables in gardens. But few species of plant-lice are known to operate in the above manner. Only five are recalled (named with their food-plants). Several of the flowering plants are subject to root attack. For remedies tobacco water is thought the best; others that may be experimented with are hot water, kerosene emulsion, common soapsuds, whale-oil soapsuds, pyrethrum water, hellebore tea, alum water, and lime water. Lime or wood ashes washed into the soil may serve as preventives.

The Angoumois-Moth, Sitotroga cerealella. (Country Gentleman, for March 9, 1893, lviii, pp. 188–9, cols. 4, 1, 2 — 68 cm.)

Replying to inquiry of the insect infesting wheat in York county, Penn., is given: its operations in Europe; its history in the United States; is a southern species, and rare in the State of New York; notice of the few occasions in which it has been observed in this State, in museums at Albany and Geneva, and in grain stores — probably not attacking grain in the field; a Catolaccus parasite reared from infested corn; number of broods varying with the latitude and temperature, from two to eight; broods in Pennsylvania; the grain heated by the gnawing of the larvæ; the flour produced from infested wheat unwholesome and producing disease; bisulphide of carbon remdy for the insect when within the grain.

[Extended in pp. 377–386, of this Report (x).]

Report of the Committee on Entomology. (Proceedings of the Western New York Horticultural Society, for January, 1893, pp. 28–43. Also, separate, with cover and title, March 21, 1893, 16 pp.) Read before the society at its annual meeting, January 26, 1893.

Notices as follows: Remarkable exemption from inscct injuries during the year. Various pests of the year (twelve species remarked upon). The Gypsy-moth, *Ocneria dispar*, in Massachusetts — work done for its extermination. A destructive shade-tree pest, *Zeuzera pyrina* — its spread and injuries. An elm-tree bark-borer, *Saperda tridentata* — its work and remedies for it. Experiment Station publications — insects attacks discovered by them — ten noted. Spraying and insecticides — results during the year and new insecticides introduced. Bounties for insect pests — offered in Newton, Mass., and what may be done in like manner elsewhere.

[Published in the Ninth Report on the Insects of New York, 1893, pp. 422–437.]

The Periodical Cicada. (Country Gentleman, for March 23, 1893, lviii, p. 226, col. 3 — 20 cm.)

Replying to inquiries from Plainfield, N. J.— This will not be a locust year in New Jersey or in New York. Next year an extensive brood will appear along the Hudson river valley, and in parts of Connecticut, New Jersey, Pennsylvania, Maryland, and Virginia. It probably will not be abundant in the vicinity of Plainfield, N. J. Fruit-trees are often injured by it, nurseries and young orchards especially. Its injuries through oviposition cannot be prevented by applications to the trees. It may be more easily killed before it becomes winged; and the mature insect may be driven from orchards by taking advantage of high winds.

Mites Attacking Mushrooms. (Country Gentleman, for March 23, 1893, lviii, pp. 228–9, cols. 4, 1 — 27 cm.)

"Some small reddish crawling lice," reported from Newburgh, N. Y., as infesting "by millions," a large mushroom bed in a steam-heated cellar, are doubtless mites. Examples should have been sent for name. Mention of a mushroom cellar on the imperial farm at Vincennes, France, infested with immense numbers of mites of a gray color. *Tyroglyphus rostroserratus* infests mushroom beds in the vicinity of Paris — also of a gray color. A new species of *Rhizoglyphus* occurring in pits in mushrooms was lately received from Suffolk county, L. I. The Newburgh species may be *Bryobia pratensis* which often enters buildings. Sulphur commended for killing the mites, and how used; bisulphide of carbon might also be tried, in manner directed.

[See pages 449, 450 of this Report (x).]

Flower Crickets and Apple Twigs. (Country Gentleman, for March 30, 1893, lviii, p. 246, col. 2 — 17 cm.)

Eggs in apple twig from Fremont county, Colorado, are those of one of the flower crickets, but of which species cannot be determined Mr. Allis, of Adrian, Mich., is of the opinion that *Œcanthus niveus* is confined to the apple and other hard wood, while the oviposition usually referred to this species as found in canes and grapevines belongs to *Œcanthus fasciatus*. The oviposition of these crickets needs further observation and study.

But little harm can result to apple-trees from these egg deposits. The harm is more than counterbalanced by the good done in the large number of plant-lice eaten by *Œcanthus* in its early stages.

The Onion-Fly — *Phorbia ceparum*. (Country Gentleman, for March 30, 1893, lviii, p. 246, c. 2, 3 — 20 cm.)

The onion-fly [replying to inquiry] is distinct from the cabbage-fly, *Anthomyia brassicæ* Bouché, although so similar that the same preventives and remedies may be used for each.

A strongly-recommended remedy is the burdock infusion, of which the method of making is given. Other remedies are kerosene emulsion, tansy decoction, whale-oil soap solution, soot and water, and liquid manures.

As a preventive, is given — the preparation of the soil by deep working, manuring, and rolling. Also, directions for removing infested plants from the ground and for their disposal.

Miss Ormerod's Report. (Country Gentleman, for April 13, 1893, lviii, p. 289, c. 2 — 35 cm.)

Miss Ormerod's work in economic entomology commended; the value of her reports enhanced by their prompt publication: their satisfactory appearance; convenient arrangement of their material; contents of the 16th report; an interesting notice of "club-root." Nearly half the infestations noticed occur also in the United States. Credit due the author for her successful introduction in England of spraying with Paris green and water for insect pests.

Myriapods and Mites in "Scabby" Potatoes. (Country Gentleman, for April 27, 1893, lviii, p. 329, cols. 1, 2 — 37 cm.)

Potatoes from Scarsdale, N. Y., show numerous deep cavities which contain many "thousand-legged" worms, of the species known as *Julus cœruleocinctus* Wood, which is at times quite injurious to potatoes. Neither they nor wire-worms nor earth-worms or mites cause the "scab" with which they are often associated, but are drawn to it as an attractive feeding ground. The "scab" is caused by the fungus *Oospora scabies* Thaxter; bacteria presence sometimes accompanies it. Five of the best preventives of the scab are named. Thousand-legged worms are difficult to contend with; perhaps gas-lime or kainit may arrest their injuries. Mites also occupied the cavities with the *Julidæ*, perhaps referable to *Rhizoglyphus phylloxeræ*. Another instance of its occurrence cited, as also of other species of mites at another time.

[Extended in pages 445-449 of this Report (x).]

Spraying for Codling-Moth. (Country Gentleman, for April 27, 1893, lviii, p. 329, c. 2, 3 — 19 cm.)

In reply to questions — spray soon after the blossoms fall; a second spraying may be made a week or two thereafter; is hardly necessary to spray for the second brood of moths; the arsenites are preferable for the purpose to other insecticides; ordinary soapsuds would not suffice -- a strong soap solution might answer; tobacco solution could not be depended upon, but it might repel oviposition.

[Insects on Lettuce and Cabbage.] (Gardening, for May 1, 1893, i, p. 264, c. 2 — 14 cm.)

Replying to inquiries from Medical Lake, Washington: The caterpillar injuring lettuce was probably *Plusia simplex;* the one burrowing into the heads of summer cabbage and causing wilting and rot, was probably *Plusia brassicæ.* The Plusias may be killed by air-slaked lime, or by pyrethrum powder, or by hot water.

The plant-lice on cabbage, *Aphis brassicæ*, should be sprayed from the under side of the leaves with soapsuds.

The Clover-Hay Worm — Pyralis Costalis (Fabr.). (Country Gentleman, for May 4, 1893, lviii, p. 349, c. 1–3 — 70 cm.)

Appearance of the cocoons; diversity in its scientific designation; features of the *Pyralidæ;* description of the moth and of the caterpillar; injuries not reported from the insect in Europe; injuries recorded in the United States by Walsh; life-history as given by Riley; additional information by Prof. Webster; extent of its injuries to hay; feeds on timothy and possibly straw· preventives and remedies; farther study needed.

When to Spray. (Country Gentleman, for May 11, 1893, lviii, p. 368, c. 2 — 15 cm.)

In answer to inquiries from Brockport, N. Y.: Spray for the canker-worm with Paris green when the apple-tree buds are opening, again before blossoming. For the codling-moth, after the blossoms have fallen, and again a week or ten days later. For preventive of apple scab, spray with a solution of copper sulphate before growth starts, or with ammoniacal solution of copper carbonate. For pear-tree blight, spray with the last-named solution as the leaves begin to open, and repeat two or three times at intervals of two weeks. For quince-tree blight, same as preceding. A formula is given for an insecticide and fungicide combined.

Clover-Leaf Weevil. (Country Gentleman, for May 18, 1893, lviii, p. 386, c. 4 — 29 cm.)

Clover fields in Hillsboro, Va., injured by the clover-leaf weevil, *Phytonomus punctatus.* Imported from Europe; when first noticed; distribution; ravages arrested by fungus attack; indication of attack; habits, life-history and figures in the *Country Gentleman,* for May 29, 1889, in the Annual Report of the Department of Agriculture for 1881, and in the First Report on the Insects of New York. Two remedies: Plowing the field before the larvæ have matured; crushing the larvæ by going over the field after dark with a heavy roller.

Apple-Tree Borer. (Country Gentleman, for May 18, 1893, lviii, p. 387, c. 1 — 17 cm.)

Two pupæ sent from Fairlee, Md., found in the trunk of an apple-tree are those of the apple-tree borer, *Saperda candida* Fabr. *Chrysobothris femorata* (Fabr.) — also an apple-tree borer, is referred to. Probing the Saperda burrow with a wire is the remedy usually employed. A newspaper arranged according to directions given, around the base of the tree, is claimed to be an effectual preventive.

The Bud-Worm. (Country Gentleman, for May 18, 1893, lviii, p. 387, c. 1 — 14 cm.)

The best remedy known for the bud-moth [*Tmetocera ocellana*] is spraying with Paris green just as the buds begin to open. Paris green may be used in a stronger solution without injuring the opening buds, if combined with Bordeaux mixture, than if used alone. Bordeaux mixture would also ward off the very prevalent apple-scab.

A Danger to Apple Buds. (The New York Homestead, for May 25, 1893, xxvii, p. 236, c. 4 — 18 cm.)

The insect eating into the apple buds at Lancaster, N. Y., is the "bud-worm" of *Tmetocera ocellana.* Its injuries, appearance, and habits are given. Its rapid increase necessitates effort for its arrest. How and when the Paris green spray should be applied.

The Pear-Midge. (Albany Evening Journal, for May 20, 1893, p. 6, c. 5—8 cm.)

The pear-midge has made its appearance in Columbia and Greene counties in this State. When first observed; an introduced insect; nature of its injuries; preference for the Lawrence pear.

The Invasion of Plant-Lice in New York. (American Farmer, lxxiv, for June 1, 1893, p. 1, c. 4—28 cm.)

The apple-tree aphis, *Aphis mali*, is unusually abundant, apparently throughout the State. Importance of reducing it by spraying. The early rains do not seem to have materially diminished it. Anxiety of the hop-growers lest the conditions favorable to aphis multiplication this year should so increase the hop-vine aphis that its injuries of 1886 shall be repeated; they are urged to watch for its first appearnce and at once spray for it. The "hop-washings" in England.

[See pages 426–429 of this Report (x).]

The Apple-Tree Aphis. (Country Gentleman, for June 8, 1893, lviii, p. 419, c. 2—15 cm.)

Replying to an inquiry from Seneca county, N. Y.: The aphis may occur on the opening buds without blighting the blossoms. Young aphides are destroyed by heavy rainfalls. Their multiplication may seriously impair fruit crops. Young apple trees may be killed by aphis attack. Importance of spraying to prevent injury just after the aphides have hatched.

Some Potato Pests. (Country Gentleman, for June 8, 1893, lviii, p. 419, c. 2, 3—18 cm.)

A "small black flea" perforating the leaves of potatoes in Scarsdale, N. Y., is the cucumber flea-beetle, *Crepidodera cucumeris*. Its food-plants and remedies.

Wire-worms and thousand-legged worm, *Julus cæruleocinctus*, referred to as operating on field potatoes. *J. cæruleocinctus* not the cause of the scab.—See *Country Gentleman*, for April 27, 1893, p. 329. Kainit given as a remedy for the thousand-legged worm. Wire-worms would not be killed by kainit unless applied in too expensive quantities.

A Greenhouse Pest. (Gardening, for June 15, 1893, i, p. 313, c. 1–3—61 cm.)

Reply made to a communication from Boise, Idaho, of flies injuring plants in a greenhouse:—The fly seems to be an undescribed species. It is one of the "midges" and belongs to the genus *Sciara*, and according to Mr. R. H. Meade, near to the European *S. nervosa*. Some of the flies, received in 1889 from a gentleman in Albany as injuring mushrooms, were sent to Mr. William Falconer. He states that "he had never regarded them as injurious to mushrooms, although there were thousands of them in the mushroom cellars." Remedy, pyrethrum powder. The Sciaræ are numerous in species, both in this country and in Europe. Little careful study has been given them. Two species of Sciara — "the yellow-fever fly" and "the snake-worm"— are referred to.

[Extended in pages 397-399 of this Report (x).]

The Apple-Tree Aphis. (American Farmer, for June 15, 1893, lxxiv, p. 8, c. 6 — 41 cm.)

Whether the unusual abundance of aphides this year will prove destructive to fruit crops will depend largely on meteorological and other conditions that can not be foretold. Recent protracted rains have destroyed large numbers. Nursery trees are frequently killed by them. The apple-tree aphis is vulnerable to proper spraying during a few days of its life, just after hatching. The eggs can not be killed by the winter spraying formerly recommended. Kerosene emulsion, tobacco water, and soapsuds are the best insecticides for the apple aphis. How to kill the bud-worm of *Tmetocera ocellana*.

Immense Swarms of a Butterfly. (New York Homestead, for June 22, 1893, xxvii, p. 273, c. 1, 2 — 19 cm.)

Butterflies sent from Kansas, occurring in immense companies, are the milk-weed butterfly, *Danais Archippus* (Fabr.). It is noted for its congregating in millions for southern migration in September. Accounts by Thaxter, Dr. Hamilton, and Scudder of such assemblies. Its observation at Schoharie. Necessity for its migration southward. From its food-plants it is a harmless species.

A New Peach Insect. (Country Gentleman, for June 29, 1893, lviii, p. 508, c. 2 — 8 cm.)

A plant-bug sent from Brockport, N. Y., as having last year nearly destroyed a crop of peaches by making them rough and pithy, is *Pentatoma juniperina* (Linn.). It has not been previously reported as injurious to peaches, nor has anything been recorded of its habits by our writers.

[Extended in pages 430-432 of this Report (x).]

Caterpillar on Rye. (Country Gentleman, for June 29, 1893, lviii, p 508, c. 2 — 10 cm.)

A caterpillar feeding on the heads of rye in several localities near Stone Ridge, N. Y., is that of one of the Noctuid moths, *Leucania albilinea* Hübner. In former years it has been destructive to wheat, rye and heads of timothy in Pennsylvania, Maryland, and Kansas. It has been called the "wheat-head army-worm," from its resemblance to the army-worm, *Leucania unipuncta*.

The Hellgrammite Fly. (Country Gentleman, for June 29, 1893, lviii, p. 508, c. 3 — 8 cm.)

Identification is made of the pupa of the hellgrammite fly, *Corydalis cornuta* (Linn.) from Cos Cob, Conn. Its transformations and some of its habits are given, with its principal features.

Ants on Fruit-Trees. (Country Gentleman, for July 6, 1893, lviii, p. 523, c. 1 — 19 cm.)

Ants occurring on fruit-trees are believed not to be injurious to the tree or fruit, but are attracted to feed on the "honey-dew" secreted by the infesting plant-lice or aphides. Two species often met with are *Camponotus herculaneus* (Linn.) and *Cremastogaster cerasi* (Fitch). The aphides cause the injury to the foliage; they may be killed by spraying the first that appear, before they find shelter in the curled leaves, with tobacco water, soapsuds, or kerosene emulsion.

[Extended in pages 365–369 of this Report (x).]

A New Grapevine Pest. (Country Gentleman, for July 6, 1893, lviiii, p. 523, c. 1, 2 — 11 cm.)

In reply to a correspondent from North Carolina who writes of the habits and ravages of *Anomola marginata*, for the first time, on his grapevines, answer is made, that although the beetle is widely distributed over the southern part of the United States, it has not been recorded as injurious to the grape, except in a single instance, in Louisiana. Shaking them from the vines into a collector such as recommended by Prof. Smith for the collection of the rose-bug, is, perhaps, the best that can be done to reduce their number. Paris green might safely be used before the grapes begin to ripen.

[Extended on pages 411–413 of this Report (x).]

Ants on Peonies. (Country Gentleman, for July 6, 1893, lviii, p. 524, c. 1, 2 — 12 cm.)

Peonies in Albany thickly populated with black ants fail to give perfect blossoms. The ants are probably merely drawn to them to feed on the sweet secretion of the buds, or on the small insects that visit them — possibly an aphis, but no species is recorded as occurring on the peony. Ants have been seen to carry away small insect visitors of the peony which may have been injuring the blossoms. In Florida they are serviceable in preying on some of the smaller insect pests of the orange.

[See pages 368–369 of this Report (x).]

Three-lined Leaf-Beetle. (Country Gentleman, for July 6, 1893, lviii, p. 524, c. 2 — 9 cm.)

An insect destructive in gardens in Buffalo, N. Y., is identified as *Lema trilineata*, conspicuously marked with three black lines on its wing-covers, and belonging to the destructive family of *Chrysomelidæ*. It is, at times, abundant, and often injurious to the potato crop. Remedies are, beating from the plant into water and kerosene, or spraying with Paris green.

A Useful Beetle. (Country Gentleman, for July 6, 1893, lviii, p. 524, c. 3 — 10 cm.)

A beetle (described) found in Albany in a box of Sicily lemons when opened, is the *Calosoma sycophanta*, of Europe, closely resembling our beautiful *Calosoma scrutator*. These *Carabidæ* are serviceable in their hunting for and feeding on injurious insects, coursing over the ground or climbing trees for their capture, whence they are known as "caterpillar hunters."

[The Angoumois Moth.] (Orange County Farmer, for July 6, 1893, xii, p. 4, c. 5 — 10 cm.)

Corn received from Dr. Collier of the New York State Agricultural Station — the seed from which it was grown said to have been received from Port Jervis, N. Y., and thought to have been infested, shows the work of the above-named insect, *Sitotroga cerealella* (Olivier). From the statement, it can not be determined where the corn became infested.

The remedy for the insect is the vapor of bisulphide of carbon in a close bin or vessel.

[The Wheat-Midge in Central New York.] (Albany Evening Journal, for July 10, 1893, p. 8, c. 9 — 9 cm.)

The wheat-midge is reported from Onondaga county, but not in numbers that threaten much harm, now that the wheat is already hardening. Attacks by the insect in 1884 and in 1854 in New York State are referred to, and also the injury it has been causing for several years in Nova Scotia.

The Wheat-Head Army-Worm. (Country Gentleman, for July 13, 1893, lviii, p. 539, c. 2 — 20 cm.)

Caterpillars which were sent from Chelton Hills, Pa., as being destructive to fields of timothy, are those of *Leucania albilinea*, noticed in the *Country Gentleman*, for June 28, p. 508, as "A Caterpillar on Rye." Also occurs on wheat. Abundant in the Western States. Not unusual in New York (*Fourth Report on the Insects of New York*, p. 56). Habits little known. Infested fields should be thoroughly plowed and raked over in the autumn.

The Zebra Caterpillar. (Country Gentleman, for July 13, 1893, lviii, p. 539, c. 2, 3 — 18 cm.)

The caterpillar feeding on the leaves and pods of pease in Albany, N. Y., is *Mamestra picta*. It is a general feeder on garden plants, preferring those of the *Cruciferæ* and *Leguminosæ*. The mature caterpillar is briefly described. It would be unsafe to apply arsenical poisons if the caterpillars eat into the pods. Picking them off by hand or shaking them from the vines would be a safer method.

Wheat-Weevil. (Country Gentleman, for July 13, 1893, lviii, p. 540, c. 2 — 6 cm.)

A wheat-bin infested with weevil the preceding year, might be fumigated, if tight, with sulphur. When attacking the wheat, the weevil may be killed with the vapor of bisulphide of carbon.

Ground-Beetle. (Country Gentleman, for July 13, 1893, lviii, p. 540, c. 2 — 8 cm.)

The grubs supposed to be killing watermelon plants by feeding on their roots, at Cheviot, N. Y., are one of the *Carabidæ*, possibly a *Pterostichus*. It is quite improbable that their presence among the roots could have caused the death of the vines, as they are carnivorous—living on other insects. *Amara obesa*, also a carnivorous species, referred to.

Although "worms" were sent in the bottle, only one larva was contained in it when received.

Insect on Wistaria. (Country Gentleman, for July 20, 1893, lviii, p. 557, c. 2 — 17 cm.)

An insect occurring in abundance on Wistaria, in Cheviot-on-Hudson, is the two-spotted tree-hopper, *Enchenopa binotata* (Say). It is described and the appearance of its egg-covering given. Spraying the young larvæ in May or early June with kerosene emulsion would arrest the attack. References to articles on it.

Maple-Tree Borer. (Country Gentleman, for July 20, 1893, lviii, p. 557, c. 1, 2 — 15 cm.)

Glycobius speciosus is identified, from Adams, N. Y., and its principal features and its serious injuries to maples given. A preventive is coating the trunk of the tree with soft soap and carbolic acid to prevent deposit of the eggs, and a remedy, cutting out the young larvæ.

Elm-leaf Beetle. (Country Gentleman for July 20, 1893, lviii, p. 558, c. 1 — 8 cm.)

The beetle is identified from New Britain, Conn., and references given to the principal articles upon it in the *Country Gentleman* for the past few years.

Water-Beetle. (Country Gentleman, for July 20, 1893, lviii, p. 558, c. 2 — 9 cm.)

Replying to inquiries from Geneva, N. Y., *Dytiscus Harrisii* (Kirby) is identified, and its marked features given and its habits. The insect may be harmful in feeding on the spawn of fishes and young fish. Its generic name refers to its facility in diving.

A Silk-Worm Moth. (Country Gentleman, for July 20, 1893, lviii, p. 558, c. 2, 3 — 12 cm.)

A moth drawn to an electric light in Albany is *Telea Polyphemus* (Cramer). From its large size it was named after the one-eyed giant, Cyclops, of mythology. Its cocoon is made of strong silk, but can not be reeled. Notice of the unsuccessful experiment of M. Trouvelot in cultivating the caterpillar at Medford, Mass., for utilizing the silk. In the notice of this experiment it was named the "American silk-worm."

Woolly Plant Louse. (Country Gentleman, for July 20, 1893, lviii, p. 558, c 3—8 cm.)

An aphis infesting maple leaves in Red Bank, N. J., is *Pemphigus acerifolii* Riley—a rather rare species usually. From the downy secretion enveloping it, it is difficult to reach it with insecticides. A strong solution of whale-oil soap should be effectual in destroying it.

The Walnut Span-Worm. (Gardening, for August 15, 1893, i, p. 377, c. 2—8 cm.)

A "brown worm" infesting and injuring black walnut trees in Kansas City is probably *Boarmia plumigeraria* Hulst — one of the Geometridæ. It has recently come into notice as a walnut-tree pest in some localities in the Western States. As yet no better remedy is known than spraying with Paris green or London purple in water.

How to Control the Squash-bug. (Gardening, for August 15, 1893, i, p. 377–8, c. 3, 1—16 cm.)

To inquiry from Lowell, Mass., answer is made that this pest may best be controlled by trapping and killing the hibernating individuals when they come abroad for oviposition, for which directions are given. Additional remedies are, destroying the eggs and newly-hatched bugs and protecting the stalks with a mixture of ashes and salt. A preventive is said to be ashes or dry earth with a few drops of spirits of turpentine, sprinkled over the plants.

Humming-Bird Moth. (Country Gentleman, for August 17, 1893, lviii, p. 634, c. 1 — 10 cm.)

Moths, the characteristic features of which are given, are identified as the *Sesia uniformis* of former authors. How they resemble humming-birds in their flight and manner of taking their food, is stated. [The species is now listed as *Hemaris Thysbe* var. *ruficaudus.*]

Bag-Worm. (Country Gentleman, for August 17, 1893, lviii, p. 634, c. 2 — 8 cm.)

A "cocoon" taken from a locust in Buckland, Va., is the case of the bag-worm or basket-worm, *Thyridopteryx ephemeræformis*—a common insect in the Southern States. Its case serves for larval protection, for pupation and oviposition — the female never leaving it. When injurious from abundance the caterpillars may be destroyed by hand-picking and burning or by spraying with Paris green and water.

Grain-Weevil. (Country Gentleman, for August 31, 1893, lviii, p. 674, c. 3 — 10 cm.)

For killing the weevil infesting bins of wheat of one thousand bushels each, in Williamsport, Ind., bisulphide of carbon is recommended for evaporation in open vessels on the top of the grain, using a pound and a half to each ton of grain if the bins are tight at sides and bottom. The operation of the "Tracy House," used for killing the bean-weevil, is described and suggested for use when large amounts of grain are to be treated for the weevil or other [stored grain pests.

The Insects of the Past Year and Progress in Insect Studies. [Read before the Albany Institute April 15, 1890.] (Transactions of the Albany Institute, xii [August], 1893, pp. 227–240.)

Pages 227-229 treat of the injuries from the grain aphis (*Siphonophora avenæ*) and of the hop aphis (*Phorodon humuli*), the prevalence of the apple-tree tent-caterpillar (*Clisiocampa Americana*) and the white-marked tussock-moth (*Orgyia leucostigma*), the unusual abundance of the forest tent-caterpillar (*Clisiocampa sylvatica*), *Otiorhynchus ovatus*, and *Silvanus surinamensis* — which, together with several foot-notes, are in addition to the paper as published in the 7th *Report on the Insects of New York*, 1891, pp. 331-342.

The Cabbage Aphis. (Country Gentleman, for September 14, 1893, lviii, p. 717, c, 1, 2 — 29 cm.)

Aphis brassicæ Linn. is one of the most difficult of the aphids to control by insecticides. Its mealy or powdery coating renders kerosene emulsion only partially effective. It has, however, been highly recommended for it by Prof. J. B. Smith and satisfactorily tested by him, as was also fish-oil soap— 1 lb. to 8 gallons of water, and also ground tobacco dust. How a liquid insecticide should be used against it. Soapsuds said to be efficient. Pyrethrum powder, also hot water recommended. If the eggs survive the winter on the leaves, destroying the stripped leaves ordinarily left in the fields would be very serviceable.

A Beetle Destroying Strawberry Plants. (Albany Evening Journal, for September 27, 1893, p. 1, c. 6 — 11 cm.)

A beetle eating innumerable holes in the leaves of strawberry plants, in Connecticut, is the *Paria aterrima*. The grub feeds on the roots and has been known as the strawberry-root worm. Its injury is new to the Eastern States. The remedy for it is the application of Paris green to the plants in August and September.

Plugging Trees with Sulphur. (Country Gentleman, for September 28, 1893, lviii, p. 753, c. 3, 4 — 35 cm.)

There is no virtue in sulphur placed in holes bored in trees and plugged, in preventing insects feeding on the foliage. It has proved valueless in experiments made for testing it. Where it has seemed to be successful, the apparent success may be otherwise explained. Sulphur is not soluble in sap, and even if it were it would be beyond the reach of the sap at the depth at which it is usually placed. Experiments made by Dr. Fitch apparently showed that sulphur, if it could be taken in the circulation, promoted the growth and health of the apple-tree tent-caterpillar. An Iowa fruit-grower testifies to the worthlessness of the "sulphur cure."

Black Blister Beetle Attack on Asters. (Gardening, for October 1, 1893, ii, p. 28, c. 3 — 16 cm.)

Insects sent from Illinois as destructive to asters, are *Epicauta Pennsylvanica* DeGeer. The method employed by the correspondent for killing them which proved so successful, viz., sprinkling the beetles with a fine spray and then applying pyrethrum powder, is probably as good a one as can be used, as this species is known to be readily affected by pyrethrum, and the wetting would cause the powder to adhere. Pyrethrum is only a contact insecticide. Some insects, as the rose-bug, are not killed by it.

The Clover-Seed Caterpillar. (Country Gentleman, for October 5, 1893, lviii, p. 773, c. 1, 2 — 20 cm.)

Clover-seed submitted from Miami county, Ind., much of which "has been hulled out like beans eaten by bugs" and left so light as "to blow away from the huller in cleaning," shows the work of the clover-seed caterpillar, *Grapholitha interstinctana* Clemens. Characters of the caterpillar and moth and life-history are given. Its limited literature and its known distribution. Cutting the clover in June will check its injuries.

Grasshopper Plague in New York. (Country Gentleman, for October 12, 1893, lviii, p. 793, c. 1-4 — 107 cm.)

New York State is exempt from the Rocky Mountain locust, *Melanoplus spretus; M. femur rubrum* and *M. atlanis* are the two destructive species of the Eastern States; injuries from them in New Hampshire, Maine, etc.; comparison of appearance and habits of the two; their operations in western counties of New York the present year; other associated species; present condition of the plague; will the insects abound next year? how to prevent their ravages, through destruction of eggs, plowing under, use of the hopperdozer and the bran-mash poison.

[See pages 439–445 of this Report (x).]

A Potato-Beetle Killer. (Orange County Farmer, for October 19, 1893, xiii, p. 1, c. 7 — 15 cm.)

A beetle sent as "the new potato-bug killer," of which sensational stories have appeared in many papers this year, is identified as *Lebia grandis*, one of the Carabidæ, and long known as an efficient destroyer of the potato-beetle. The instantaneous death resulting from its bite and its ferocity as narrated are, of course, imaginative.

Insect Pests. (Gardening, for November 15, 1893, ii, p. 77 — 14 cm.)

Of three species of insect larvæ sent for name from Medical Lake, Washington, and received in poor condition, only one — said to occur in great number on apple-trees — can be doubtfully identified, as *Sphinx drupiferarum*. Of one of the larvæ, feeding on rutabagas, the features are given.

On Arsenical Spraying of Fruit-Trees While in Blossom. (Insect Life, vi, 1893, pp. 181–185.)

It is still a question if the observed mortality of bees visiting sprayed blossoms is the result of the arsenic or some other cause or causes. The experiments of Professors Webster and Cook are cited. A satisfactory test would be the examination of the stomachs of bees believed to have been poisoned by the arsenic. Legislation in Ontario against spraying fruit-trees while in blossom. May arsenic blight the blossoms? Until the harmlessness of spraying at this time can be established it should be discontinued, but if harmless it should not be intermitted during the blossoming season, when several pests can be better controlled than at any other time. Seventeen species are named which are operating destructively at this time.

Eighth Report on the Injurious and Other Insects of the State of New York for the Year 1891. Albany, 1893. [Issued February 7, 1894.] Pages 218, figures 53. (Forty-fifth Annual Report on the New York State Museum for the Year 1891. Albany, 1892 [issued in February, 1894], pp. 103–320, figs. 53.)

The contents are: INTRODUCTORY. INJURIOUS INSECTS: Synchlora glaucaria, the Raspberry Geometer. Bucculatrix Canadensisella, the Birch-leaf Bucculatrix. Diplosis pyrivora, the Pear-midge. Clastoptera obtusa, the Obtuse Clastoptera. Clastoptera pini, the Pine Clastoptera. Chauliodes pectinicornis, the Comb-horned Fish-fly. Corydalis cornuta, the Horned Corydalis. NOTES ON VARIOUS INSECTS. Thalessa lunator, the Lunated Long-sting. ? Janus flaviventris, the Currant-stem Girdler. Nematus Erichsonii, the Larch Saw-fly. Feniseca Tarquinius, the little Orange Butterfly. Eudryas grata, the Beautiful Wood-nymph. Scoliopteryx libatrix, the Scallop-wing. Exechia species? a Fungus Gnat. Telephorus? bilineatus, occurring on snow. Lachnosterna fusca, the White-grub of the May-beetle. Cyllene pictus, the Hickory Borer. Tenebrio molitor, the Meal-worm. Pulvinaria innumerabilis, the Maple-tree Scale Insect. Gryllus luctuosus, the Common Black Cricket. Trombidium locustarum, the Locust Mite. INSECT ATTACKS — THEIR REMEDIES AND PREVENTIVES. Remedies for the Peach-tree Borer. An Ichneumonized Caterpillar. Interesting case of Parasitism. A New Onion Pest, Agrotis ypsilon. The Stalk-borer, Gortyna nitela, as an External Feeder. The Cow-horn Fly in New York. Wire-worms and Remedies for them. The Rose-bug and How to Kill it. The Maple-tree Borer, Glycobius speciosus. The Squash-bug, Anasa tristis. The Hop-vine Aphis and Remedies. The Melon Aphis, Aphis cucumeris. Melon and Strawberry Pests: Aphis cucumeris and Corimelæna pulicaria. Scale Insects on Camellia and Oleander. A Grapevine Scale Insect, Lecanium sp.? Apple-tree Insects of Early Spring. Some Injurious Insects of 1890. APPENDIX: (A) ENTOMOLOGICAL ADDRESSES. Some Injurious Insects of Massachusetts. Our Insect Enemies and How to Meet them. (B) PUBLICATIONS OF THE ENTOMOLOGIST DURING

1891. (C) PUBLICATIONS OF THE ENTOMOLOGIST FOR 1875 AND 1876. (D) Contributions to the Department. (E) CLASSIFIED LIST OF INSECTS NOTICED IN THIS REPORT. GENERAL INDEX.

Ninth Report on the Injurious and Other Insects of the State of New York, for the year 1892. Albany, 1893. [Issued March 2, 1894.] Pages 211, figures 34. (Forty-sixth Report on the New York State Museum, for the year 1892. Albany, 1892 [issued in March, 1894], pp. 289-495, figs. 34.)

The contents are: TRANSMITTAL. INJURIOUS INSECTS: Anthrenus scrophulariæ and Attagenus piceus, two Carpet Beetles. Tenebrio obscurus, the American Meal-worm. Pollenia rudis, the Cluster-fly. Murgantia histrionica, the Harlequin Cabbage-bug. Psylla pyricola, the Pear-tree Psylla. Chortophaga viridifasciata, the Green-striped Locust. NOTES ON VARIOUS INSECTS, etc. Eriocampa cerasi, the Cherry-tree or Pear-tree slug. Papilio Cresphontes, the Yellow-banded Swallow-tail. Podosesia syringæ, the Syringa Borer. Carpocapsa pomonella, the Codling-moth. Dynastes Tityus, as a Fruit-eater. Crioceris asparagi, the Asparagus Beetle. Systena frontalis, injuring Gooseberry Foliage. Chauliognathus Pennsylvanicus, the Pennsylvania Soldier-Beetle. Pissodes strobi, the White-pine Weevil. Myzus cerasi, the Cherry-tree Aphis. Pemphigus tessellata, the Alder-blight Aphis. Phylloxera vitifoliæ, the Grapevine Phylloxera. Crangonyx mucronatus, a Blind Shrimp in Wells. Insectivorous Birds for Protection. INSECT ATTACKS: Resistance of Fleas to Insecticides. White Grubs Injuring Nursery Stock. The White Grub Eaten by the Robin. A Maple-tree Pruner, Elaphidion parallelum. The Striped Cucumber Beetle, Diabrotica vittata. The Grape Curculio, Craponius inæqualis. The Peach-bark Scolytus, Phlœotribus liminaris. An unrecognized Attack on Pease. The Plum-tree Aphis, and the Brown Rot. The Currant Aphis, Myzus ribis. Aphides and Myriapods as Aster and Lily Pests. Some Apple-tree Insects. Beet Insects. Diseased Austrian Pines. APPENDIX. (A) CATALOGUE OF THE KNOWN HOMOPTERA OF THE STATE OF NEW YORK IN 1851. (B) ENTOMOLOGICAL ADDRESSES. (C) LIST OF PUBLICATIONS OF THE ENTOMOLOGIST. (D) PUBLICATIONS OF THE ENTOMOLOGIST DURING THE YEARS 1870-1874. (E) CONTRIBUTIONS TO THE DEPARTMENT. (F) CLASSIFIED LIST OF INSECTS NOTICED IN THIS REPORT. GENERAL INDEX.

Grubs Destroying Mermet Roses. (The Florist's Exchange, for February 10, 1894, vi, p. 176, c. 1 — 7 cm.)

Grubs working at the roots of Mermet roses belong to the "white grubs" and probably to the genus of *Lachnosterna*, the larvæ of which can not be specifically determined. When attacking single plants the roots may be partly uncovered and the grubs taken and destroyed. When this is not practicable, kerosene emulsion may be poured over the roots and followed by an application of water to carry it into the ground and reach the grubs.

A Maple-Tree Scale Insect. (Gardening, for March 15, 1894, ii, p. 206 — 18 cm.)

Silver maples in Maryland, brought three years ago from an eastern nursery and now seriously affected with a scale insect (no examples sent), are probably infested with the "maple-tree scale insect," *Pulvinaria innumerabilis* (Rathvon). The characters and habits of this species are given and the means of destroying it with kerosene emulsion at its hatching time. If it be some other species it could be destroyed by the same means, but would require examination with a magnifier to discover the vulnerable egg-hatching period. Mr. Wm. Falconer's experience with scale insects quoted.

The Rose Slug. (Gardening, for April 1, 1894, ii, p. 230 — 27 cm.)

A remedy is asked for destruction of roses by the rose slug, for the past two years in Tracy City, Tenn. The most simple remedy is dusting with hellebore or spraying with one ounce of the powder in one gallon of water, preferably after dark, when the slugs are feeding on the upper surface of the leaves. Mr. Howard's "spraying with cold water remedy" is given. Brief account of the common rose slug, *Monostegia rosæ*, and of two other species (sawflies) recently introduced from Europe, viz., the bristly rose worm, *Cladius pectinicornis* Four., and the curled rose worm, *Emphytus cinctus* (Linn.)

White Worms at the Roots of House-plants. (Gardening, for April 15, 1894, ii, p. 257, c. 2 — 7 cm.)

Strong mustard water applied will bring the worms to the surface of the ground where they may be readily killed. Tobacco water or pyrethrum water will probably kill the worms. One ounce of corrosive sublimate to thirty gallons of water has been recommended, but it is too poisonous a substance for general use.

Apple Maggot — Trypeta Pomonella. (Country Gentleman, for May 3, 1894, lix, p. 349, c. 1, 2 — 40 cm.)

The small larvæ which destroy apples by tunneling them in every direction as described in an inquiry of name and remedy, from New Salem, N. Y., are the "apple maggot" of *Trypeta pomonella* Walsh. Figures of the insect in its different stages are given, as also its habits, etc. It is known to infest seventy varieties of apples. It can not be reached by spraying with insecticides. The best remedies are, destroying the infested fruit, and searching for and destroying the pupæ in bins and barrels. Where a valuable study and extended account of the insect may be found.

The Foe of Shade-Trees. (Albany Evening Journal, for May 7, 1894.)

Notice of the elm-tree bark-borer [*Saperda tridentata*] infesting shade-trees in Albany. How the borer works, and the best remedies to be employed for repelling egg-deposit or destroying the grubs.

The Cottonwood Beetle. (Syracuse Union, for May 9, 1894, p. 2, c. 1 — 44 cm.)

A beetle sent for determination, etc., as destroying acre after acre of basket-willows in the vicinity of Syracuse, is identified as *Lina scripta* (Fabr.). Has been destructive to cotton-woods in Western States, but not in the State of New York. Observed in Keene Valley feeding on willows. Description of the larva and beetle given. Nature of its injuries. May be controlled by spraying with Paris green. Force pumps that may be used.

[Extended in Ms. of Report (xi).]

The Insect that Kills the Pine-Tree Borers. (Gardening, for May 15, 1894, ii, p. 292, c. 2 — 8 cm.)

Clerus formicarius was brought over from Germany, by A. D. Hopkins, Entomologist of West Virginia Agricultural Experiment Station, at Morgantown, W. Va., and introduced into the pine forests of that State, to prey upon *Dendroctonus frontalis* and other Scolytid bark-borers that were rapidly destroying the pines and rendering them unfit for timber.

Probably White Grubs. (Country Gentleman, for May 17, 1894, lix, p. 386, c. 2 — 22 cm.)

"White worms about as large as a man's little finger," reported as destroying a lawn, from Oceanic, N. Y., are in all probability white grubs of the May beetle. It is difficut to stop their ravages in lawns and grass lands. The best method known to us is a liberal application of kerosene emulsion, to be followed by heavy waterings to carry the kerosene into the ground to reach and kill the grubs.

Grubs of the size above stated should mature and stop their injuries about the middle of the following month, preparatory to their pupation and change to beetles during the summer.—Benefit may be derived by placing lanterns over tubs of water and kerosene on the lawn, to attract and drown the beetles.

The Periodical Cicada, or the Seventeen-year Locust. Issued as a Circular of 4 pages, Albany, June 19, 1894.

Remarks on the interest attaching to this insect; the two races of *C. septendecim* and *C. tredecim;* the six broods in the State of New York, and particularly the Hudson river valley brood; transformations of the insect; remarkable above-ground chambers built by the pupæ in a locality at New Baltimore, N. Y., for purposes unknown. Figures of the chambers, and of the transformations and egg-laying referred to, given. Request made for replies to twenty questions proposed, relating to the present occurrence of the Cicada.

[See pages 420–425 of this Report (x).]

Pear-Leaf Blister Mite. (Country Gentleman, for June 21, 1894, lix, p. 468, c. 4 — 28 cm.)

Leaves of Kieffer pear-trees (other varieties not affected) sent from Haddonfield, N. J., show the attack of the above-named insect, *Phytoptus pyri*. The development of the gall is given, and features of the microscopic mite that causes it. The attack is rapidly spreading in New York and elsewhere. Picking off and destroying affected leaves in May is serviceable. The proper remedy is spraying with a strong kerosene emulsion (1 to 7) in winter. It can be controlled by this means.

[See pages 453–459 of this Report (x).]

Chestnut Weevil. (Country Gentleman, for July 5, 1894, lix, p. 504, c. 1 — 4 cm.)

From Westchester, Pa., a remedy is asked for the "chestnut worm." *Balaninus caryatrypes* is probably referred to. No remedy is known, unless perhaps one has been discovered by Mr. Gerald McCarthy of the N. C. Agricultural Experiment Station, who has been making special study of the insect.

Rose-Bugs. (Country Gentleman, for July 5, 1894, lix, p. 504, c. 1, 2 — 12 cm.)

The formula for the ammoniacal solution of copper is given in response to request, it having been represented as a remedy for the rose-bug. It will not be effective for this purpose if we may judge from experiments made by Dr. J. B. Smith. The mechanical devices recommended by Dr. Smith for collecting and destroying this insect should be used when it occurs in immense numbers, as in New Jersey.

Friendly Insects. (Country Gentleman, for July 5, 1894, lix, p. 504, c. 2 — 7 cm.)

Specimens from Nassau, N. Y., are identified as pupæ of the "twice-stabbed lady-bird," *Chilocorus bivulnerus* Muls. They are not injurious, but beneficial from their feeding on plant-lice or scale insects, and should, therefore, be protected.

Hellgrammite Fly. (Country Gentleman, for July 12, 1894, lix, p. 520, c. 2 — 3 cm.)

The insect, from Cornwall, N. Y., is identified as *Corydalis cornuta,* and its features given. Its larva is known to fishermen as "the dobson."

Plant-Lice at the Roots of Asters, etc. (Gardening, for July 15, 1894, ii, p. 358, c. 1 — 12 cm.)

Root-lice attacking asters, chrysanthemums and other plants at Dayton, Ohio, are probably *Aphis Middletonii* Thomas. For destroying them, drawing away the earth and applying soapsuds, tobacco water, pyrethrum water or hot water is recommended. The ants that attend them are harmless to the plants.

Ants in Strawberry Beds. (Country Gentleman, for August 2, 1894, lix, p. 568, c. 1 — 9 cm.)

The ants may be destroyed by the use of bisulphide of carbon as directed, if their nests or hills can be found; or, if occurring abundantly upon the plants, pyrethrum water or the dry powder may be used.

Grapevine Caterpillar. (Country Gentleman, for August 2, 1894, lix, p. 568, c. 1 — 8 cm.)

The caterpillar is that of *Thyreus Abbotii;* its distinguishing features are given, and its comparative abundance stated. The other caterpillar noticed on the grape — "looking like a snake, with the head of a frog" — is probably one of the long-bodied and sharp-headed "measuring worms" of the Geometridæ.

Enemies of the Potato Beetle. (Country Gentleman, for August 2, 1894, lix, p. 568, c. 2 — 6 cm.)

Replying to the question — what are the enemies of the potato beetle — the insect enemies alone are so many that a simple list of them would require much space. Papers on them may be found in the publications of Dr. Riley and Dr. Packard, and elsewhere.

Elm-Leaf Beetle. (Country Gentleman, for August 16, 1894, lix, p. 600, c. 2 — 6 cm.)

For the insect [elm-leaf beetle] killing the elm trees in Montclair, N. J., spraying the foliage with Paris green or London purple is recommended, and reference made to previous articles on the insect in the *Country Gentleman*, to be found in the indexes of the volumes.

The Above-Ground Buildings of the Seventeen Year Cicada. (New York Daily Tribune, for August 21, 1894, p. 12, c. 2 — 4 cm.)

Brief abstract of a paper read before the American Association for the Advancement of Science, at Brooklyn, N. Y., in which an account of the structures is given, and the mystery connected with their exceptional occurrence in localities in New York and New Jersey and the purpose that they served, noticed.

Worms destroying Canna Leaves. (Florist's Exchange, for September 8, 1894, vi, p. 788 — 12 cm.)

Caterpillars sent from Charleston, S. C., as destroying the foliage of cannas, are of two species. One has completed its transformations and given out the Hesperid butterfly, *Pamphila Ethlius* after a pupation of eleven days. The other, an Arctian, has spun up in cocoon and may be the common *Spilosoma isabella.*

Sumac Galls. (Country Gentleman, for September 20, 1894, lix, p. 686, c. 1 — 13 cm.)

Galls (described) from Clinton, N. Y., result from the operations of an aphis, *Melaphis rhois* (Fitch). Its life-history is briefly given. The galls occur on *Rhus glabra* and *R. typhina*. Its former rarity in New York is noticed, and its occurrence also in some Western States.

The Box-Elder Plant-Bug. (Country Gentleman, for September 27, 1894, lix, p. 699, c. 2, 3 — 17 cm.)

An insect observed in abundance on the city sidewalks of Shenandoah, Iowa, judging from the description given of it, is the box-elder plant-bug, *Leptocoris trivittatus* (Say). It is a western insect long known as destructive to foliage and blossoms, which has lately developed a fondness for fruit. Means for its destruction are mentioned, and the principal features from which it can be recognized.

[See page 434 of this Report (x).]

A Beetle Feeding on Green Corn. (Country Gentleman, for September 27, 1894, lix, p. 701, c. 2 — 18 cm.)

A beetle sent from Hartford, Conn., found feeding in the tips of standing sweet corn during the month of August, is one of the Scarabæidæ, *Euphoria Inda* (Linn.). It has on different occasions been recorded as injurious to sweet corn while in the milk. It is not known if it commences the attack, or if it merely follows that of birds. Its injuries committed on ripe fruit, are referred to.

Muskmelon Borers at the South. (Country Gentleman, for October 4, 1894, lix, p. 721, c. 2–4 — 55 cm.)

Correspondents from Pendleton, S. C., and Asheville, N. C., are answered: there are two melon-boring caterpillars in the Southern States, destructive to crops — the one, *Eudioptis nitidalis* (Cramer), the other, *Eudioptis hyalinata* (Linn.). Their larval features are given, so far as known, and their feeding habits. To what extent each species operates in the Southern States, is not known. Remedies are suggested for their injuries, the efficiency of which must depend on a farther acquaintance with their life-histories. Some of the literature upon them is cited.

Pear Rust. (Country Gentleman, for October 4, 1894, lix, p. 722, c. 1, 2 — 16 cm.)

A pear received from Genesee county, N. Y., shows a "rust" upon its surface which is not a fungus. It nearly comports with the described features of the "orange rust" of Florida, caused by attack of the orange mite, *Typhlodromus oleivorus* Ashmead; and it is not improbable that this pear rust may be produced by a Phytoptus mite, which may prove to be, upon further observations and the detection of the mite, *Phytoptus pyri*, overflowing from the foliage upon the fruit.

"Pear Rust"—Cause Unknown. (Country Gentleman, for October 25, 1894, lix, p. 773, c. 3 — 12 cm.)

Further examination of a rusted pear submitted to Prof. Galloway, chief of the Division of Vegetable Pathology at Washington, renders it probable that the peculiar appearance of the fruit is but an unusual development of its natural rust — the cause of which is unknown.

The Indian Cetonia. (Gardening, for November 1, 1894, iii, pp. 55, 56, c. 3, 1 — 23 cm.)

Beetles which are thought to be killing a young pear-tree in White Plains, N. Y., by piercing the bark and extracting the sap, are the Indian Cetonia, *Euryomia* [*Euphoria*] *Inda*. The beetle is known to injure ripe fruits by eating into them and to be fond of the sap of the sugar-maple. The above report lends confirmation to a statement made many years ago, but questioned, that it gnawed the bark of young apple-trees for the sake of the sap.

The beetle also injures corn while in the milk by burrowing beneath the husks and eating the kernels. Little can be done to prevent its injuries, except "hand picking." It is apparently local, and has its years of abundance.

Injurious Beetles. (Gardening, for November 1, 1894, iii, p. 56, c. 1, 2 — 22 cm.)

Of the two beetles sent from Detroit, Mich., for name, the one that occurs "in clusters on the trunks of the Norway maple" is thought by the sender to be destructive in the larval state by boring in the trunk of maple, beech, and birch. It is *Euryomia* [*Euphoria*] *Inda*, of which the early history is unknown. If it can be shown to be a borer of these trees, it would be an interesting discovery.

The other beetle seen "coming out of holes in the common maple" is the locust-borer, *Cyllene robiniæ* (Forster). It has no connection with the maple, and probably, from their resemblance, it has been confounded by the person sending it with the maple-tree borer, *Glycobius* [*Plagionotus*] *speciosus* (Say).

A Maple-Tree Borer. (Gardening, for November 1, 1894, iii, p. 56, c. 2 — 12 cm.)

A pupal-case from Millville, N. J., projecting from a maple-tree, is that of *Ægeria acerni* Clemens. In some localities in the Western States, it is very destructive to soft maples. Its egg-deposit may be prevented by white-washing the trunk, or by an occasional wash of soft soap.

The Squash-Bug. (Gardening, for November 1, 1894, iii, p. 56, c. 2, 3 — 11 cm.)

Remedies for the squash-bug, *Anasa tristis* (DeGeer), is asked for, from Convent Station, N. J.

The best remedies are believed to be, placing "traps" of bark, chips, etc., on the ground near the hills, and collecting the bugs that take shelter beneath them; and searching for and crushing the egg-clusters to be found on the under-side of the leaves.

Report of the State Entomologist to the Regents of the University of the State of New York, for the Year 1893. Albany, November, 1894. 26 pp.

Contains — Transmittal: Increasing Interest in the Work of the Department; Publications of the Entomologist: Additions to the State Collection: Collections Made in the Adirondack Mountains: Operations Against the Gypsy Moth in Massachusetts: The Destructive Wheat-midge in Western New York: Remarkable Appearance of Aphids or Plant-Lice: A Grasshopper Plague in Western New York: Insect Defoliators of Shade and Forest-Trees: APPENDIX: Index to Report for 1886.

[Included in part in this Report (x).]

The San José Scale. (Albany Evening Journal, for November 7, 1894, p. 6, c. 5 — 20 cm.)

The San José Scale, *Aspidiotus perniciosus*, is found in a pear orchard at Kinderhook, N. Y., where it had been introduced in nursery stock purchased in New Jersey two years ago. As soon as it was detected, the trees were taken up and burned, and it was hoped that it had been exterminated, but, unfortunately, other trees from the same source, received previously, were also infested. It is now found in abundance on these: they will also at once be taken up and burned.

This scale — seen in San José twenty years ago,— has also been introduced into Maryland and Virginia, and exists at least in one other locality in New York, viz., in nurseries on Long Island. Its successive broods, and fruit-trees on which it occurs, are stated.

"North Dakota's New Bug." (Country Gentleman, for November 22, 1894, lix, p. 841, c. 2, 3 — 32 cm.)

An insect, the appearance and habits of which are given in the Minneapolis Journal by a correspondent from Jamestown, North Dakota, is undoubtedly the box-elder plant-bug, *Leptocoris trivittatus* (Say) — the same as noticed in the *Country Gentleman* of September 29th. It has never before been recorded as appearing in such number. The object of these gatherings can not be accounted for. Its distribution throughout the western part of the United States is stated. That it has not extended eastward of the Mississippi River is strange, since its favorite food-plant on which it breeds, *Negundo aceroides*, is widely distributed throughout the eastern half of the United States. Reference is made to other notices of the insect.

[See page 435 of this Report (x).]

Experiment Station Work on Long Island. (American Agriculturist, for December 1, 1894, liv, p. 404, c. 1 — 3 cm.)

Letter in relation to the value of the work being done on Long Island through the Geneva Agricultural Experiment Station, as shown in the discovery of the San José scale in nurseries on the Island: the great importance of arresting its spread and accomplishing its extermination in its eastern occurrence.

Grubs in Manure. (Country Gentleman, for December 27, 1894, lix, p. 931, c. 4 — 18 cm.)

The "white grubs" found in manure, are not those of "the tumble-bug" as stated by a correspondent, nor of the May-beetle, but of another species allied to the latter, viz., *Ligyrus relictus.* The food-habits of the two will distinguish *L. relictus* when found in manure. There need be no fear of using manure in which "white grubs" are found for field crops, as they can not be injurious to vegetation.

(D)

ENTOMOLOGICAL PUBLICATIONS OF J. A. LINTNER, 1862--1869.

Metamorphoses of Ceratomia quadricornis HARRIS. (Proceedings of the Entomological Society of Philadelphia, i, 1862, pp. 285–293.) Also, separate, with cover and half-title page, December, 1862.

Oviposition; description of the egg; the larva in its first stage; the molting operation described; the second, third and fourth stages; time of molting; the fifth stage after the fourth molt; the mature larva; preparation for pupation; the pupal cell and its construction described; the final molt to the pupa; the pupa described; length of the seven stages; when the moth emerges; larval liability to being parasitized; features of the imago.

Notes on Some of the Diurnal Lepidoptera of the State of New York, with Descriptions of their Larvæ and Chrysalides. (Proceedings of the Entomological Society of Philadelphia, iii, 1864, pp. 50–64.) Also, separate, with cover and title page, May, 1864.

The following species are noticed: Papilio Turnus *Linn.*, Papilio Asterias *Fabr.*, Papilio Troilus *Linn.*, Pieris oleracea (*Harris*), its three broods, Colias Philodice *Godt.*, Grapta comma (*Harris*), Grapta Faunus *Edw.*, Grapta Progne (*Fabr.*), Grapta j-album (*Godt.*), Vanessa Antiopa (*Linn.*), Vanessa Milbertii (*Godt.*), Limenitis Arthemis (*Drury*), Limenitis disippus (*Godt.*), Pyrameis huntera (*Sm.–Abb.*). Also, notes of capture of some of the Diurnals, with notes of comparative abundance.

Description of the Larva of Dryocampa rubicunda (*Fabr.*). (Proceedings of the Entomological Society of Philadelphia, iii, 1864, pp. 426, 427.)

The mature larvæ taken from sugar-maple is described.

Notes on some Sphingidæ of New York, with Descriptions of their Larvæ and Pupæ. (Proceedings of the Entomological Society of Philadelphia, iii, 1864, pp. 645–672.) Also, separate, with cover and title page, December, 1864.

Importance of the knowledge of the early stages of the Sphingidæ; Sesia Thysbe *Fabr.*, its larva and pupa, with features of the several segments; Sphinx quinquemaculata *Stephens*, three varieties of the larva, and the pupa; Sphinx cingulata, the three larval varieties, and the pupa; Sphinx ——?

[eremitus (*Hübn.*)], larva and pupa; Sphinx cinerea *Harris*, larva, food-plants, pupa, imagoes and "assemblying;" Sphinx Kalmia *Sm.-Abb.;* Sphinx drupiferarum *Sm.-Abb.*, larva, food-plants and pupa; Philampelus satellitia [P. Pandorus (*Hübn*)], larva and pupa; Philampelus Achemon (*Drury*), larva, pupa, and imago; Deilephila Chamænerii *Harris*, larva, pupa, imago; Deilephila lineata (*Fabr.*), larva; Darapsa Myron (*Cramer*), larva, pupa, imago; Ceratomia quadricornis *Harris* [C. Amyntor (*Hübn.*)], pupa; Smerinthus excæcatus (*Sm.-Abb.*), larva, pupa; Smerinthus ——? [excæcatus], larva, care of Smerinthus pupæ; Smerinthus juglandis (*Sm.-Abb.*), larva, pupa; Ellema Harrisii *Clemens*, larva, pupa; Sphinx larvæ on poplar (Notodonta dictæa (*Linn.*) = Pheosia rimosa *Pack.*]; list of undescribed larvæ of N. Y. State Sphingidæ.]

A Hundred-fold Return for a Trifling Expenditure. (Utica Morning Herald, for May 11, 1866, 48 cm.)

The study of entomology in its utilitarian aspects commended; notices the growing appreciation of entomological investigations, and commending to the patronage of the public the *Practical Entomologist*, published at a nominal price by the Entomological Society of Philadelphia, with special reference to an article in it on a remedy for the Black-knot of plum and cherry-trees.

Description of a New Species of Grapta, and Notes on G. interrogationis. (Transactions of the American Entomological Society, ii, 1869, pp. 313–319.) Also, separate, May, 1869.

Description of *Grapta umbrosa*, and difference from *G. interrogationis;* compared, also, with *G. c-aureum* Fabr., of Europe.

[Subsequently shown, by breeding, to be a seasonal variety of *G. interrogationis* Fabr.]

(E)

CONTRIBUTIONS TO THE DEPARTMENT IN 1893.

The following are the contributions that have been made to the Department during the year 1893.

HYMENOPTERA.

Cluster of cocoons of *Apanteles congregatus* (Say) from a plum-tree. From JAMES WYNKOOP, Catskill, N. Y.

Thalessa atrata (Fabr.). From W. McALLISTER, Albany, N. Y. The same, taken from numbers ovipositing in a maple stump, June 29th; from G. R. HITT, Albany, N. Y. The same, July 10th; from P. F. MATTIMORE, Menands, N. Y.

LEPIDOPTERA.

Larva of *Thyreus Abbotii* Swainson, June 27th. From JAMES A. VAN HORN, Albany, N. Y. The same insect, from Mrs. E. B. SMITH, Coeymans, N. Y.

Larva of *Ampelophaga Myron* (Cramer), ichneumonized, September 4th. From JOHN T. ROBERTS, Syracuse, N. Y.

Ceratomia Amyntor (Hübner), imago, July 1st. From H. GUYER, Albany, N. Y.

The bag-worm, *Thyridopteryx ephemeræformis* (Haworth). From F. STRAUB, Burton, Texas.

Actias Luna (Linn.). From P. F. MATTIMORE, Menands, N. Y.

Larvæ of *Hadena turbulenta* (Hübn.) feeding on catbrier (*Smilex*). From H. G. DYAR, New York city.

Larva of *Gortyna cataphracta* Grote, boring in raspberry cane, June 19th. From Prof. C. H. PECK, Menands, N. Y.

Larva of *Gortyna nitela* Guen., in dahlia stalk, July 17th. From PRICE & REED, Albany, N. Y.

Larvæ of *Leucania albilinea* Hübn., on heads of rye, June 18th. From C. C. HARDENBERGH, Stone Ridge, N. Y. The same, June 29th; from A. PARDEE, Jr., Chelton Hills, Pa.

Ephestia interpunctella Zeller. Moths emerging in a warm room, April 12th. From J. F. Rose, South Byron, N. Y.

Larvæ of *Tmetocera ocellana* Schiff., nearly mature; and *Coleophora* sp. (probably *Fletcherella* — imago not yet obtained), from pear-trees, June 3d. From David K. Ball, West Brighton, N. Y.

Clover seed injured by larvæ of *Grapholitha interstinctana* Clemens, September 7th. From John M. Jenkins, Miami Co., Ind.

The Angoumois moth, *Sitotroga cerealella* (Olivier), in wheat; from J. E. Wittmer, Montgomery Co., Pa. The same, in corn stored in a commission house; from H. R. Wright, Albany, N. Y.

Cocoons of *Antispila nyssæfoliella* Clemens, within cuttings of leaves of *Nyssæ multiflora* — the sour gum, together with some of the cut leaves. From H. G. Dyar, New York city.

Cocoons of *Bucculatrix pomifoliella* Clem., on apple twigs; from E. Rumley, Clyde, N. Y. The same, with numerous puparia of *Derostenus* sp.?; from F. A. Fitch, Randolph, N. Y.

Cocoons of *Micropteryx pomivorella* Packard, from apple. From James Fletcher, Ottawa, Canada.

Diptera.

Galls of *Lasioptera vitis* O. S., on grapevine, June 27th. From George Uhrig, Hudson, N. Y.

Pears infested with the pear-midge, *Diplosis pyrivora* Riley, May 22d. From Theo. A. Cole, Catskill, N. Y.

Examples of *Sciara caldaria* n. sp. infesting a greenhouse. From Mrs. G. Seaman, Boise, Idaho.

Larva of *Scenopinus fenestralis* (Linn.), from underneath a carpet, January 24th. From Mrs. H. D. Graves, Ausable Forks, N. Y.

Parasitized larvæ of *Eristalis tenax* (Linn.), August 31st; from J. F. Rose, South Byron, N. Y. The same, from J. B. Names, Phœnix, N. Y.

The cluster-fly, *Pollenia rudis* (Fabr.), infesting a dwelling-house, August 31st. From Wirt D. Walker, Pittsfield, Mass. Also, the same, from Mrs. E. B. Smith, Coeymans, N. Y.

The chrysanthemum-fly, *Phytomyza chrysanthemi* Kowarz, mining leaves of Cinerarias in greenhouses of St. Vincent's Male Orphan Asylum, Albany, N. Y., February 13th. From James O. Fanning, Albany, N. Y.

Coleoptera.

Dytiscus Harrisii Kirby, July 9th. From R. E. Taylor, Geneva, N. Y.

Examples of *Megilla maculata* (De Geer), April 19th, from a large hibernating colony underneath a wood-sorrel. From Mrs. C. H. Wheeler, Boston, Mass.

Epilachna borealis Thunb., July 17th. From O. W. Smith, Meriden, Conn.

The rose-beetle, *Macrodactylus subspinosus* (Fabr.), from apples, July 1st. From Hon. James A. Place, Oswego, N. Y.

Euphoria melancholica (Gory), *Neoclytus erythrocephalus* (Fabr), and *Donacia piscatrix* Lac. From L. N. Gillis, Alexandria, Va.

Plagionotus speciosus (Say) — living imago, July 7th. From D. F. Harris, Delano, N. Y.

Monohammus confusor (Kirby), living imago, from 4th floor of the Capitol. From M. Cassidy, Albany.

Pupæ of *Saperda candida* Fabr., May 8th. From J. R. Mordecai, Fairlee, Md.

The strawberry weevil, *Paria aterrima* (Oliv.) — 7 examples of imago, feeding on strawberry leaves, September 13th. From S. B. Hill, Waterbury, Conn.

The elm-leaf beetle, *Galerucella xanthomelæna* (Schrank) in egg, larva, and imago, July 12th. From Theo. A. Stanley, New Britain, Conn.

Larvæ of the plantain flea-beetle, *Dibolia borealis* Chev., mining plantain leaves, June 19th. From C. L. Shear, Alcove, N. Y.

Bruchus obtectus Say, from beans stored in the pod in 1891. From Prof. F. L. Harvey, State College, Orono, Me.

The oil-beetle, *Meloe angusticollis* Say, August 30th. From Mrs. H. D. Graves, Ausable Forks, N. Y. The same, from Mrs. E. B. Smith.

Macrobasis unicolor (Kirby), feeding on egg-plant and potatoes, July 17th. From W. H. Bentley, Bull's Head, N. Y.

Otiorhynchus ovatus (Linn.) — several examples from cabbage, August 17th. From R. J. Dimon, Hastings, N. Y., per Dr. P. Collier.

Larvæ of the punctured clover-leaf weevil, *Phytonomus punctatus* (Fabr.), from an infested clover field. From J. R. Neer, Hillsboro, Va. Same, from Mrs. E. B. Smith, Coeymans, N. Y.

Larvæ of the quince curculio, *Conotrachelus cratægi* Walsh, and 3 of the imagos, October 8th. From T. C. Maxwell Bros., Geneva, N. Y.

Lixus concavus Say. From Mrs. E. B. Smith, Coeymans, N. Y.

The rice-weevil, *Calandra oryzæ* (Linn.) — the larva and imago in corn, September 11th. From E. C. Brown & Co., Rochester, N. Y.

Hemiptera.

Pentatoma juniperina (Linn.), injuring peaches, June 14th. From George A. Rich, Brockport, N. Y.

The four-lined leaf-bug, *Pœcilocapsus lineatus* (Fabr.), June 27th. From N. Pomroy, Lockport, N. Y.; from Mr. Hunting, Gallupville, N. Y.

The giant water-bug, *Belostoma Americanum* Leidy, taken from beneath ice in running water, January 18th. From Allen D. Wadsworth, East Chatham, N. Y.

Enchenopa binotata (Say), from Wistaria, July 3d. From R. R. Livingston, Cheviot-on-Hudson.

Siphonophora sp.? on *Celastrus scandens.* From Miss J. A. Lansing, Albany, N. Y.

The apple-tree aphis, *Aphis mali* (Fabr.), abounding on apple-buds, May 8th. From J. J. Bullen, Lincoln, N. Y.

Migrant from plum of hop-vine aphis, *Phorodon humuli* (Schrank), June 8th. From A. Rickard, Middleburgh, N. Y.

Phorodon humuli (Schrank) — migrants and their first brood, from Otsego county; also a small hop-vine leaf of about one-fourth inch area, containing 25 migrants, from Munnsville, N. Y. From C. C. Risley, Chairman Hop-Growers' Association, Waterville, N. Y.

Larvæ, pupæ, and imago of pear-tree aphis: the same of quince-tree aphis, May 8th. From Prof. C. H. Peck, Menands, N. Y.

Pulvinaria innumerabilis Rathvon with its egg-masses, June 5th. From Sylvester Gridley, Waterville, N. Y.

Lecanium hesperidum Linn., on fern; and *Mytilaspis pomorum* Bouché on *Cratægus oxycantha.* From C. S. Sheldon, State Normal School, Oswego, N. Y.

Orthoptera.

The walking-stick, *Diapheromera femorata* (Say), October 8th. From Ernest Kuehn, Albany, N. Y. The same, from Thomas Grayles, Albany, N. Y.

Egg deposit in apple-twigs of probably *Œcanthus niveus* (DeGeer). From D. F. Woodruff, Fremont county, Colorado.

Amblycorypha oblongifolia (DeGeer). From Mrs. E. B. Smith, Coeymans, N. Y.

Neuroptera.

Pupa of *Corydalis cornuta* (Linn.), June 16th. From J. C. Leonard, Cos Cob, Conn. Living imago of the same, June 22, from Herbert Bothwell, Albany, N. Y.

Thysanura.

Lepisma sp.? from papers in the Capitol. From Miss J. S. Hoag, Albany, N. Y.

Arachnida.

Trichodectes sphærocephalus Nitzsch, on wool of sheep. From J. B. Nichols & Son, Liberty, N. Y.

Myriapoda.

Julus cœruleocinctus Wood, from flower-beds. From Wm. Letchworth, Portage, N. Y.

(F)

CONTRIBUTIONS TO THE DEPARTMENT IN 1894.

Hymenoptera.

The large digger-wasp, *Sphecius speciosus* (Drury). From J. A. Paine, Tarrytown, N. Y.

Pelecinus polyturator (Drury), Sept. 7th. From John G. Linsley, Oswego, N. Y.; also from George R. Howell, Albany, N. Y.

Numerous larvæ of *Lophyrus Lecontii* Fitch, feeding on white pine, August 21st. From J. H. Ten Eyck Burr, Cazenovia, N. Y.

Examples of the wheat saw-fly, *Cephus pygmæus* (Linn.). From Prof. J. H. Comstock, Cornell University, Ithaca, N. Y.

Lepidoptera.

Larvæ (10) of *Papilio Asterias* Fabr., feeding on parsley. From Wm. Falconer, Glen Cove, L. I., N. Y.

Papilio Cresphontes Cramer — crippled examples and puparia, and *Sphinx kalmiæ* Sm.-Abb. From Miss J. A. Lansing, Albany, N. Y.

Amphion Nessus (Cramer) — imago, July 23d. From J. Byrne, Cambridge, N. Y.

Ampelophaga Myron (Cramer), August 5th, parasitized by *Apanteles congregatus* (Say). From Julius S. Linsley, Oswego, N. Y.

Cocoons of *Orgyia leucostigma* (Sm.-Abb.), abounding on apple-trees — one hundred on some trees in an orchard. From J. F. Rose, South Byron, N. Y.

Actias Luna (Linn.) attracted to light, June 21st. From C. E. Rider, Albany, N. Y. The same, from M. Mandlebaum, Albany, N. Y.

Telea Polyphemus (Linn.), June 14th. From P. M. Van Epps, Glenville, N. Y.

Many larvæ of the Pyralid, *Mecyna reversalis* Guenée, September 20th, feeding on Genista in a conservatory. From Wm. Falconer, Glen Cove, L. I., N. Y.

Larvæ and cases of *Phycis indiginella* Zeller, from apple, March 24th. From W. C. Brass, Carlisle, Ark.

Larvæ of *Oxyptilus periscelidactylus* (Fitch) from tips of grapevine, May 24th. From Walter F. Taber, Poughkeepsie, N. Y.

Larvæ of a Tortricid? (imago not yet obtained) feeding on pease in the pod, in Canada. From N. B. Keeny & Son, Leroy, N. Y.

Larvæ of *Cacœcia rosana* (Linn.) in tied-up leaves of the snow-berry, *Symphoricarpum racemosus.* From Miss J. A. Lansing, Albany, N. Y.

Larvæ of *Coleophora* sp. and *Tmetocera ocellana* (Schiff.) on apple twigs, May 29th. From W. A. Lefler, Albion, N. Y.

Diptera.

Eggs of the pear-midge, *Diplosis pyrivora* Riley, in pear blossoms, May 10th. From Dr. John B. Smith, New Brunswick, N. J.

Many larvæ of *Phora agarici* n. sp., infesting "the new mush-room," *Agaricus subrufescens* Peck, October 5th. From Wm Falconer, Glen Cove, L. I., N. Y.

The cluster-fly, *Pollenia rudis* (Fabr.), September 1st. From Wirt D. Walker, Pittsfield, Mass.

Larvæ and pupæ of *Phorbia cilicrura* Rondani, July 12th, in seed potatoes. From James D. McCann, Elmira, N. Y.

Coleoptera.

Calosoma scrutator (Fabr.) and *Calosoma calidum* (Fabr.) and *Chelymorpha Argus* Licht. From Mrs. Jordan, Greenbush, N. Y.

Buprestis fasciata Fabr., July 31st. From Mrs. E. C. Anthony, Gouverneur, N. Y.

The raspberry gouty gall-beetle, *Agrilus ruficollis* (Fabr.). From M. Brooks, Athens, N. Y.

Copris anaglypticus Say, June 20th. From Prof. James Hall, Albany, N. Y.

Examples of *Dichelonycha elongata* (Fabr.), June 14th, from mountain ash, *Pyrus Americana.* From Richard H. Lawrence, South Salem, N. Y.

Allorhina nitida (Linn.) — 14 examples. From Wm. Falconer, Glen Cove, L. I., N. Y.

Euphoria Inda (Linn.), feeding on corn in the field, in August. From Fred Sturgis, Hartford, Conn. The same, feeding on the sap of trees: from E. Bayley, White Plains, N. Y.

Oak branches cut by *Elaphidion parallelum* (Newm.) From Mrs. G. W. Rains, Newburgh, N. Y.

Branches of apple-tree, ¾ in. diameter, cut off by *Elaphidion* sp. From M. Brooks, Athens, N. Y.

Cyllene robiniæ (Foerst.), reported as emerging from the common maple — probably sent instead of *Plagionotus speciosus*. From Mrs. M. F. Mendell, Detroit, Mich.

Plagionotus speciosus (Say). From W. S. Eggleston, Mt. Riga, N. Y.

Monohammus confusor Kirby, June 25th. From Francis Starr, Albany, N. Y.

Monohammus scutellatus (Say). From Robert Lenox Banks, Albany, N. Y.

Lema trilineata (Olivier). From W. H. Harrison.

Crioceris asparagi (Linn.) and *Crioceris* 12-*punctata* (Linn.), May 2d, from asparagus beds at Brighton. From Silas J. Robbins, Brighton, Monroe Co., N. Y.

Examples of the cottonwood leaf-beetle, *Lina scripta* (Fabr.), devastating osier willows near Syracuse, N. Y., May 4th. From A. Landberg, Syracuse, N. Y.

Galerucella xanthomelæna (Schrank), from the garret of a dwelling-house on Long Island, May 7th. From Dr. J. W. Hall, New York city.

Chelymorpha Argus Licht., June 6th, from a mangel-wurzel field. From John Pigeon, Saugerties, N. Y.

The oil-beetle, *Meloe angusticollis* Say, October 8th. From Jesse Parker, Albany, N. Y.

Macrops indistinctus Dietz, September 13th, reared from a larva in root of celery. From F. A. Sirrine, Jamaica, L. I., N. Y.

A strawberry-weevil, *Anthonomus* sp., July 15th. From H. Stewart, Highlands, N. C.

Larvæ of the chestnut-weevil, *Balaninus ?caryatrypes* Bohe., September 30th. From J. A Lochner & Co., Albany, N. Y.

The grain-weevil, *Calandra granaria* Linn. From Mrs. S. A. Little, Malcom, N. Y.

Hemiptera.

Eggs, pupa, and imagos of *Anasa tristis* (DeGeer), August 14th. From Dr. H. C. Coon, Alfred, N. Y.

Acholla multispinosa DeGeer, occurring on peach-trees, May 8th. From Malcom Little, Malcom, N. Y.

Belostoma Americanum Leidy and *Cicada tibicen* Linn., July 30th. From N. Pomroy, Lockport, N. Y.

Above-ground chambers of the 17-year Cicada, *Cicada septendecim* Linn. From H. VAN SLYKE, New Baltimore, N. Y. The same (3) from near Poughkeepsie; from HENRY S. CURTIS, Poughkeepsie, N. Y. The same, from Bath-on-Hudson, near the rifle range; from W. H. COLEMAN, Albany, N. Y. The same (37), from New Baltimore, N. Y., from W. W. BYINGTON, Albany, N. Y. The same (9), from South Mountain, near Nyack; from BENJAMIN LANDER, Nyack, N. Y.

Above-ground chamber of *Cicada septendecim* L., collected by Prof. J. S. NEWBERRY from a cellar in Rahway, N. J., in 1877. From Prof. DANIEL S. MARTIN, Rutgers Female College, New York.

Above-ground chambers (2) of *Cicada septendecim* race tredecim, Brood xviii, 1894, from the valley of the North Fakins, Knox Co., Missouri. From JASPER BLINE, per W. H. Coleman.

Many pupa cases of *Cicada septendecim* L., from the Rural Cemetery at Menands, in May. From W. H. COLEMAN, Albany, N. Y.

Pupæ and imagos of *Cicada septendecim* L. From M. BROOKS, Athens, N. Y.

Cicada tibicen Linn. From D. F. HARRIS, Adams, N. Y.

Eggs of pear-tree Psylla, *Psylla pyricola* on Bartlett pear twigs, April 23d, and pupæ in May. From M. BROOKS, Athens, N. Y.

The pine-leaf scale-insect, *Chionaspis pinifoliæ* Fitch. From B. KEMPER, Muscatine, Iowa.

The scurfy bark-louse, *Chionaspis furfurus* (Fitch), encrusting twigs of *Cydonia Japonica*, in Arlington, N. J. From A. H. STRATTON, New York city.

Mytilaspis pomorum Bouché, on crab apple; from J. T. ROSE, South Byron, N. Y. The same, on an apple, September 13th; from ROMEYN B. HOUGH, Lowville, N. Y. The same, on lilac; from Miss MARY L. VAN ORDEN, Catskill, N. Y. The same, on apple, from P. D. COOKINGHAM, Pleasant Plains, N. Y.

The gloomy scale, *Aspidiotus tenebrosus* Comstock, occurring on maple. From C. R. MORE, Bird's Nest, Va.

The pernicious scale, *Aspidiotus perniciosus* Comstock, from pear-tree. From L. L. MORRELL, Kinderhook, N. Y.

Lecanium juglandis Bouché, occurring on plum twigs in May. From W. C. BARRY, Rochester, N. Y.; from C. M. HOOKER, Rochester, N. Y., and from Prof. C. H. PECK, Menands, Albany county, N. Y.

Lecanium Fitchii Signoret, occurring in clusters on blackberry canes, June 1st. From Prof. C. H. PECK, Menands, N. Y.

The magnolia scale, *Lecanium tulipifera* Cook. From J. W. ALLIS, Rochester, N. Y.

Lecanium sp.? on oak. From ELLWANGER & BARRY, Rochester N. Y.

Asterolecanium quercicola Bouché, on oak. From Mrs. GEORGE W. RAINS, Newburg, N. Y.

Gossyparia ulmi Geoff., in abundance on elm twigs. From GEORGE T. POWELL, Ghent, N. Y.

ORTHOPTERA.

Egg deposit of white flower cricket, *Œcanthus niveus* (DeGeer) in raspberry cane. From Dr. H. C. COONS, Alfred, N. Y.

The walking stick, *Diapheromera femorata* (Say). From JESSE PARKER, Albany, N. Y. The same, from C. R. HELLER, Albany, N. Y.

Larva of the mole cricket, *Gryllotalpa borealis* Burm., with a fungus growing from its middle. From Mrs. M. W. WELCH, Lake Comfort, N. C.

THYSANURA.

Examples of *Schoturus nivicola* (Fitch), from myriads occurring on trunks of pear-trees, April 13th. From EDWIN C. POWELL, Ghent, N. Y.

Therinobia furnorum (Prov.), (=Lepisma domestica *Packard*) from flour barrels. From JOHN FONDA, Albany, N. Y.

MYRIAPODA.

Juiidæ — species not determined, injurious to tobacco plants. From J. R. LOWE, Big Flats, N. Y.

CRUSTACEA.

Crangonyx mucronatus Forbes — an eyeless shrimp drawn from a driven well. From FRANK M. SIMONS, Ingleside, N. Y.

MISCELLANEA.

Vespa vulgaris Linn., *Pelecinus polyturator* Drury, *Papilio Turnus* Linn., *Deilephila lineata* (Fabr.), *Agrotis herilis* Grote, *Agrotis subgothica* Haw., *Leucania unipuncta* (Haw.), *Hæmatopis grataria* (Fabr.), *Eristalis tenax* (Linn.), *Anasa tristis* (DeGeer), *Euschistus fissilis* Uhler, *Cicada tibicen* Linn., *Cicada septendecim* Linn., *Gastroidea polygoni* (Linn.), *Lachnosterna fusca* (Frohl.), *Amblycorypha oblongifolia* (DeGeer). From Mrs. EMILY B. SMITH, Coeymans, N. Y.

(G)

CLASSIFIED LIST OF INSECTS NOTICED IN REPORTS I-X.

Hymenoptera.

Cladius viminalis *Fallen*, the poplar saw-fly.
Nematus Erichsonii *Hartig*, the larch saw-fly.
Nematus salicis-pomum *Walsh*, the willow-apple gall saw-fly.
Monostegia ignota (*Norton*), the strawberry slug.
Eriocampa cerasi (*Peck*), the cherry-tree or pear-tree slug.
Cephus pygmæus (*Linn.*), the wheat saw-fly.
Phyllœcus flaviventris (*Fitch*), the currant stem girdler.
Urocerus Cressoni *Norton*, Cresson's horn-tail.
Tremex columba (*Linn.*), the pigeon Tremex.
Amphibolips prunus (*Walsh*), the oak-plum gall Cynips.
Cryptus mundus *Provancher*.
Hemiteles thyridopterigis *Riley*.
Limneria fugitiva (*Say*).
Rhyssa persuasoria (*Linn.*), an European long-sting.
Thalessa atrata (*Fabr.*), the black long-sting.
Thalessa lunator (*Fabr.*), the lunated long-sting.
Thalessa Nortoni *Cresson*, Cresson's Thalessa.
Pimpla conquisitor (*Say*).
Pimpla inquisitor (*Say*).
Lampronota frigida *Cresson*, a parasite on the vagabond Crambus.
Sigalphus curculionis *Fitch*, a curculio parasite.
Apanteles congregatus (*Say*).
Microgaster gelechiæ (*Riley*).
Alysia manducator *Panzer*.
Chalcis flavipes *Fabr*.
Catolaccus species, an Angoumois moth parasite.
Perilampus violaceus *Dalm*.
Isosoma captivum *Riley* MS.
Isosoma grande *Riley*, the large joint-worm fly.

Isosoma hordei (*Harris*), the joint-worm fly.
Isosoma tritici *Riley*, the wheat Isosoma.
Isosoma vitis *Saunders*, the grape-seed midge.
Torymus species, parasitic on Cecidomyia betulæ.
Encyrtus bucculatricis *Howard*.
Semiotellus chalcidiphagus *Walsh*.
Pteromalus gelechiæ *Webster*, parasitic on the Angoumois moth.
Pteromalus sp? from bag-worms.
Tridymus species, parasitic on Lasioptera vitis.
Cirrospilus flavicinctus *Riley*.
Entodon species, parasitic on Cecidomyia betulæ.
Derostenus sp.? parasitic on the apple-leaf Bucculatrix.
Tetrastichus species, parasitic on Cecidomyia betulæ.
Trichogramma pretiosa *Riley*, egg-parasite of currant saw-fly.
Camponotus herculaneus (*Linn.*), the large black ant
Formica nigra *Linn.*, the black ant.
Monomorium carbonarium *Smith*.
Monomorium molestum (*Say*), the little yellow ant
Cremastogaster cerasi (*Fitch*), the cherry-tree ant.
Solenopsis geminata (*Fabr.*).
Pemphredon concolor *Say*, a wood wasp.
Eumenes fraternus *Say*, the fraternal potter wasp.

Lepidoptera.

Danais Archippus (*Fabr*), the milkweed butterfly.
Heliconia Charitonia (*Linn.*).
Pyrameis Atalanta *Linn.*, the red admiral.
Thecla strigosa *Harris*, the striped Thecla.
Feniseca Tarquinius (*Fabr.*), the little orange butterfly.
Pieris rapæ *Linn.*, the cabbage butterfly.
Papilio Cresphontes *Cramer*, the yellow-banded swallow-tail.
Nisoniades Icelus *Lintn.*
Nisoniades Somnus *Lintn.*
Nisoniades Persius *Scudd.*
Nisoniades Petronius *Lintn.*
Nisoniades Propertius *Scudd-Burg.*
Nisoniades Nævius *Lintn.*
Eudamus Electra *Lintn.*
Eudamus Nevada *Scudd.*
Eudamus Proteus (*Linn.*).

Thyreus Abbotii *Swains.*
Ampelophaga Myron (*Cramer*), the green grapevine Sphinx.
Protoparce celeus *Hubn.*, the five-spotted Sphinx.
Sphinx Canadensis *Boisd.* the Canadian Sphinx.
Smerinthus geminatus *Say*, the twin-spotted Sphinx.
Melittia ceto *Westw.*, the squash-vine borer.
Podosesia syringæ (*Harris*), the Syringa borer.
Sannina exitiosa (*Say*), the peach-tree borer.
Alypia octomaculata (*Fabr.*), the eight-spotted forester.
Eudryas grata (*Fabr.*), the beautiful wood-nymph.
Pyrrharctia isabella (*Sm.-Abb.*), the black-and-red woolly-bear.
Halisidota caryæ (*Harris*), the hickory tussock caterpillar.
Ocneria dispar (*Linn.*), the gypsy-moth.
Orgyia leucostigma (*Sm.-Abb*), the white marked tussock-moth.
Lagoa opercularis (*Sm.-Abb.*), the rabbit-moth.
Phobetron pithecium (*Sm.-Abb.*), the hag-moth.
Thyridopteryx ephemeræformis *Haworth*, the bag or basket-worm.
Œdemasia concinna (*Sm.-Abb.*), the red-humped apple caterpillar.
Actias Luna (*Linn.*), the Luna moth
Eacles imperialis (*Drury*), the pine emperor moth.
Anisota senatoria (*Sm.-Abb.*), the senatorial oak-moth.
Dryocampa rubicunda (*Fabr.*), the rosy Dryocampa.
Hemileuca Maia (*Drury*), the Maia moth.
Clisiocampa Americana *Harris*, the apple-tree tent-caterpillar.
Clisiocampa sylvatica *Harris*, the forest tent-caterpillar.
Tolype laricis (*Fitch*), the larch lappet.
Heteropacha Rileyana *Harvey*.
Cossus centerensis *Lintn.*, the poplar Cossus.
Cossus querciperda *Fitch*, the oak Cossus.
Zeuzera pyrina (*Fabr.*), the leopard-moth.
Agrotis clandestina (*Harris*), the W-marked cut-worm.
Agrotis saucia (*Hübner*), the variegated cut-worm.
Agrotis ypsilon (*Rott.*), the black cut-worm.
Agrotis species, cut-worms.
Mamestra grandis (*Boisd.*), a poplar feeding cut-worm.
Mamestra picta *Harris*, the zebra cabbage caterpillar.
Hyppa xylinoides *Guenée*.
Nephelodes violans *Guenée*, the bronze-colored cut-worm.
Gortyna cataphracta *Grote*, the raspberry-cane borer.
Gortyna immanis (*Guen.*), the hop-vine grub.

Gortyna nebris *Guenée.*
Gortyna nitela *Guenée*, the stalk-borer.
Leucania unipuncta (*Haw.*), the army worm.
Scoliopteryx libatrix (*Linn.*), the scallop-wing.
Aletia agillacea *Hübn.*, the cotton-worm.
Plusia cultus *Lintn.*
Plusia dyaus *Grote.*
Plusia brassicæ *Riley*, the cabbage Plusia.
Heliothis armiger *Hübn.*, the corn-worm.
Catocala nubilis (*Hübn.*).
Erebus odora (*Linn.*).
Homoptera lunata (*Drury*).
Nematocampa limbaria (*Walk.*).
Synchlora glaucaria (*Guenée*), the raspberry Geometer.
Zerene catenaria *Cramer.*
Eubyia cognataria (*Guenée*).
Anisopteryx vernata (*Peck*), the spring canker-worm.
Anisopteryx pometaria *Harris*, the fall canker-worm.
Eudioptis hyalinata (*Linn.*), the melon-worm.
Eudioptis nitidalis (*Cramer*), the pickle-worm.
Crambus vulgivagellus *Clemens*, the vagabond Crambus.
Crambus exsiccatus *Zeller*, the dried Crambus.
Cacœcia rosaceana *Harris*, the oblique-banded leaf-roller.
Cacœcia argyrospila (*Walker*), the V-shaped Tortrix.
Tortrix fumiferana *Clem.*, the spruce-bud worm.
Penthina nimbatana (*Clemens*), the rose-leaf tyer.
Tmetocera ocellana (*Schiff.*), the eye-spotted bud-moth.
Phoxopteris nubeculana (*Clem.*), the apple-leaf sewer.
Carpocapsa pomonella (*Linn.*), the codling-moth.
Carpocapsa saltitans *Westw.*, the jumping-seed moth.
Mellisopus latiferreana *Wlsm.*
Tinea pellionella (*Linn.*), the clothes-moth.
Incurvaria acerifoliella (*Fitch*), the maple-leaf cutter.
Pronuba yuccasella *Riley*, the Yucca moth.
Sitotroga cerealella (*Olivier*), the Angoumois moth.
Anarsia lineatella *Zeller*, the peach-twig moth.
Coleophora Fletcherella *Fern.*, the apple case-bearer.
Coleophora malivorella *Riley*, the apple-tree case-bearer.
Tischeria malifoliella *Clem.*, the apple-leaf miner.
Bucculatrix Canadensisella *Chamb.*, the Canadian Bucculatrix.
Bucculatrix pomifoliella *Clemens*, the apple-leaf Bucculatrix.

DIPTERA.

Pulex irritans *Linn.*, the common flea.
Cecidomyia balsamicola *Lintn.*, the balsam Cecidomyia.
Cecidomyia destructor *Say*, the Hessian-fly.
Cecidomyia leguminicola *Lintn.*, the clover-seed midge.
Cecidomyia sp.?, within a jumping gall.
Diplosis pyrivora *Riley*, the pear midge.
Diplosis tritici (*Kirby*), the wheat midge.
Lasioptera vitis *O S.*, the grapevine gall midge.
Sciara caldaria *Lintn.*, the green-house Sciara.
Sciara coprophila *Lintn.*, the manure-fly.
Sciara mali (*Fitch*), the apple midge.
Sciara militaris *Now*, the "snake-worm."?
Sciara Thomæ (*Linn.*), the "snake-worm."?
Sciara species, the fungus gnats.
Epidapus scabies *Hopkins*, the potato-scab gnat.
Exechia sp., a fungus gnat.
Simulium molestum *Harris* MS., the black-fly.
Bibio albipennis *Say*, the white-winged Bibio.
Anopheles quadrimaculatus *Say*, the winter mosquito.
Chironomus nivoriundus *Fitch*, the snow-born midge.
Trichocera brumalis *Fitch*, the mid-winter Trichocera.
Scenopinus fenestralis (*Linn.*).
Promachus Fitchii *Ost.-Sack.*
Erax rufibarbis *Macq.*
Microdon globosus (*Fabr.*).
Helophilus latifrons (*Loew*).
Mallota posticata (*Fabr.*).
Spilomyia fusca *Loew.*
Hypoderma bovis (*De Geer*), the ox warble-fly.
Cutereba emasculator *Fitch*, the emasculating bot-fly.
Hæmatobia serrata *R. Desv.*, the cow-horn fly.
Pollenia rudis (*Fabr.*), the cluster-fly.
Lucilia macellaria *Fabr.*, the "screw-worm."
Hylemyia deceptiva *Fitch*, the deceptive wheat-fly.
Phorbia ceparum (*Meigen*), the onion-fly.
Phorbia cilicrura (*Rondani*), the locust-egg Anthomyian.
Phorbia floccosa (*Macq.*).
Anthomyia brassicæ *Bouché*, the cabbage-fly.
Anthomyia radicum *Linn.*, the root-fly.
Anthomyia raphani *Harris*, the radish-fly.

Anthomyia similis *Fitch*, the similar wheat-fly.
Anthomyia zeæ *Riley*, the seed-corn fly.
Pegomyia betarum (*Lintn.*), the beet-fly.
Pegomyia vicina *Lintn.*, a beat-leaf miner.
Trypeta longipennis *Wied.*
Trypeta pomonella *Walsh*, the apple-maggot
Drosophila ampelophila *Loew*, the pickled-fruit fly.
Drosophila sp., a flour-paste fly.
Meromyza Americana *Fitch*, the wheat-stem maggot.
Chloropisca prolifica *Osten-Sacken*, the prolific Chlorops.
Phytomyza chrysanthemi *Kowarz*, the marguerite-fly.
Phytomyza nigricornis *Macq.*
Phora agarici *Lintn.*, the mushroom Phora.

Coleoptera.

Calosoma calidum (*Fabr.*), the fiery caterpillar hunter.
Bembidium quadrimaculatum (*Linn.*).
Harpalus caliginosus (*Fabr.*).
Aleochara anthomyiæ *Sprague.*
Phalacrus politus *Mels.*, in wheat.
Megilla maculata *De Geer*, the spotted lady-bird.
Hippodamia convergens *Guer.*, the convergent lady-bird.
Adalia bipunctata (*Linn.*), the two-spotted lady-bird.
Harmonia picta *Rand.*, the painted lady-bird.
Anatis ocellata (*Linn.*), the fifteen-spotted lady-bird.
Chilocorus bivulnerus *Muls.*, the twice-stabbed lady-bird.
Epilachna borealis (*Fabr.*), the northern lady-bird.
Vedalia cardinalis *Muls.*
Læmophlœus alternans *Erich.*
Dermestes lardarius *Linn.*, the bacon-beetle.
Dermestes vulpinus *Fabr.*, a leather-beetle.
Attagenus piceus (*Oliv.*), the black carpet-beetle.
Anthrenus scrophulariæ (*Fabr.*), the carpet-beetle.
Lathridius ruficollis *Marsh.*
Elateridæ species, wire-worms.
Alaus oculatus (*Linn*), the owl-beetle.
Agriotes mancus *Say*, the wheat wire-worm.
Melanotus communis (*Gyll.*).
Limonius confusus *Le Conte.*
Cebrio bicolor (*Fabr.*).

Agrilus anxius *Gory*, the willow Agrilus.

Agrilus ruficollis (*Fabr.*), the raspberry gouty-gall beetle.

Chauliognathus Pennsylvanicus (*DeGeer*), Pennsylvania soldier-beetle.

Chauliognathus marginatus (*Fabr.*), the margined soldier-beetle.

Telephorus bilineatus (*Say*), the two lined soldier-beetle.

Trichodes Nuttalli *Kirby*.

Thanasimus dubius (*Fabr*).

Ptinus brunneus *Duftsch.*

Ptinus quadrimaculatus *Mels.*

Sitodrepa panicea (*Linn.*), a leather-beetle.

Sinoxylon basilare *Say*, the red-shouldered Sinoxylon.

Amphicerus bicaudatus (*Say*), the apple-twig borer.

Polycaon confertus *Lec.*

Lyctus opaculus *Lec.*

Aphodius fimetarius (*Linn.*), a dung-beetle.

Aphodius inquinatus (*Herbst.*), a dung-beetle.

Macrodactylus subspinosus (*Fabr.*), the rose-bug.

Lachnosterna fusca (*Fröhl.*) and congeners, the white grubs.

Lachnosterna tristis (*Fabr.*).

Anomala lucicola (*Fabr.*), the light-loving grapevine beetle.

Anomala marginata (*Fabr.*), the margined Anomala.

Dynastes Hyllus *Chevr.*

Dynastes Tityus (*Linn.*), the Rhinoceros beetle.

Allorhina nitida (*Linn.*), the fig eater.

Euphoria Inda (*Linn.*), the Indian Cetonia.

Orthosoma brunneum *Forst.*

Hylotrupes bajulus (*Linn.*)

Chion cinctus (*Drury*), the banded Chion.

Elaphidion parallelum *Newm.*, the oak-pruner.

Cyllene robiniæ (*Foerst.*), the locust borer.

Cyllene pictus (*Drury*), the hickory borer

Plagionotus speciosus (*Say*), the maple-tree borer.

Xylotrechus colonus (*Fabr.*).

Psenocerus supernotatus (*Say*).

Monohammus confusor (*Kirby*), the long-horned pine-borer.

Saperda candida *Fabr.*, the round-headed apple-tree borer.

Saperda tridentata *Oliv.*, the common elm tree borer.

Oberea bimaculata (*Oliv.*), the raspberry-cane girdler.

Lema trilineata (*Olivier*), the three-lined leaf-beetle.

Crioceris asparagi (*Linn.*), the asparagus beetle.

Crioceris 12-punctata *Linn.*, the 12-spotted asparagus beetle.
Chrysochus auratus (*Fabr.*), the golden Chrysochus.
Typophorus canellus (*Fabr.*).
Doryphora decemlineata (*Say*), the Colorado potato-beetle.
Diabrotica 12-punctata (*Oliv.*), the 12-spotted Diabrotica.
Diabrotica vittata (*Fabr.*), the striped cucumber beetle.
Trirhabda Canadensis (*Kirby*).
Galerucella luteola (*Mull.*), the elm-leaf beetle.
Haltica bimarginata (*Say*), the alder flea-beetle.
Haltica chalybea *Illig.*, the grapevine flea-beetle.
Crepidodera rufipes (*Linn.*), the red-footed flea-beetle.
Orthaltica copalina (*Fabr.*).
Phyllotreta vittata (*Fabr.*), the striped flea-beetle.
Systena frontalis (*Fabr.*).
Systena tæniata (*Say*), the broad-striped flea-beetle.
Dibolia borealis *Chev.*, a plantain leaf miner.
Odontata dorsalis *Thunb.*
Coptocycla bicolor *Fabr.*, the golden tortoise beetle.
Coptocycla clavata (*Fabr.*), the clubbed tortoise beetle.
Bruchus Chinensis *Linn.*, a southern pea weevil.
Bruchus lentis *Boheman*, the lentil weevil.
Bruchus obtectus *Say*, the bean weevil.
Bruchus rufimanus (*Boheman*), the European bean weevil.
Tenebrio obscurus *Fabr.*, the American meal-worm.
Tenebrio molitor (*Linn.*), the meal-worm.
Tribolium ferrugineum (*Fabr.*).
Hymenorus obscurus (*Say*).
Meloe angusticollis *Say*, the oil-beetle.
Macrobasis unicolor (*Kirby*), the ash-gray blister-beetle.
Epicauta vittata (*Fabr.*), the striped blister-beetle.
Epicauta cinerea (*Forst.*), the margined blister-beetle.
Epicauta Pennsylvanica (*De Geer*), the black blister-beetle.
Pomphopœa Sayi *Le Conte*, Say's blister-beetle.
Otiorhynchus ovatus (*Linn.*), the ovate snout-beetle.
Otiorhynchus singularis *Linn.*
Otiorhynchus sulcatus (*Fabr.*).
Aramigus Fulleri (*Horn*), Fuller's rose-beetle.
Phytonomus punctatus (*Fabr.*), the punctured clover-leaf weevil.
Pissodes strobi (*Peck*), the white-pine weevil.
Pachylobius picivorus (*Germ.*).
Lixus concavus *Say*.

Tachypterus quadrigibbus (*Say*), the apple curculio.
Coccotorus scutellaris *Lec.*, the plum gouger.
Anthonomus signatus *Say*, the strawberry weevil.
Conotrachelus nenuphur (*Herbst*), the plum curculio.
Conotrachelus cratægi *Walsh*, the quince curculio.
Craponius inæqualis (*Say*), the grape curculio.
Trichobaris trinotata (*Say*), the potato-stalk weevil.
Sphenophorus caryosus (*Oliv.*).
Sphenophorus robustus *Horn*.
Sphenophorus sculptilis *Uhler*, the sculptured corn curculio.
Calandra oryzæ (*Linn.*), the rice weevil.
Calandra granaria (*Linn.*), the grain weevil.
Monarthrum mali (*Fitch*), the apple-tree bark-beetle.
Xyleborus dispar (*Fabr.*), the pear-blight beetle.
Tomicus sp? a balsam-fir bark beetle.
Tomicus typographus (*Linn.*).
Scolytus rugulosus (*Ratz.*), the wrinkled Scolytus.
Polygraphus rufipennis (*Kirby*), the spruce-bark beetle.
Phlœotribus liminaris (*Harr.*), the peach-bark Scolytus.
Hylesinus opaculus *Lec.*, the elm-bark beetle.
Dendroctonus rufipennis (*Kirby*).
Crypturgus pusillus *Gyll.*
Brachytarsus variegatus (*Say*).

Hemiptera.

Corimelæna pulicaria *Germ.*, the flea-like negro-bug.
Podisus cynicus (*Say*).
Podisus modestus *Dallas*.
Podisus spinosus (*Dallas*), the spined soldier-beetle.
Cosmopepla carnifex (*Fabr*).
Lioderma ligata (*Stall*).
Pentatoma juniperina (*Linn.*), the juniper plant-bug.
Murgantia histronica (*Hahn.*), the Harlequin cabbage-bug.
Leptoglossus oppositus (*Say*).
Anasa tristis (*De Geer*), the squash-bug.
Leptocoris trivittatus (*Say*), the box-elder plant-bug.
Blissus leucopterus (*Say*), the chinch-bug.
Pyrrhocoris calmariensis *Fallen*.
Largus succinctus (*Linn.*), the margined Largus.
Dysdercus suturellus *Her.-Sch.*, the cotton-stainer.

Lygus invitus (*Say*), the contrary plant-bug.
Lygus pratensis (*Linn.*), the tarnished plant-bug.
Pœcilocapsus lineatus (*Fabr.*), the four-lined leaf-bug.
Acanthia lectularia (*Linn.*), the bed-bug.
Corythuca arcuata (*Say*).
Corythuca ciliata (*Say*), the ciliated Tingis.
Phymata Wolfii *Stal.*, "an ugly bee-slayer."
Prionidus cristatus (*Linn.*), the nine-pronged wheel-bug.
Sirthenia carinata (*Fabr.*).
Rasahus biguttatus (*Say*).
Melanolestes abdominalis (*Her.-Sch.*).
Melanolestes picipes (*Her.-Sch.*), the black corsair.
Conorhinus sanguisugus *Le Conte*, the "blood-sucking cone-nose."
Opsicœtus personatus (*Linn.*), the bed-bug hunter.
Belostoma Americanum *Leidy*, the giant water-bug.
Cicada septendecim *Linn.*, the seventeen-year Cicada.
Cicada tredecim *Riley*, the thirteen-year Cicada.
Cicada tibicen (*Linn.*), the harvest-fly.
Ceresa bubalus (*Fabr.*), the buffalo tree-hopper.
Ptyelus lineatus (*Linn.*), the lined spittle-hopper.
Clastoptera obtusa (*Say*), the alder spittle-insect.
Clastoptera pini *Fitch*, the pine Clastoptera.
Enchenopa binotata (*Say*), the two-marked tree-hopper.
Typhlocyba rosæ (*Harris*), the rose-leaf hopper.
Typhlocyba vitis (*Harris*), the grapevine leaf-hopper.
Psylla buxi *Linn.*, the box Psylla.
Psylla pyricola *Foerster*, the pear-tree Psylla.
Chermes pinicorticis (*Fitch*), the pine-bark Chermes.
Pemphigus imbricator (*Fitch*), the beech-tree blight aphis.
Pemphigus tessellata (*Fitch*), the alder-blight aphis.
Colopha ulmicola (*Fitch*), the cockscomb elm-gall aphis.
Aphis brassicæ *Linn.*, the cabbage aphis.
Aphis cucumeris *Forbes*, the melon aphis.
Aphis mali *Fabr.*, the apple-tree aphis.
Aphis Middletonii *Thomas*, the aster-root aphis.
Aphis prunifoliæ *Fitch*, the plum-tree aphis.
Siphocoryne pastinaceæ (*Linn.*), the parsnip aphis.
Myzus cerasi (*Fabr.*), the cherry-tree aphis.
Myzus ribis (*Linn.*), the currant aphis.
Megoura solani *Thomas*, the potato aphis.
Phorodon humuli (*Schrank*), the hop-vine aphis.

Siphonophora granaria (*Kirby*), the grain aphis.
Phylloxera vitifoliæ (*Fitch*), the grapevine Phylloxera.
Icerya Purchasi *Maskell*, the cottony-cushion scale.
Dactylopius destructor *Coms.*, the destructive mealy-bug.
Dactylopius longifilis *Coms.*, the long-threaded mealy-bug.
Pulvinaria innumerabilis (*Rathv.*), the maple-tree scale-insect.
Lecanium sp., a grapevine scale-insect.
Aspidiotus nerii *Bouché*, the white scale.
Chionaspis furfurus (*Fitch*), the scurfy bark-louse.
Chionaspis pinifoliæ (*Fitch*), the pine-leaf scale-insect.
Mytilaspis pomorum (*Bouché*), the apple-tree bark-louse.

Physopoda.

Heliothrips hæmorrhoidalis *Bouché.*
Thrips species.

Orthoptera.

Gryllotalpa borealis *Burm.*, the mole cricket.
Gryllus luctuosus *Serv.*, the doleful cricket.
Œcanthus niveus *Harris*, the white-flower cricket.
Microcentrum retinervis (*Burm.*), the angular-winged katydid.
Melanoplus atlanis (*Riley*), the lesser migratory locust.
Melanoplus femur-rubrum (*De Geer*), the red-legged grasshopper.
Melanoplus spretus (*Uhler*), the Rocky Mountain locust.
Chortophaga viridifasciata (*De Geer*), the green-striped grasshopper.
Mantis Carolina *Linn.*, the Carolina Mantis.
Mantis religiosus *Linn.*, the *Prie-Dieu.*
Diapheromera femorata (*Say*), the walking-stick.
Blattidæ, cockroaches.
Ectobia Germanica (*Fabr.*), the Croton-bug.

Neuroptera.

Chauliodes pectinicornis (*Linn.*), the comb-horned fish-fly.
Chauliodes rasticornis *Ramb.*, the tooth-horned fish-fly.
Chauliodes serricornis *Say*, the saw-horned fish-fly.
Corydalis cornuta (*Linn.*), the horned Corydalis.
Chrysopa species, lace-winged flies
Dendroleon obsoletum (*Say*), a climbing ant-lion.
Myrmeleon immaculatus (*De Geer*), the spotless Myrmeleon.
Bittacus pilicornis *Westw.*, the hairy-horned scorpion-fly.
Bittacus strigosus *Hagen*, the striped scorpion-fly.

Panorpa communis *Linn.*, the common scorpion-fly.
Panorpa maculosa *Hagen*, the spotted scorpion-fly.
Panorpa nematogaster *McLachl*, a Java scorpion-fly.
Panorpa rufescens *Ramb.*, the rufescent scorpion-fly.
Boreus brumalis *Fitch*, the mid-winter Boreus.
Boreus nivoriundus *Fitch*, the snow-born Boreus.

Pseudoneuroptera.

Capnia pygmæa (*Burm.*), the small snow-fly.
Nemoura nivalis *Fitch*, the large snow-fly. The shad-fly.
Clothilia pulsatoria *Linn.*, the death-watch.
Atropos divinatoria (*O. Fabr.*), the divining Atropos.
Psocus sp? from Bucculatrix.
Psocus venosus *Burm.*
Hexagenia bilineata (*Say*).
Ephemera natata *Walker.*
Ephemera sp.?, a May-fly.
Cænis nigra *Hagen* MS.

Thysanura.

Campodea fragilis *Meinert.*
Smynthurus hortensis *Fitch*, the garden-flea.
Achorutes purpurescens (*Lubbock*).
Schoturus nivicola (*Fitch*), "the snow-flea."
Aphorura armata *Tullberg.*
Anurida maritima *Guerin.*

Arachnida.

Tetranychus telarius (*Linn.*), the red-spider.
Trombidium locustarum *Riley*, the locust mite.
Bryobia pratensis *Garman*, the clover mite.
Dermanyssus avium *Dugès*, the chicken-louse.
Gamasus obovatus *Lintner*, associated with Julus in potatoes.
Uropoda Americana *Riley*, the Colorado potato beetle mite.
Ixodes bovis *Riley*, the cattle tick.
Tyroglyphus Lintneri *Osborn*, a tomato-infesting mite.
Tyroglyphus longior (*Gervais*), a mite in smoked meat.
Tyroglyphus phylloxeræ (*Plan.-Riley*), the phylloxera mite.
Tyroglyphus siro (*Linn.*), the cheese mite.
Rhizoglyphus rostroserratus (*Mégnin*), a mushroom mite.
Heteropus ventricosus *Newport*, the ventricose mite.

Phytoptus ?persicæ, a peach-tree Phytoptus.
Phytoptus phlœocoptes *Nalepa*, a plum-tree Phytoptus.
Phytoptus pyri (*Scheuten*), the pear-leaf blister mite.

Myriapoda.

Julus cæruleocinctus *Wood*, the blue-banded Julus.
Polydesmus complanatus (*Linn.*).
Thousand-legged worms.
Cermatia forceps (*Raf.*), a household centipede.

Crustacea.

Crangonyx mucronatus *Forbes*, an eyeless fresh-water shrimp.

Vermes.

Anguillulidæ, eel-worms.
Gordius linearis,
Gordius robustus, } hair-worms or hair-snakes.
Gordius varius,
Syngamus trachealis, the gape-worm.

(H)

ERRATA (ADDITIONAL) IN PRECEDING REPORTS.*

Additional Errata in First Report.

Page 40, line 14, for *Sylvanus* read *Silvanus*.
Page 42, line 23, for Tenthridinidæ read Tenthredinidæ.
Page 156, line 4 from bottom, for *pinifoliœ* read *pinifoliella*.
Page 227, lines 15 and 16 from bottom, for p. 682 *et seq.*, read pp. 477–484.
Page 264, line 5, for 183 read 1834.
Page 268–269, for *Pentatomoidœ* read *Pentatomoidea*.
Page 272, line 2, for *ribes* read *ribis*.
Page 297, line 5 from bottom, for *togata* read *tergata*.
Page 300, line 14, for *Telamone* read *Telamona*.
Page 302, line 4, for 264 read 254.
Page 314, last line, for *Cyniphidœ* read *Cynipidœ*.
Page 330, line 11, for *fuscata* read *fuscatus*.
Page 330, line 2 from bottom, for ix read x.
Page 331, line 2, for *aculifer* read *aculiferus*.
Page 343, line 14 from bottom, for *marcellaria* read *macellaria*.

Additional Errata in Second Report.

Page 23, line 13 from bottom, for *Ampelophila* read *Drosophila*.
Page 57, line 19, for 487 read 497.
Page 125, line 11, for *Sciari* read *Sciara*.
Page 146, line 23, for *Euschistes* read *Euschistus*.
Page 152, line 32, for *Cimex lectularia* read *C. lectularius*.
Page 166, line 14 from bottom, for *Euchetes* read *Euchœtes*.
Page 180, line 1, for Fitch read (Fitch).
Page 207, lines 19 (and under figures), for *purpurascens* read *purpurescens*.
Page 213, line 5 from bottom, for *Corydalus* read *Corydalis*.
Page 241, line 2 from bottom, for *Anophales* read *Anopheles*.

Errata in Third Report.

Page 116, line 5, for *Anaitis* read *Anatis*.
Page 138, line 16 from bottom, for NUTTALI read NUTTALLI.
Page 140, line 9, for chaleid *Copodosoma truncatella* read chalcid *Copidosoma truncatellum*.
Page 140, line 17, for *Irus* read *strigosa*.
Page 141, line 7, for *fusciventris* read *fasciventris*.
Page 144, line 6, for *picivorous* read *picivorus*.
Page 153, line 23, for *Euschistes* read *Euschistus*.
Page 153, line 24, for *Phylira* read *Phyllira*.

* If desired, the errata may be inserted as slips in the respective Reports.

Additional Errata in Fourth Report.

Page 50, lines 3, 8, 12, 13, 20, for *definata* read *definita.*
Page 67, line 23, for Daniels read Daniell.
Page 71, lines 19 and 20, for auxiliary read first.
Page 72, lines 17 and 40, for Wager read Waga.
Page 73, line 6, after p. 152 add (of Synop. Br. Ins.).
Page 104, bottom line, for back read bark.
Page 137, line 6, for *hypophleas* read *hypophlœas.*
Page 139, line 9, for *Cramer* read (*Cramer*).
Page 151, line 9, for 41, 44 read 41–44.
Page 180, line 18 from bottom, for *Periplanata* read *Periplaneta.*
Page 197, line 14 from bottom, for *Tenthridinœ* read *Tenthredinœ.*
Page 206, line 2, for *crocotaria* read *crocataria.*
Page 207, line 16 from bottom, for *vestata* read *vestita.*
Page 208, line 8 from bottom, for *obtusa* read *obtrusa.*
Page 483, line 5, for crocatoria to crocataria.

Additional Errata in Fifth Report.

Page 193, line 2, for *Adolecephala* read *Adelocephala.*
Page 199, line 7 from bottom, for *Ceratocampadœ* read *Ceratocampidœ.*
Page 245, line 25, for *quadrinota* read *quadrinotata.*
Page 266, line 15, for *pinifolii* read *pinifoliœ.*
Page 268, line 22, for *fraterna* read *fraternus.*
Page 271, line 4 from bottom, for *Blaphar-* read *Blephar-.*
Page 300, line 9 from bottom, for *Chrysomelidœ* read *Bruchidœ.*
Page 303, line 17, for *Tachus* read *Tachys.*
Page 303, line 18, for *Homolota* read *Homalota.*
Page 320, last line, for *hyalinatalis* read *hyalinata.*

Additional Errata in Sixth Report.

Page 120, line 2 from bottom, for Henshaw read Dimmock.
Page 146, line 22, precede with — it and.
Page 151, lines 11 and 15, *longipennis* and *Columbia* are the same.
Page 170, line 25, for *Anthomenus* read *Anchomenus.*
Page 188, line 19, for *confusor* read *confusus.*

Additional Errata in Seventh Report.

Page 229, line 24, for *abbreviatella* read *abbreviata.*
Page 325, line 10 from bottom, for *Periplanata* read *Periplaneta.*
Page 334, line 12, for *pygmeus* read *pygmœus.*
Page 360, line 12 from bottom, for Oliv. read (Oliv.).
Page 367, lines 28 and 29, for *Cuterabra* read *Cuterebra.*
Page 369, line 10, for *Amblycomorpha* read *Amblycorypha.*
Page 382, line 24, for *Cuterabra* read *Cuterebra.*
Page 384, line 18, for *Amblycomorpha* read *Amblycorypha.*

Additional Errata in Eighth Report.

Page 106, line 29, for *C. pyrivora* read *D. pyrivora.*
Page 163, dele last line.
Page 167, line 12, for *pygmeus* read *pygmœus.*
Page 238, line 8 from bottom, for *Masicora* read *Masicera.*
Page 275, line 12, for *Chalciddiœ* read *Chalcididœ.*
Page 289, line 3, for *definata* read *definita.*
Page 291, lines 3 and 8 from bottom, for *Deshaiziana* read *Deshaisiana.*
Page 298, line 6, for *Helophilus* read *Hydrophilus.*
Page 300, line 12 from bottom, for *Chlosops* read *Chlorops.*

Additional Errata in Ninth Report.

Page 296, line 7, for pelargium read pelargonium.
Page 296, line 14, for *Garpocapsa* read *Carpocapsa.*
Page 313, line 14, for *Chlorops* read *Chloropisca.*
Page 450, line 11, for *Gonopteryx* read *Gonoptera.*
Page 455, line 4 from bottom, for *Lecontii* read *Lecontei.*
Page 461, line 13, for *Xylocapa* read *Xylocopa.*

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* European. † In Europe and America.

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ERRATA FOR REPORT X.

Page 349, line 27, for gasoline read gas-lime.
Page 436, line 2 from bottom, after Dakota, insert South Dakota, Idaho.
Page 480, line 10, for fourth and fifth read third and fourth.
Page 483, line 5, for crocatoria read crocataria.
Page 494, line 18 from bottom, for *ruficaudus* read *ruficaudis*.
Page 515, line 8, for *Lecontii* read *Lecontei*.
Page 524, line 6, for cultus read culta.
Page 529, line 8 from bottom, for histronica read histrionica.
Page 537, line 16, dele the line.
Page 542, line 3, c. 2, for maizii read maizi [tessellata].
Page 544, line 25 from bottom, c. 2, for [variegatus] read , of Europe.
Page 545, line 16 from bottom, c. 2, for persicæ-nigra read persicæ-niger.
Page 546, c. 2, dele lines 10, 11, 27, and in line 34, fasciatus, x, 486.
Page 558, line 33, c. 2, for viii, 187 read viii, 298.
Page 562, line 25 from bottom, c. 1, for [Kermes] read [Chermes].
Page 564, line 9, c. 2, for Systera read Systena.
Page 567, line 4, c. 1, for Daimia read Daimio.
Page 567, line 31, c. 1, dele Ip. on hickory.
Page 568, line 27 from bottom, c. 2, for Therinobia read Thermobia.
Page 569, line 8, c. 2, for 141-150, read 141, 150.
Page 570, bottom line, for Entodon read Entedon.
Page 574, line 24, c. 2, dele [Evoxycoma].
Page 577, line 18 from bottom, c. 2, for Therinobia read Thermobia.
Page 578, line 24, c. 2, before 493 insert x,.
Page 602, line 14, for pastinacæ read pastinaceæ.
Page 604, line 8 from bottom, c. 2, for pilisicollis read pilosicollis.
Page 607, line 6 from bottom, for leucostigmia read leucostigma.
Page 622, line 26 from bottom, c. 2, before 497 insert x,.
Page 632, line 30, for Sitrodrepa read Sitodrepa.
Page 632, bottom line, before Phymata insert Wolffii,.

Additional Errata in Preceding Reports.

Report 1, page 57, line 20 from bottom, for tiers read tyers.
Report 1, page 336, line 5, for *Daimia* read *Daimio*.
Report 1, page 351, line 31, for Cockchaffer read Cockchafer.
Report 1, page 362, line 31, c. 2, for marcellaria read macellaria.
Report 2, page 255, line 7 from bottom, c. 2, for 180 read 184.
Report 3, page 138, line 7 from bottom, for Dactolypius read Dactylopius
Report 3, page 194 (of index) line 27, c. 1, dele rubicunda.
Report 3, page 196 (of index) lines 22 and 23 from bottom, read rubicunda, Dryocampa.
Report 4, page 154, line 8 from bottom, for *tamariscis* read *tamarisci*.
Report 4, page 226, line 18, c. 2, for ovinus read bovinus.
Report 4, page 232, line 14 from bottom, for *basilis* read *basalis*.
Report 6, page 176, line 22, and in index, for pilisicollis read pilosicollis.
Report 7, page 371, line 9, and in index, for *Daimia* read *Daimio*.
Report 9, page 426, line 2 from bottom, and in index, for fulvipes read fusciceps.

REPORT

OF THE

ASSISTANT ZOOLOGIST.

Report of the Assistant Zoologist.

Dr. F. J. H. Merrill, *Director New York State Museum:*

Dear Sir.— I respectfully submit the following report of the work of the Zoological Department of the New York State Museum, for the period beginning October 1, 1893, and ending June 30, 1894.

In December the mammals which had been exhibited at the World's Fair were returned to the Museum and placed in their proper places on the upper floor of the building. They were apparently in as good condition as when they were sent to Chicago.

The collection of New York land and fresh-water shells exhibited at Chicago were returned at the same time. The collection has since been arranged in the table-case at the west end of the floor devoted to z ology, and as it now stands it is an exact reproduction of the Chicago exhibit, in everything except the cases.

In order to accommodate the collection it was necessary to place the specimens formerly exhibited in the table-case in the drawers underneath.

The rearrangement of the conchological collections, which was begun in 1891, has been continued. During the period covered by this report I have reidentified, labeled and placed on exhibition several thousand specimens of the Gould, Smithsonian and other collections.

In June I made a careful examination of the alcoholic collection, and in needful cases renewed the strength of the alcohol. The specimens are now secure against decay and will need no further attention for several years.

During the year I have completed a bulletin on the geographical distribution of the species of Unionidæ inhabiting New York, and the manuscript has been placed in your hands for publication. If funds are not available to publish it as a bulletin I recommend that it be published as part of the annual report of the State Museum.

I send herewith a list of the mollusca known to inhabit the vicinity of Albany and Troy. It is in the nature of a revision of Truman H. Aldrich's List of Shells Inhabiting the Vicinity of Troy, published in the Twenty-second Annual Report on the State Cabinet.

Respectfully submitted,

WILLIAM B. MARSHALL.

December 24, 1894.

List of Shells Inhabiting the Vicinity of Albany and Troy, N. Y.

By WILLIAM B. MARSHALL,

Assistant Zoologist.

In the Twenty-second Annual Report on the State Cabinet of Natural History, 1868, Appendix C, p. 17, Mr. Truman H. Aldrich published "A Partial List of Shells found near Troy, N. Y." The list was the result of collections made during the summers of two years, 1866 and 1867, and confined to a radius of six miles with Troy as the center. Mr. Aldrich remarks in a note at the beginning of his list that it is by no means complete.

In 1887, Mr. C. E. Beecher, then assistant in paleontology in the Museum, presented a large collection of shells to the New York State Museum. This collection, numbering perhaps 20,000 specimens and as many more which were called duplicates, is composed almost entirely of United States land and fresh-water shells. The specimens from several localities, particularly those from the vicinity of Ann Arbor, Mich., Warren, Pa., and Albany, N. Y., were collected by Mr. Beecher himself. The vicinity of Albany and Troy was frequently and carefully searched and it is reasonable to suppose that the collection contains specimens of all or nearly all the species inhabiting this neighborhood. With such fine material at hand I have undertaken to revise Mr. Aldrich's list with a view to making it more complete, and for the purpose of adding several notes to those already embodied in his list.

The list as revised is not restricted to the same area as Aldrich's list, although the limits have been extended very little.

The following species of shells are represented in the collection of the State Museum by specimens from the neighborhood of Albany and Troy:

Unio pressus, *Lea*. (See note 2.)
Unio Tappanianus, *Lea*. (See note 3.)
Unio radiatus, *Lamarck*. (See note 5.)
Unio nasutus, *Say*. (See note 6.)
Unio complanatus, *Solander*. (See note 7.)
Unio ochraceus, *Say*.
Unio cariosus, *Say*.
Margaritana marginata, *Say*.
Margaritana rugosa, *Barnes*
Margaritana undulata, *Say*. (See note 8.)
Anodonta undulata, *Say*. (See note 9.)
Anodonta Ferussaciana, *Lea*. (See note 10.)
Anodonta Lewisii, *Lea*.
Anodonta implicata, *Say*.
Anodonta fluviatilis, *Dillwyn*.
Sphærium simile, *Say*.
Sphærium striatinum, *Lam*.
Sphærium rhomboideum, *Say*.
Sphærium transversum, *Say*.
Sphærium securis, *Prime*.
Pisidium Virginicum, *Bourg*.
Pisidium compressum, *Prime*.
Goniobasis Virginica, *Gmelin*.
Goniobasis livescens, *Menke*.
Bythinia tentaculata, *Linn*. (See note 11.)
Bythinella obtusa, *Lea*.
Gillia altilis, *Lea*.
Somatogyrus subglobosus, *Say*.
Amnicola porata, *Say*.
Amnicola pallida, *Anthony*.
Pomatiopsis lapidaria, *Say*.
Lyogyrus lustricus, *Say*.
Valvata tricarinata, *Say*.
Vivipara contectoides, *W. G. B.* (See note 12.)
Melantho decisa, *Say*.
Melantho integra, *Say*.
Melantho rufa, *Haldeman*.
Lioplax subcarinata, *Say*. (See note 13.)
Carychium exiguum, *Mull*.
Limnæa desidiosa, *Say*.
Limnæa catascopium, *Say*.
Limnæa umbilicata, *Adams*.
= caperata, *Say*, var.
Limnæa humilis, *Say*.
Physa ancillaria, *Say*.
Physa heterostropha, *Say*.
Bulinus hypnorum, *Linn*.
Planorbis trivolvis, *Say*.
Planorbis bicarinatus, *Say*.
Planorbis exactus, *Say*.
Planorbis deflectus, *Say*.
Planorbis hirsutus, *Gould*.
Planorbis parvus, *Say*.
Segmentina armigera, *Say*.
Ancylus fuscus, *Adams*.
Ancylus parallelus, *Haldeman*.
Ancylus tardus, *Say*.
Limax maximus, *Linnæus*. (See note 15.)
Limax flavus, *Linnæus*. (See note 15.)
Limax campestris, *Binney*.
Limax agrestis, *Linnæus*. (See note 15.)
Zonites fuliginosus, *Griffith*.
Zonites intertextus, *Binney*.
Zonites arboreus, *Say*.
Zonites viridulus, *Menke*.
Zonites internus, *Say*.

Zonites multidentatus, *Binney*.
Patula alternata, *Say*.
Patula perspectiva, *Say*.
Patula striatella, *Anthony*.
Strobila labyrinthica, *Say*.
Stenotrema monodon, *Racket*.
Vallonia pulchella, *Müller*.
Triodopsis palliata, *Say*.
Triodopsis appressa, *Say*.
Triodopsis inflecta, *Say*.
Triodopsis tridentata, *Say*.
Mesodon albolabris, *Say*.
Mesodon thyroides, *Say*.
Mesodon Sayii, *Binney*.
Pupa muscorum, *Linnæus*.
Pupa pentodon, *Say*.
Pupa fallax, *Say*.
Pupa curvidens, *Gould*.
Pupa corticaria, *Say*.
Pupa armifera, *Say*.
Vertigo Gouldii, *Binney*.
Vertigo simplex, *Gould*.
Vertigo Bollesiana, *Morse*.
Vertigo ovata, *Say*.
Ferussacia subcylindrica, *Linn*.
Succinea avara, *Say*.
Succinea ovalis, *Say*.
Succinea obliqua, *Say*.

Mr. Chas. T. Simpson has reported Unio luteolus and Mr. Aldrich has recorded the other sixteen species of the following list as occurring in the vicinity of Troy. I have never seen specimens of any of these species from this neighborhood and can not confirm the records.

Unio alatus, *Say*. (See note 1.)
Unio luteolus, *Lamarck*. (See note 4.)
Anodonta Benedictii, *Lea*.
Anodonta edentula, *Say*. (See note 9.)
Melania elevata, *Say*.
Pleurocera subulare, *Lea*.
Amnicola limosa, *Say*.
Limnæa reflexa, *Say*.
Limnæa ampla, *Mighels*.
Limnæa elodes, *Say*.
Planorbis campanulatus, *Say*. (See note 14.)
Macrocyclis concava, *Say*.
Helix chersina, *Say*.
= Zonites fulvus, *Drapamand*.
Vitrina limpida, *Gould*.
Helicodiscus lineatus, *Say*.
Mesodon exoletus, *Binney*.
Succinea Totteniana, *Lea*.

FAMILY.	Genus.	No. in this list.	No. from other sources.	No. in each genus.	No. in each family.
Unionidæ	Unio	7	2	9	.....
	Margaritana	3	....	3	19
	Anodonta	5	2	7	.....
Corbiculidæ	Sphærium	5	....	5	7
	Pisidium	2	....	2	
Strepomatidæ	Goniobasis	2	1	3	.....
	Pleurocera	....	1	1	4
Rissoidæ	Bythinia	1	....	1	.....
	Bythinella	1	....	1	.....
	Gillia	1	....	1	....
	Somatogyrus	1	...	1	9
	Amnicola	2	1	3	.....
	Pomatiopsis	1	....	1	.....
	Lyogyrus	1	....	1	.....
Valvatidæ	Valvata	1	....	1	1
Viviparidæ	Vivipora	1	....	1	.....
	Melantho	3	....	3	5
	Lioplax	1	....	1	.....
Auriculidæ	Carychium	1	....	1	1
Limnæidæ	Limnæa	4	3	7	.....
	Physa	2	....	2	.....
	Bulinus	1	....	1	21
	Planorbis	6	1	7	
	Segmentina	1	....	1	.....
	Ancylus	3	....	3	.....
Selenitidæ	Macrocyclis	....	1	1	1
Limacidæ	Limax	4	....	4	.....
	Zonites	6	1	7	12
	Vitrina	....	1	1	.....
Helicidæ	Patula	3	....	3	.....
	Helicodiscus	....	1	1	.....
	Strobila	1	....	1	.....
	Stenotrema	1	....	1	.....
	Vallonia	1	....	1	.....
	Triodopsis	4	....	4	.....
	Mesodon	3	1	4	15
Pupidæ	Pupa	6	....	6	10
	Vertigo	4	....	4	
Shenogyridæ	Ferussacia	1	....	1	1
Succinidæ	Succinea	3	1	4	4
		93	17	110	110

NOTE 1.

Unio alatus, Say.— De Kay says that "Dr. Newcomb has obtained very fine specimens from the Northern canal, near Waterford." Dr. De Kay was correct in his identification of *N. alatus.* He may have quoted the wrong locality. The word "fine" in his note about Newcomb's specimens would indicate that they were living specimens taken in their natural station and not dead specimens which had been transported from a distance.

Of this occurrence of this species in this vicinity of Waterford Aldrich says: "In the spring of 1867, the canal was searched for it, both above and below Waterford, for several miles, without success. Mr. H. Rousseau of this city found a single valve in the canal at the weigh lock."

The Museum collection contains several specimens of the species from Lake Champlain and several from Onondaga county.

NOTE 2.

Unio pressus, Lea.— Described under the name of *Unio compressus* The type specimens were obtained from Norman's Kill, about two miles south of Albany.

NOTE 3.

Unio Tappanianus, Lea.— In most systematic lists *Unio Tappanianus* and *Unio pressus* are widely separated. I have placed them next to each other because of their resemblance in general appearance and in beak sculpture; and because *Tappanianus* is more or less symphynote like *pressus.*

NOTE 4.

Unio luteolus, Lamarck.— This species is rare everywhere east of Mohawk, if, indeed, it occurs at all east of that point. There are no specimens in the Museum collection from the vicinity of Troy or Albany and only one specimen from Mohawk. In Onondaga county the species becomes quite abundant and is plentiful throughout the western part of the State. The only evidence known to me of the occurrence of the species in this vicinity is that of Mr. Chas. T. Simpson. In the Nautilus for January, 1892, he records the species from "Cohoes Falls, Hudson R."

The following is extracted from a letter received from Mr. Simpson in February, 1892. "Specimen No. 85437 (*of the U. S. Nat. Museum*) is labeled *Unio luteolus, Lam.*, Cohoes Falls, Hudson R. The name is in Dr. Lea's writing, but I think the locality is marked by some one else.

I have just examined the shell, which is an undoubted female *luteolus*. No. 85435 is a shell sent by Dr. James Lewis, from Mohawk, N. Y., and in a note Mr. Lewis says: 'The only living specimen I ever found here.'"

NOTE 5.

Unio radiatus, Lamarck.— It is sometimes very difficult to distinguish specimens of this species from *Unio luteolus*, but all the specimens from this vicinity that I have seen have been typical *U. radiatus*

NOTE 6.

Unio nasutus, Say.— Aldrich remarks that many specimens of this species are deformed. In a paper on "Some abnormal and pathologic forms of fresh-water shells from the vicinity of Albany, N. Y.,"* Mr. C. E. Beecher has described and figured an abnormal female specimen of *Unio nasutus* taken from the canal at West Troy. The peculiarity of this specimen is that the valves show plications produced by growth over the gills while distended with fry. De Kay says: "Dr. Newcomb has, I understand, detected in the Champlain canal a variety of this species with a single tooth in the left valve.

NOTE 7.

Unio complanatus, Solander.— This is our most common species. The color of the exterior varies from nearly black through various shades of brown to bright green. Many specimens have brilliant rays of yellow and green. Nacre purple or white.

Deformed or abnormal specimens are common. In the paper referred to under the preceding species, there are figures of four specimens of *Unio complanatus* which show some marked peculiarity.

NOTE 8.

Say's types of this species were obtained from Norman's Kill.

NOTE 9.

Anodonta undulata, Say.— This species is not included in Aldrich's list. He probably collected specimens of this species and named them *A edentula*, a perfectly natural mistake, as the two species are scarcely distinguishable. So far as known to me *A. edentula* does not occur in this vicinity.

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* 36th Ann. Rept. State Mus. p. 51, pl. 2.

NOTE 10.

Anodonta Ferussaciana, Lea.— It is probable that *Anodonta subcylindracea* Lea, is a synonym. *Ferussaciana* is usually applied to western specimens and *subcylindracea* to eastern specimens.

NOTE 11.

Bithinia tentaculata, Linn.— This is an introduced European species. Its occurrence in this country was first recorded by Rev. W. M. Beauchamp, he having found specimens of it at Oswego, in 1879. The State Museum has several hundred specimens collected by Dr. Charles E. Beecher in the Champlain canal in 1879. Dr. Beecher informs me that he found three or four specimens in the same place in 1878.

NOTE 12.

Vivipara contectoides, W. G. B.— This species was colonized in the Erie canal at Mohawk by Dr. James Lewis in 1868. It has spread through the canal and is now one of the most abundant shells in the vicinity of Albany.

NOTE 13.

Lioplax subcarinata, Say.— Aldrich's list contains no mention of this species and it is probable that the species did not inhabit this neighborhood when Aldrich prepared his list. Dr. Charles E. Beecher informs me that he collected some specimens at the mouth of the Norman's Kill in 1878. Dr. Lewis, to whom the specimens were shown, said that in all probability the species had migrated into the Hudson from the Delaware, through the Delaware and Hudson canal. At the present time the species is abundant in this vicinity.

NOTE 14.

Planorbis campanulatus, Say.— So far as known to me this species does not occur in the living state in this vicinity. It is quite abundant in the fossil state, in a marl bed in Greene county, about fifteen miles south of Albany.

NOTE 15.

Limax maximus, Linn., Limax flavus, Linn., Limax agrestis, Linn.— These three species of slugs have been introduced into this country from Europe.

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CLAY INDUSTRIES OF NEW YORK

PREPARED UNDER THE DIRECTION OF

FREDERICK J. H. MERRILL, PH. D.

BY

HEINRICH RIES, PH. B.

ALBANY
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Note by the Director.

The study of the Quaternary deposits of the Hudson River valley was undertaken by me several years ago, and a paper on the subject was published in the American Journal of Science.* In continuation of this it seemed important to investigate the economic side of the question and report on the brick industry, which is so highly developed in this region. The confining duties of administrative work in the museum rendered it necessary for me to delegate the work of the economic investigation, and it was placed in the hands of Mr. Heinrich Ries, Ph. B., who, during the summer of 1891, made a careful study of the methods of brick manufacture in the Hudson River valley, and extended the investigation of the Quaternary geology of this region.† During the season of 1892, the necessity for making a representative collection of clays throughout the State of New York, for the World's Columbian Exposition, afforded an opportunity for obtaining information concerning the clay industries of the interior of New York and of Long Island. As the result of his work conducted during these two seasons, Mr Ries has prepared the following report. Nearly every locality of importance in the State has been visited, and as it is the only exhaustive report on the subject which has been prepared in this country, it commends itself to all who seek information concerning the industrial uses of clay in New York.

F. J. H. MERRILL,
Director.

PREFACE.

The following report is intended to deal chiefly with the economic aspect of the subject. In the time at my command it has not been possible to visit all the deposits which are being worked, and, therefore, much information has necessarily been gathered by correspondence. The analyses given in the report have all, unless otherwise stated, been made by Dr. H. T. Vulte, of Columbia College, New York city. All the methods described for obtaining the raw material and working it up to a finished product are those employed in the State of New York.

The writer wishes to express his thanks to Dr. F. J. H. Merrill for suggestions offered during the course of the work. Credit for assistance rendered is due to Messrs E. J. Riederer, of New York city, C. L. Sanford of Southold, L. I., E. J. Burke

* Vol. XLI, June, 1891.

†The results of this work were published in the Annual Report of the State Geologist for 1890.

of Rochester. Mr J. J. Clearwater of Highland, N. Y., and Messrs P. H. and J. Conlon of Newark, N. J., have kindly furnished the records of a number of wells bored by them. In the preparation of this report the following books and periodicals have been consulted: The Clay Worker, the Brickmaker, Brick, Tiles and Terra cotta by C. T. Davis, Engineering News, Engineering Record, and the Encyclopedia Britannica.

The increasing value of clay for the manufacture of brick, tile, terra cotta, pottery, etc., and the ever growing demand for these products have given rise to an industry which is rapidly assuming vast proportions, and will in the near future become one of the most extensive and important in the country. Scattered over New York are extensive deposits of clay, many of them capable of being used for the manufacture of terra cotta, roofing tile and the coarser grades of pottery. To add to their value the most extensive beds of clay are situated in close proximity to the water ways and railroads which lead to the principal cities of the state. The commoner kinds of clay products, such as building brick, are marketed within the state, but the higher grades, such as terra cotta and roofing tile, have found good markets outside of New York.

The following table gives the receipts derived from the various branches of the clay industry during the year of 1892:

Building, front and paving brick	$8,500,000
Terra cotta	100,000
Sewer pipe	260,000
Fire brick*	50,000
Stoneware clay	10,000
	$8,870,000

As will be seen from the above statement bricks are the chief source of income. That the other branches of the clay industry are not further advanced is probably due in a large measure to the fact that the clay deposits of the state have been so little exploited or otherwise examined. Though many of the deposits have been opened up and are still being worked, there are numerous others scattered over the state which are still untouched.

*This does not include those manufactured in the state from clays obtained in other states.

Few of the clays are found to be of sufficiently refractory character to be used for making fire brick, gas retorts, or other products which in use are subjected to a high degree of heat; but for the manufacture of coarse pottery, terra cotta, paving brick, etc., many of the clays are eminently suited.

Within the last four or five years the manufacturers in New York have turned their attention toward the extensive beds of argillaceous shale which the state contains, and which on trial have given very satisfactory results. Several large firms are using them for the manufacture of sewer pipe, terra cotta and roofing tile. The shale formations at present used are the Salina, Hamilton and Chemung. The Hudson River shales are no doubt sufficiently argillaceous over many areas to be used for the manufacture of clay products, and the same may be said of the Niagara shale, which weathers to a red clay. A sample of this latter shale from Niagara Falls was first ground and then molded in a stiff mud machine and found to burn to a white brick, which was unaffected by a temperature of 2,500 degrees.

That the clays and shales of New York are comparatively undeveloped is, no doubt, largely due to the lack of knowledge of their extent and character. There seems, however, to be no reasonable doubt that they will in future become a valuable source of revenue.

HEINRICH RIES.

NEW YORK CITY, April, 1893

GEOLOGY AND GEOGRAPHY OF THE CLAY DEPOSITS.

Deposits of clay occur in nearly every county of New York. They belong to three geological periods, viz.:

Quaternary, Tertiary and Cretaceous.

The first class is by far the most common. The second class is somewhat indefinite in extent, but a large number of the Long Island deposits probably belong to it.* Of the third class there are undoubted representatives on Long Island and Staten Island, as well as some additional ones on Long Island, which are questionable.

The clays of the mainland are all Quaternary so far as known. The problems of the Quaternary formations in New York are by no means solved, and it is not always possible to decide on the causes leading to the deposition of any particular body of clay by a single visit to the locality.

A great majority of the deposits are local and basin-shaped, lying in the bottoms of valleys which are often broad and fertile. They vary in depth from four to 20 or even 50 feet; as a rule they are underlain by modified drift or by bed rock. The clay is generally of a blue color, the upper few feet being weathered mostly to red. Stratification is rarely present, but streaks of marl are common. In some of the beds small pebbles, usually of limestone, are found, and these have to be separated by special machinery in the process of manufacture. In many instances the clay is covered by a foot or more of peat.

The basin-shaped deposits are no doubt the sites of former ponds or lakes, formed in many instances by the damming up of the valleys, and which have been filled later with the sediment of the streams from the retreating ice sheet. The valleys in which these deposits lie are usually broad and shallow. The broad flat valley in which the Genesee River flows from Mt. Morris to Rochester is a good example. The waters of the river

* F. J. H. Merrill, Geol. of L. I., Ann. N. Y. Acad. Sci., Nov., 1884.

were backed up by the ice for a time, during which the valley was converted into a shallow lake in which a large amount of

Old lake bottom, Spencer, N. Y.

aluminous mud was deposited. This material has been employed for common brick.

An idea of the depth of clay and alluvium in the Genesee valley may be had from the following table:

The figures have been taken from the records of salt wells.

York†	York Salt co.	Clay	52 ft.
Piffard†	Genesee Salt co.	Clay and gravel	64 ft.
" †	Livingston Salt co.	"Soil"*	158 ft.
Cuylerville†	....	"Soil"	184 ft.
Mt Morris‡	Royal Salt co.	"Soil"	191 ft.

For other localities the following depths are given:

Aurora†	....	Blue clay	15 ft.
Wyoming†	Pioneer Well	Soil and clay	40 ft.
Warsaw†	Standard Salt co.	Surface, soil and clay	26 ft.
" †	Guinlock and Humphrey	Clay	17 ft.

There are a number of these deposits which are of sufficient interest, geologically as well as commercially, to be mentioned in some detail.

* The term soil is probably meant to indicate sand and clay.

† I. P. Bishop, 5th Ann. Rep't, N. Y. State Geologist. 1885.

‡ Ann. Rep't, Sup't Onondaga Salt Springs for 1888, p. 19.

There is a bed of clay at Dunkirk having a depth of over 20 feet. The upper six feet are yellow and of a sandy nature, while the lower two thirds is blue and of much better quality. It is mentioned by Prof. Hall* in his report, and is an instructive example of the manner in which the clay changes in color, downward as far as the water can percolate and oxydize the iron.

Around Buffalo is an extensive series of flats underlain by a red clay. A thin layer of sand suitable for tempering overlies the clay in spots, and limestone pebbles are scattered through it. Similar deposits occur at several localities to the north of the ridge road and around Niagara Falls, also at Tonawanda and La Salle, to the north of Buffalo, as well as south of it along the shore of Lake Erie. No doubt much of this clay was deposited during the former extension of the Great Lakes.

Prof. Hall mentions deposits of clay at the following localities: at Linden one mile south of Yates Center; † along the shore of Lake Ontario east of Lewiston; on Cashaqua Creek ‡ deposits of tenacious clay due to the crumbling of the argillaceous green shales; in Niagara County § beds of clay are said to occur in every town, but they often contain a considerable amount of lime.

A bed of blue and red clay is being worked at Brighton near Rochester. This deposit lies near the head of Irondequoit bay and was deposited by some stream flowing into it. To the southeast of Rochester is a large esker which extends in a northeast direction to near Brighton. Mr. Upham, who has described this esker, considers that it was formed by a river which flowed between walls of ice and deposited the bed of clay above mentioned.‖

Clays are also found at several points in the valley of the Oswego River from Syracuse to Oswego, an important one being at Three Rivers.

An extensive bed of red and gray clay, 20 acres in extent and horizontally stratified, occurs at Watertown. The deposit is 20 feet thick and rests on Trenton limestone.

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* Geology of New York, 4th District, 1843, p. 362.

‡ Ibid. p. 227.

† Ibid. p. 437.

§ Ibid, p. 444.

‖ Proc. Amer. Asso. Adv. Sci., vol. XLI.

Another deposit of considerable size is being worked at Ogdensburg. The clay is blue and has a depth of 60 feet.

At Madrid, in St. Lawrence county, is a small deposit, probably the remnant of a formerly extensive one. The section is:

Yellow stratified sand	3 feet
Blue clay with shells....................	1 "
Blue clay.............................	20 "
Total thickness.....................	24 "

The shells are probably *Macoma fusca.*

Turning our attention to the southern portion of the state we find clays in abundance, in all the valleys, and lowlands. The extensive marshes near Randolph and Conewango are said to be underlain by clay throughout their entire extent.*

At Levant, four miles east of Jamestown, Chautauqua county, is an interesting bed of blue clay underlying an area of several acres. It is probably of post-glacial age, and the section as determined by an artesian well-boring is:

Yellow sand............................	4 feet
Quicksand	4 inches
Yellow clay............................	5 feet
Blue clay	70 "
Hardpan................................	... "
Total thickness	83 "

The owner of the clay bed informed me that leaves were often found between the layers of the clay at a depth of 15 or 20 feet.

At Breesport near Elmira is a bank of blue clay rising from the valley to a height of 50 feet. It was evidently formed when the valley was dammed up, and has subsequently been much eroded so that all that now remains is a narrow terrace along the side of the valley. A similar deposit is found at Newfield south of Ithaca. A moraine crosses the valley a mile or two south of it. Deposits of clay suitable for brick and tile occur extensively in the lowlands bordering the Mohawk River from Rome to Schenectady. The beds vary in thickness from six to 15 feet and are mostly of a red, blue, or gray color.

* Geol. New York, 4th district, 1.

Among the most extensive and important clay formations occurring in New York are those of the Hudson valley.* Here are deposits of two types. (1) Estuary deposits of fine stratified sand, yellow and blue clay, and (2) cross bedded delta deposits, the materials of which are much coarser. The estuary deposits indicate a period of depression, and deposition in quiet water. The clay is chiefly blue, but where the overlying sand is wanting or is of slight thickness, it is weathered to yellow, this weathering often extending to a depth of 15 feet below the surface, and to a still greater depth along the line of fissures through which the water can percolate. The depth of oxidation is of course influenced by the nature of the clay; the upper portion weathering easily on account of its more sandy nature and hence looser texture. Horizontal stratification is usually present and the layers of clay are separated by extremely thin laminæ of sand At some localities the layers of the clay are very thin and alternate with equally thin layers of sandy clay. This condition is found at Haverstraw, Croton, Dutchess Junction, Stony Point, Fishkill, Cornwall, New Windsor, Catskill and Port Ewen. At all of the above-mentioned localities except the last two, the clay is overlain by the delta deposits of rivers tributary to the Hudson, and the alternation of layers may be due to variations in the flow of the rivers emptying at those points, the sandy layers being deposited during period of floods. The delta of Catskill creek has been found at Leeds, some two miles west of the Hudson River.† The delta of Rondout creek which flows into the Hudson at Port Ewen will no doubt be found by following the creek back to the ancient shore line of the Hudson estuary. Isolated ice-scratched bowlders are not uncommonly found in the clay.

There is often a sharp line of division between the yellow weathered portion and the blue or unweathered part of the clay. The line of separation between the clay and overlying sand is also quite distinct in most cases. Of the blue and the yellow clay the former is the more plastic, but both effervesce readily with acid due to the presence of three to six per cent of carbonate of lime, and

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*H. Ries, Rep't of N. Y. State Geologist, 1890.

†W. M. Davis, Proc. Bos. Soc. Nat. His. Nov. '92.

are therefore, properly speaking, marly clays. The clay is underlain by a bed of gravel, sand, hardpan, bowlder, till or bed rock. From Albany to Catskill the underlying material is a dark gray or black sand with pebbles of shale and quartz. The sand grains are chiefly ground up shale, the rest being siliceous and calcareous with a few grains of feldspar and garnet. This sand can often be used for tempering but at Catskill contains too much lime for this purpose.

I have not observed this underlying sand and gravel to reach a greater height than 90 to 100 feet.

From Catskill northward the clay is in most cases covered by but a foot or two of loam. South of Catskill the character of the overlying material varies. At Catskill a terrace extends back two miles and probably more; it is deeply incised by Catskill and Kaaterskill Creeks and smaller streams; rocky islands project above its surface at various points. Along the West Shore track, about 150 feet south of the station, the side of the cutting consists of thin alternating layers of clay and sand 27 feet thick. Above this in places is nine feet of fine stratified yellowish sand. The clay extends along the track for about one fourth mile until it meets an outcrop of Hudson River sandstone. On the south side of the Catskill Mt. R. R. 100 feet from the bridge is an exposure of sand and gravel, the pebbles being very coarse. It is presumably drift material, but the exposure is an isolated one and does not show its relation to other deposits of the vicinity. At Smith's Dock, on the land of T. Brousseau near the river, the upper portion of the terrace escarpment consists of fine stratified sand, which has been excavated to a depth of 12 feet without finding clay, while farther back from the river the clay extends to within two feet of the terrace level.

The Hudson River shale rises steeply along the water's edge from here down to Malden, and crops out at numerous points in the terrace escarpment. The clay along here is probably not of great depth. Clay is found in the railroad cutting to the north of Malden station, about seven feet above the track level, and clay is exposed in numerous cuttings of the West Shore Railroad, from Malden to Mt. Marion.

From Glasco to Rondout the terrace, which is perhaps one eighth mile broad at Glasco, narrows as it nears Rondout, and has an average height of 150 feet. The clays, so far as could be ascertained, lie on the upturned edges of the Utica shale.

At the rear of A. S. Staples' yard hardpan underlies the clay. The overlying material at this locality consists of sand and gravel in many instances stratified and sometimes cross-bedded. The sand in some spots is 10 to 15 feet thick and fine enough to be blown by the wind.

At Port Ewen the clay is mostly blue, resting on a mass of hardpan, and in a few places on the glaciated rock surface. According to Mr. Kline, of Port Ewen, the clay around the village is nowhere over 18 feet in actual thickness and is underlaid by hardpan. A point worthy of notice is the difference in level of 50 feet between the terrace at Port Ewen and at Glasco.

It has been suggested by Dr. F. J. H. Merrill that this may be due to the fact that when sediment is deposited in the basin its edge would be higher than the center. The Quaternary formation broadens on toward the west, and Port Ewen would be a point on the basin's edge while Glasco is near the center.

In this connection the following well records are of interest: A boring made on the property of Isaac Tamney, at Eddyville, showed

Sandy loam	10	feet
Quicksand	70	"
Blue clay	10	"
Gravel	...	"
	90	"

In boring another well at the same locality the following strata were passed through:

Yellow clay	10	feet
Blue clay	137	"
Gravel	5	"
	152	"

Still another at Rosendale, on the land of R. Lefever:

Loam and yellow clay	20	feet
Sand	50	"
Blue clay	30	"
Gravel	...	"
	100	"

At Lefever Falls:

Coarse sand	40	feet
Quicksand	60	"
Blue clay	42	"
Rock	...	"
Total thickness	142	"

At Rosendale Plains:

Sandy soil	10	feet
Blue clay	10	"
Quicksand	10	"
Blue clay and quicksand alternating	150	"
Total thickness	180	"

We now come to a narrow portion of the river from Staatsburg to New Hamburg, where the terrace if present is of small extent and presumably underlain by drift material.

Where the river broadens out again at Roseton at the head of Newburg bay, there is a thick bed of clay. It is nearly all blue and underlies the remnant of a terrace 120 feet high, which has escaped entire destruction owing to its position in a reëntrant angle of the upper Cambrian limestone ridge along the river at this point. The overlying stratified sand and gravel is 10 to 15 feet thick. At Jova's upper yard the clay rests on the glaciated limestone, over whose surface are scattered several bowlders of the same rock. The clay at Rose's yard is 180 feet thick, while that at Jova's has a total thickness of 240 feet. A boring of 135 feet made at Rose's yard at river level is of interest in connection with the depth of the preglacial channel of the Hudson.

About 800 feet south of Roseton station the material under the terrace is a yellowish loamy clay, thinly stratified. This may be a portion of the secondary cone of the delta of Wappinger's creek at New Hamburg. North of this a cutting has been made in the terrace escarpment, the section exposed showing alternating layers of yellow and black sand.

From Newburg to New Windsor the clay is overlain by the extensive delta deposits of Quassaic Creek and Moodna River. To

Clay at New Windsor showing glaciated bowlder in it.

the east of Mrs T. Christie's yard the clay, which is mostly blue and thin layered, is overlain by fine gravel and sand obscurely cross stratified in places. Over this is three to four feet sandy soil. The upper layers of the clay are wrinkled in places, probably owing to the oblique downward pressure of the overlying delta deposits. It seems likely that at this spot only a small portion of them remain, much having probably been eroded. At Lang's yard, south of Christie's, there is four to six feet of sand and gravel over the clay, of the same nature as that previously mentioned. Scattered all through the clay are cobbles of limestone. The upper strata are loamy and contorted, while underneath in the yellow clay, which is very tough, the stratification is almost entirely obliterated. At the next bank, also belonging to Lang, there is six feet of overlying sand and gravel. Scattered through the clay are several bowlders of Calciferous sandrock, sandstone, black crystalline limestone and gneiss. The overlying material is mostly unstratified and many of the pebbles are eight inches in diameter. At the bank of J. T. Moore the clay is very tough, and the stratification is obliterated in spots. Several ice-scratched bowlders of light blue limestone, sandstone and Calciferous sandrock were found in the clay. In Moore & Lahey's bank the clay is tough and compressed, similar to the other yards. It likewise contains scratched bowlders, specially of a light blue crystalline limestone. Over the clay is two to four feet of coarse sand and gravel.

On the west side of the New York, Ontario & Western R. R., where it branches off from the West Shore R. R., a cutting in the hillside shows a cross-bedded, yellowish sand and loamy clay with patches of gravel and cobblestones in it. Following along the track a few hundred feet we come to the clay bank of C. A. and A. P. Hedges. This shows an interesting section of blue clay overlaid by 50 to 60 feet of cross-bedded delta deposits of sand and gravel. The clay layers are obliterated in spots and in others much contorted. To the north of Hedges yard in the R. R. cutting the clay is overlaid by five to six feet of sand and coarse stones, unstratified. Following up the track on the left side just beyond the crossing of the road from Canterbury to New Windsor the embankment of sand and coarse gravel is cross-stratified, being a portion of the delta of Moodna River. The character of this embankment changes after about 400 feet to unstratified drift, containing bowlders. This underlies the delta material. The upper terrace at Cornwall is underlain by bowlder drift.

Its structure is well shown along the track at Cornwall. Clay was observed in a meadow opposite the Roman Catholic church ; it was exposed in digging drainage trenches. Near this locality, but a little nearer the river, were found several mastodon bones.

At Jones' Point there was formerly a small deposit of clay, but it has been entirely worked out.

Haverstraw has three terraces, viz.: At 20, 60 and 100 feet. The clay so far as known is only found underlying the two lower ones ; the upper one being underlain by drift and delta deposits.

There is a deposit of clay at Stony Point forming a portion of the 20-foot terrace. The upper layers of clay are in places loamy and undulating. Over the clay is a mass of unstratified material from two to eight feet thick and the upper surface of the clay is uneven. The overlying unstratified material is a coarse sand full of cobblestones, of gneiss, schist and granite, all of them rounded but not scratched. On the hillside to the west of this deposit is a large, isolated bowlder of granite. The upper terrace at Stony Point is about 75 feet higher than the station level; a portion of this terrace remains about one eighth mile north of Stony Point station on the west side of the track. On the west side of the track where it crosses Cedar Pond brook the delta structure is observable in the embankment, the upper portion of which consists of coarse sand, pebbles and cobblestones which are mostly of gneiss. The lower layers exposed at this point are quite argillaceous. A short distance below the West Haverstraw station and some 500 feet west of the track, an excavation had been made for tempering material. It exposes a fine yellowish cross-stratified sand overlain by several feet of coarse sand and cobblestones.

In T. Malley's clay bank along the shore on the north side of Grassy Point, the clay is not found above tide level and is overlaid by three to four feet of fine gravel. To the northeast of P. Brophy's yard is the remnant of a terrace. It is composed of obscurely cross-stratified sand and gravel, overlaid by a few feet of loamy clay, very thinly stratified and the layers wavy. There is a bowlder of norite in this bank; there are also cobblestones of diorite, gneiss and red sandstone. About 600 feet to the west of the yard of D. Fowler Jr. and Washburn the clay is being excavated in the terrace escarpment which is here 45 to 50 feet high. It is mostly blue, thinly stratified and overlain by obscurely stratified gravel and sand. In this excavation was a small ice-scratched bowlder which had been found in the clay. At J. Brennan's yard the clay is overlain by two to three feet of fine sand, and on this is a layer of indistinctly stratified fine gravel six to seven feet thick, with a covering of one foot of soil. The terrace at this point is about 50 feet high. Cobbles one to two feet in diameter of granite, gneiss and pegmatite were found in this bank. Further south at Peck's yard, several bowlders of granite, limestone and sandstone were found in the clay. Those seen were in the lower portion of the bed but I was told that several had been found in the upper portion.

Along the river behind the yards of the Excelsior and Diamond Brick Co. most of the overlying material has been removed by stripping, but judging from what is left it must have been 10 to 15 feet thick. South of Haverstraw the contact of the clay with the underlying drift can be observed, the clay thinning out as it approaches the hill. Some two miles south from Haverstraw, and half way between the stations of Ivy Leaf and Thiells on the New York & New Jersey R. R. in the valley of Ivory Creek, is a basin-shaped deposit of clay belonging to E. W. Christie. It is not over 15 feet thick as determined by boring, and has a slightly elliptical outline. The valley in which it lies is full of glacial material, and contains numerous kames, whose axes lie parallel to the direction of the valley. The clay is underlain by drift material containing bowlders of quartzite, calciferous sandrock, granite, sandstone, gneiss and schist. Over the clay is one to two feet of sand containing large ice-scratched stones of quartzite, gneiss and schist. This clay deposit was probably formed in a small lake. If it were a portion of the Hudson River estuary deposits, it would indicate a much greater submergence than that of 100 feet, supposed for this region, for this locality is 250 feet above the level of the Hudson River. On either side of the track at Thiells are probably remnants of a terrace.

The clay bank of the Anchor Brick Co. at Croton Landing, is elliptical in outline and lies on a bed of granite, gneiss, schist, and white crystalline limestone pebbles, cemented together by clay, covered with limonite. Large pebbles are scattered through the clay, the layers of which are undulating, conforming to the shape of the underlying surface. Over the clay is four or five feet of gravel and sand. South of this yard an excavation has been made under the terrace for obtaining gravel, exposing a section of Croton delta. Projecting up into it is a mass of bowlder-till.

About the middle of Croton Point are the clay-pits of the Underhill Brick Co. Their clay is overlain by the sandy beds of Croton delta. The material composing it was evidently derived from the crystalline rocks of the surrounding country. It is often micaceous and of a yellow color. Scattered through this sand are great numbers of botryoidal sand concretions, some of them forming masses six feet long and three to four feet wide. They show the layers of deposition of the sand.

The clay at Cruger's, Montrose and Verplank lies in hollows in the rock, being as much as 50 feet thick in some places. At Cruger's it is overlain by a few feet of loam; at Montrose by stratified sand, varying in depth from five to 20 feet, according to borings made. Along the Hudson River R. R. track below Montrose, at Morton's yard, the clay is overlain by from eight to 10 feet of fine gravel, and cross-stratified sand of a dark gray or black color. The materials composing it are, to a great extent, ground up crystalline rocks. The same material covers the clay at McConnell and O'Brien's bank. At the clay beds of of the Hudson River Brick Co. at Verplank, the clay is covered by yellowish sand and fine dark-colored gravel; usually they are unstratified, but in a few spots show cross-bedding.

A short distance below Peekskill, at Bonner & Cole's yard, is a remnant of a 20-foot terrace. There is here a deposit of clay not extending more than four feet above tide, and overlain by an unstratified layer five feet thick, of coarse sand and cobblestones, mostly gneiss.

From Storm King station to Dutchess Junction there is a stretch of terrace, which extends back to the foot of Breakneck and Fishkill Mts. The maximum height of it is 210 feet. Various firms are digging clay in the terrace escarpment the greater part of its length. A well of 65 feet sunk at Aldridge's yard from tide level still showed clay, and adding to this 65 feet of clay above the river level, gives us a thickness of 130 feet at this point. The character and thickness of the overlying material varies somewhat. To the rear of Timoney's yard some 700 feet, the terrace has been excavated to a depth of 30 feet, exposing a mass of coarse sand, gravel and cobblestones, mostly granites, gneisses and schists. One portion of it is stratified, and at the base of the excavation at one point yellow clay has been found. At Timoney's yard there is one or two feet of loam overlying the clay and a growth of brush covers the terrace. At Van Buren's yard the upper layers of clay alternate with layers of sand; the upper six feet of the terrace at this point is gravel, the pebbles of it being mostly granite and gneisses. At Aldridge's yard the clay is covered by six to eight feet of unstratified gravel and sand, while at another spot on top of his bank are 12 to 15 feet of fine yellow sand; which shows no stratification. The upper layers of Barnacue and Dow's clay are like those at Van Buren's, but covered by four feet of sand and over this in places six to eight feet of coarse gravel. Nothing is known of the underlying material of these yards.

The whole of Denning's Point is covered with a fine stratified yellowish sand. The clay, which lies at the base of the point, has a thin covering of loam, and the upper layers are somewhat wrinkled.

There is another stretch of terrace, similar to that below Dutchess Junction and of the same height, extending from one half mile above Fishkill to Low Point. At most places the clay is covered by a few feet of loamy soil. Several bowlders have been found in the clay at Brockway's yard. Several feet of loam overlie the clay at Lahey's, Brockway's and Dinan and Butler's yards. At J. V. Meade's yard a short distance below Low Point, the clay is covered by about three feet of sand, faintly stratified, and above this six to eight feet of unstratified material; coarse sand, pebbles and cobblestones, some of them 18 inches in diameter. Most of them are Archean rocks, but there are also fragments of shale, limestone, sandstone and a few of them contained Palæozoic fossils.

About 1,000 feet south of Meade's yard is a gravel bank eight to 15 feet thick of material similar to that overlying the clay in Meade's bank. At the base of this embankment in a few spots yellowish clay overlaid by stratified sand has been struck.

The following sections are those of wells bored at Rhinebeck.

On the land of Robert Duckley:

Soil and yellow clay	10	feet
Blue clay	82	"
Rock	....	
Total thickness	92	"

On T. Reed's property:

Soil and yellow clay	20	feet
Quicksand	100	"
Hardpan	....	
Total thickness	120	"

15

On J. O'Brien's property:

Clay	20 feet
Quicksand	25 "
Hardpan	2 "
Gravel	....
Total thickness	47 "

The clay deposits of Hudson, Stockport and Stuyvesant are like those at Coeymans Landing, being overlaid in most places by a few feet of loam and underlain by dark sand and gravel. At Stockport two ice-scratched bowlders were found in the clay; one of them three feet in diameter, the other three times as large. To the north of Brousseau's yard at Stuyvesant the surface material is stratified sand, 15 feet of it being exposed thus far.

The delta deposits of the streams tributary to the Hudson River are extremely interesting. They give us an idea of the size of the rivers flowing into the Hudson Valley when it formed an estuary, and also indicate the amount of depression which took place at those localities. All three portions of a delta may be observed in the ancient deltas on the Hudson; they are the thin layers of loamy clay which form the secondary alluvial cone of the delta, the cross-stratified sand and gravel and the overlying unassorted material. This latter was observed at Haverstraw, New Windsor, Low Point and Dutchess Junction.

The following streams between New York and Poughkeepsie have formed delta deposits; (as noted by Dr. Merrill.*) Wappinger Creek, New Hamburg; Fishkill Creek; Indian Creek, Cold Spring; Peekskill; Croton River; Pocantico River, Tarrytown; Sawmill River, Yonkers; Tibbitt's Brook, Van Cortland; Minisceongo Creek, Haverstraw; Cedar Pond Brook, Haverstraw; Moodna River, Cornwall; and Quassaic Creek, Newburg. At the present day but traces of these deposits remain, and the streams which formed them have cut down through them below tide-level. Dr. Merrill thinks it highly probable that these deltas once filled a large portion of the valley in the Highlands. At Roseton, as already mentioned, there is a deposit which may have come from the delta of Wappinger Creek. Also at Jones' Point opposite Peekskill there is a terrace composed of transported

*Amer. Jour. Sci. iii, XLI, June 1891.

material, which Dr. Merrill for a while regarded as a portion of Peek's Kill delta; the size of the pebbles composing it however caused him to give up this view. There is however in the upper portion of the terrace, a layer of unassorted material which is slightly separated from the rest; also at the south end of the terrace, a portion of thinly and obscurely stratified loamy clay, which may have formed a portion of the secondary cone of this delta. At Croton, Haverstraw and Cornwall, also at New Windsor, the clay is overlain by delta material, and where this occurs, specially at Croton, the upper limit of the clay is comparatively low, it having probably been eroded to a certain extent by the river entering the estuary at that point, and again it is not likely that very much clay would be deposited around the mouth of the river on account of the current. This may have been the case below Peekskill.

In general the upper limit of the clay increases northward as does the terrace level. To illustrate this point we have the following altitudes:

East side.	
Croton	100
Peekskill	120
Fishkill	205
West side.	
Haverstraw	100
West Point	185
Cornwall	200
Newburg	205
Port Ewen	207
Schenectady	360

These measurements apply, of course, to the upper terrace, which can be traced along many portions of the river.*

An examination of the above figures and the distances between the points mentioned indicate an interesting fact. Between New York and Peekskill, a distance of 45 miles, the terrace rises 40 feet, or eight ninths of a foot per mile. From Peekskill to West Point the rise is eight feet per mile. From West Point to Newburg the terraces ascend two and one half feet, and from Newburg to Albany about five twelfths of a foot per mile. From the above it would seem that the uplift from New York to Albany

* For detailed statement of terrace altitudes, see H. Ries, Trans. N. Y. Acad. Sci., Nov., 1891.

did not increase uniformly, but was slightly greater along the axis of the Highlands. To determine this point definitely requires a large number of accurate terrace measurements. The following are the number of terraces noticed at the different localities:

Athens	2
Port Ewen	2
Cornwall	2
Haverstraw	2
Stony Point	3
Peekskill	1 and 2
Fishkill	2
Storm King	2
Schodack	2

The shore-line of the upper terrace is generally some distance back from the river. In fact, as we go up the river, especially above Port Ewen, the shore-line recedes. At Port Ewen the terrace is 207 feet, but it is fully 225 feet at the base of Hussey Mt, which was an island in the estuary. The terrace extends up the Walkill valley several miles.* It seems not improbable that a shore line of this Quaternary deposit will be found along the base of the Catskill Mts, or not far from there. At Coeymans Landing the terrace is 140 feet, and it rises to 177 feet at the W. S. R. R. station, about a mile from the river, then a hill hides the further continuation of it from view.

From Catskill up to Albany the terrace at most points is very wide. At Coxsackie it extends behind the hill to the south of the town and comes down along Murder Creek to Athens. From Albany an alluvial plain, belonging to this formation, spreads westward, reaching a height of 360 feet near Schenectady. The surface of these terraces is usually a loamy soil of much agricultural value.

Following up Croton River as far as Croton Lake, remnants of terraces are seen at various points, their height above the river bed decreasing as we recede from the Hudson. The majority of these detached pieces seem to belong to a terrace formed at the same time as the 100-foot one at Croton Landing. There are at a few places traces of a second and lower terrace, and besides this a third one, being formed by the river during its floods at the present day.

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* Mather, Geol. 1st Dist. N. Y, p. 131.

From the facts as observed, quoted above, the following may be deduced. That during the retreat of the ice sheet from the Hudson valley the glacial streams deposited as kames a great amount of ground up material, principally shale; the material found underlying the clays along the upper portions of the valley.

That subsequent to the retreat of the glacier there was a depression of the land, which, according to Dr. Merrill,* amounted to 80 feet at New York city and near Schenectady to about 360 feet.

During this period a great amount of plastic clay was deposited produced by glacial attrition of the shales and limestones, the latter no doubt giving to it the marly character and influencing its color.

The upper portion of the clay is more siliceous and overlying it is an extensive deposit of sand, indicating a change in the nature of the material washed into the estuary. During the period of submergence much of the siliceous matter washed into the estuary was deposited at the mouths of the tributary streams to form deltas.

Terrace and sand pit, Dutchess Junction.

It has been suggested by Dr. Merrill † that the change in the estuary deposits from clay to sand might be due to the exposure

* Amer. Jour. Sci., June, 1891.
† Amer. Jour. Sci., June, 1891.

by elevation of an area of land around the basin, which would afford more siliceous matter.

An elevation would be accompanied by an acceleration of the streams, and much of the siliceous matter transported by them would be carried farther out into the estuary and spread over its bottom, while the finer clayey sediment would be carried out to sea. A readvance of the ice, it would seem, would likewise cause an acceleration of the streams, and with the results stated above.

To account for the isolated bowlders in the clay it seems highly probable that icebergs or icefloes having stones and dirt imprisoned within their mass detached themselves from the retreating glacier, and, floating down the estuary to the sea, dropped their burdens.

The unstratified material found with it and in some cases overlying the stratified delta deposits is a matter of interest as concerns its origin. Three things may be noticed regarding it.

1. The material is sand, pebbles and cobblestones lying mixed together without any separation of the coarse from the fine.*

2 The pebbles and stone are rounded and do not show any scratches.

3 The materials are mostly of the same character as the rocks of the vicinity.

Now as the land rose from its submergence the velocity and with it the transporting power of the streams would increase, washing down quantities of large stones and gravel. Dr. Merrill considers that a rapid flow of water took place down through the Hudson Valley in the late Quaternary. This water must have come down through the valleys of the tributary streams, having a much greater velocity in their valleys than it would have after it turned into the Hudson Valley, and the checking of its velocity as it reached the Hudson would cause the deposition of the greater part of its load. A large stream rushing down the valley of the Fishkill would drop its burden specially below it, where we find them heaviest as the flow of the water was toward the south. Again, Peek's Kill would behave in a similar manner.

A curious and interesting phenomenon is the crumpling of the clay at many localities. This disturbance often extends through

* The only locality where stratification was observable was at Timoney's yard near Dutchess Junction

out the section, and has been caused by slips or pressure from above, as when the clay is covered by a thick delta deposit. Prof. R. P. Whitfield has told the writer of instances where the clay layers had been disturbed to a depth of several feet from the surface by the weight of bowlders and large trees.

In many instances there occurs a crumpled strip of clay between layers which are entirely undisturbed; this has been actually observed by the writer to have been caused by slipping of the clay.

Clay concretions.— These are of common occurrence, especially in the yellow clay. They are of varying form and size. Many of them have a cylindrical hole in the center, which is lined with carbonaceous material. The flat concretions are found parallel to the layers of the clay, and in many instances at a depth from the surface to which the roots penetrate.

Those found at a greater depth did not have the central cylindrical cavity. They are very abundant in the yellow clay at Haverstraw. Roots penetrating the clay at this locality were surrounded by lumps of clay in the form of concentric rings. These might seem to indicate the method of formation described by Prof. J. D. Dana (Manual of Geol., p. 628). Again in the yellow clay near the surface at Coxsackie were found some forms which were similar in appearance to what Dr J. I. Northrup has described as rhizomorphs.* They may be due to the roots which penetrate the clay, absorbing water from it and rejecting the contained lime, which deposits itself around the root forming the hard rhizomorph. Their interior structure was crystalline.

Another form of concretion is found in the delta sands at Croton Point. It consists of botryoidal masses of sand, cemented by oxide of iron. Some of them show the layers of deposition of the sand. The concretions are usually small, but one mass was noticed fully six feet long and four feet wide.

Concerning the origin of these concretions various opinions are expressed by different geologists.

Organic remains are extremely rare in these clays. The writer has discovered sponge spicules, probably referable to *Hyalonema* or an allied genus, and which are figured. The following

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* Trans. N. Y. Acad. Sci., Oct. 13, 1890.

diatoms were also found: *Navicula Gruendleri*, A. S.; *Navicula permagna*, Edw. (fragments); *Melosira granulata* (Ehr.) Ralfs; *Nitzshia granulata*, Grun. All fresh water species. At Croton Landing a number of impressions were found in the blue clay and these on being submitted to Prof. Hall were pronounced to be worm tracks. Mather in his report* mentions the finding of leaves in the clay beds back of the medical college at Albany, and states that they resemble those of an aquatic plant.

The Clays of the Champlain Valley†

The clays of the Champlain valley are estuary formations and of the same age as the Hudson River clays. They underlie terraces along the lake which have been elevated to a height of 393 feet above sea level. These terraces may be traced almost continuously from Whitehall, at the head of Lake Champlain, to the northern end of the lake and beyond it, but on account of the extensive erosion which has taken place they are usually narrow, and it is only at sheltered points like Port Kent and Beauport that they become specially prominent. The section involved is yellowish brown sand, yellowish brown clay and stiff blue clay, the latter being rather calcareous. The upper clay is somewhat siliceous, and its coloring is due to the weathering of the lower layer. This formation has a thickness of about 15 feet, but sometimes, as at Burlington, it reaches a thickness of 100 feet. Isolated bowlders are occasionally found in the clays, and are considered by Emmons to have been dropped there by icebergs. The clays are usually horizontally stratified, and contortions of the layers are extremely rare. Numerous fossils have been found in the overlying sands, among them being *Saxicava rugosa* and *Tellina groenlandica*, which are very common; *Tritonium anglicum*, *Tritonium fornicatum*, *Mytilus edulis*, *Pecten islandicus*, *Mya truncata*, *M. arenaria*, *Nucula portlandica;* the skeleton of a whale has also been found in these deposits.**

Openings have been made in them for the purpose of obtaining brick clays at Plattsburg and a few other localities, but owing to the lateness of the season when I visited them information was hard to obtain.

* Geol 1st, Dist. N. Y., p. 123.

†Compiled largely from Emmons Report, Geol. N. Y. 2nd Dist.

** The writer has found one species of diatom belonging to the genus *Diatoma* in the clay from Plattsburg.

Long Island Clays

Long Island is made up of a series of sands, gravels and clays, which form two parallel ranges of hills in the northern half of the island, while the southern half is a flat plain. The most southern of the ranges represents the limit of the drift.*

The clay beds are exposed along the north shore of the island and at several points along the main line of the Long Island railroad. In describing them I have gone east along the north shore and come back through the center of the island.

In a paper on the geology of Long Island, (previously cited) Dr. F. J. H. Merrill describes in detail the formations exposed on the island, and mentions the insufficiency of data necessary to afford definite conclusions concerning the sequence of geological events. Examinations of the various clay outcrops on the island made since show that eight years has made considerable changes; permitting the collection of additional data and obliterating many localities described by him. With the exception of four similar deposits on the north shore, all the clay beds as exposed at the brick yards are rather unique in appearance.

The most western clay outcrop on Long Island, of which the writer has any knowledge, is on Elm Point near Great Neck.‡ There is here a bed of stoneware clay over 30 feet thick and overlain by 15 to 20 feet of yellow gravel and drift. The clay is dark gray and contains streaks of lignite in a good state of preservation. In appearance the clay resembles the Cretaceous ones of New Jersey and will doubtless prove to be of the same age. The overlying yellow gravel contains sandstone concretions and also sandstone fragments containing Cretaceous leaves.**

There is an outcrop of clay at Glen Cove on the east shore of Hempstead Harbor and at the mouth of Mosquito Inlet. This has long been considered of Cretaceous age from the plant remains found† in sandstone fragments embedded in the clay. The layers of the latter are blue, red, black and yellow, and dip northeast 10°–15°. Near this locality and on the south shore of Mosquito Inlet is an outcrop of pink clay, belonging to Carpenter Bros. and used for fire-brick and stoneware. Dipping under it to the

* For a detailed account of the topography of Long Island see Mather, Geology of New York (1st Dist.) 1843; W. Upham, A. J. S. 111, 18; F. J. H. Merrill, Geology of Long Island, Ann. N Y Acad. Sci, 1884.

‡ H. Ries. Notes on the clays of New York State.—Trans. N. Y. Acad. Sci., XII.

** C L Pollard, Note on Cretaceous leaves from Elm Pt., L. I.—Trans. N. Y. Acad. Sci., XIII.

† A. Hollick, Trans. N. Y. Acad. Sci., XII.

north at an angle of 30° is a bed of alternating layers of quartz pebbles and clay. The pebbles crush easily to a white powder. Associated with this clay is a bed of kaolin, but the exact relations of the two deposits are not known. Kaolin also crops out from under the gravels on the west shore of Hempstead Harbor. Carpenter's clay resembles that of Cretaceous age found on Staten Island, but its age has yet to be proven. The sandstone fragments found in the clay across the inlet are found along the shore of it to Carpenter's clay, but none are found in it. Dr. Merrill has found plant remains in this clay, but they were not sufficiently well preserved for identification. (See paper previously cited.) A microscopic examination of the clay revealed the presence of the following diatoms; all freshwater forms.

Melosira granulata (Ehr.), Ralfs.
Stephanodiscus Niagaræ (Ehr.),
Diatoma hyemale (?) K. B.

On Center Island in Oyster Bay we find the most western of a series of clay beds which bear a grêat similarity to each other. The others are on West Neck, at Fresh Pond and on Fisher's Island. The clay on Center Island consists of two kinds, a lower bluish clay and an upper brown sandy clay. Overlying this latter is a stratified sand. The layers of clay undulate in several directions. Dr. Merrill mentions the occurrence, one mile north of this clay pit, of a bed of white fire clay at a depth of 25 feet under the drift and sand. The only organism thus far met in this clay is one species of diatom, viz.: *Stephanodiscus Niagaræ*; and a curious spiny hair.

At Jones' brick yard on the east shore of Cold Spring Harbor is a thick deposit of clay. The lower portion is tough and contains little sand. The upper portion is much more sandy and of a brown color. The clay bank is over 100 feet in height and the layers have crumpled on a large scale by the pressure of the advancing ice sheet. A layer of diatomaceous clay occurs in th upper portion of the clay bank, and its position is shown in the following section given by Merrill: (l. c.)

"Till" and stratified drift	10	feet.
Quartz gravel	45	"
Red and blue "loam" or sandy clay	20	"
Diatomaceous earth	3	"

Yellow and red stratified sand	20 feet.
Red plastic clay	20 "
Brown plastic clay	25 "
Total	143

"The bed of diatomaceous earth is of undetermined extent, and appears to be replaced a little to the east by a blue clay, which, however, contains some diatoms. It is undoubtedly equivalent to the bed of ochre which overlies the sand throughout the remainder of the section."

The following diatoms, all fresh-water species, occur in it:

Melosira granulata (Ehr.) Ralfs.
Stephanodiscus Niagaræ (Ehr.)
Epithemia turgida (Ehr.) Kutz.
Encyonema ventricosum, Kutz.
Cymbella delicatula, Kutz.
Cymbella cuspidata, Kutz.
Navicula viridis, Kutz.
" *coconeiformis*, Greg.
" *major*, Kutz.
" *varians*, Greg.
" *lata*, Breb.
Eunotia monodon, Ehr.
Gomphonema capitatum, Ehr.
Stauroneis Phœnecenteron, Ehr.
Fragilaria construans, Grun.
Synedra affinis, K. B.
Campyloneis Grevillei var. *Regalis*.
Triceratium trifoliatium.

The *Melosira* and *Stephanodiscus* are present in countless numbers. Only two specimens were found of the *Triceratium*, and Dr. D. B. Ward, of Poughkeepsie, who has also given me much aid in the identification of my material, informs me that this species is very common in the diatomaceous earth from Wellington, New Zealand, but he has never heard of its occurrence before in America.* Sponge spicules are not uncommon in Lloyd's Neck diatomaceous earth, and several forms are figured. Samples of the red and brown clay from the section given above were examined, but no organic remains were found in them.

* Since this report was sent to press the writer has been informed of the discovery by Mr. Lewis Woolman of this same species in certain New Jersey deposits.

(Magnified 500 diameters, except Fig. 1, which is enlarged 250 diameters.)

FIGS. 1–13. Sponge spicules. Croton Point.

FIG. 14. *Melosira granulata* (Ehr.) Ralfs. Croton Point.

FIG. 15. *Navicula Gruendeleri*, A. S. Croton Point.

FIG. 16. *Diatoma* sp? Plattsburg.

FIG. 17. Diatom fragment from Croton Point.

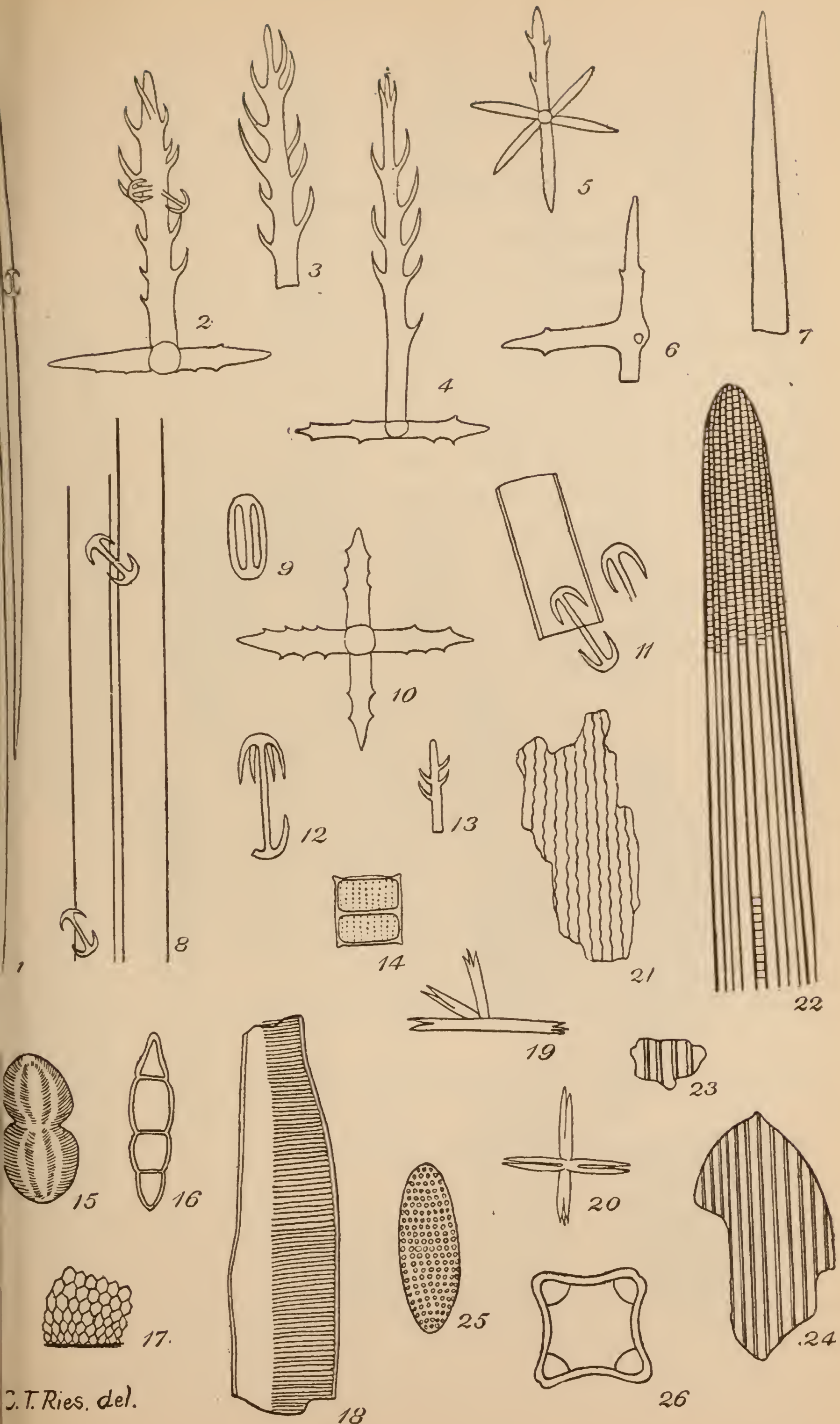
FIG. 18. *Navicula permagna*, Edw. Croton Point.

FIGS. 19, 20. Sponge spicules. Kreischerville, S. I.

FIGS. 21, 22, 23, 24. From clay at Verplank.

FIG. 25. *Nitszchia granulata*, Grun. Croton Point.

FIG. 26. From clay at Croton Point.



C. T. Ries, del.

(Magnified 500 diameters.)

FIGS. 1, 2. Jointed hair. Wyandance, L. I.

FIG. 3. Ridged tube from stoneware clay. Glen Cove, L. I.

FIGS. 4, 5. Spicules from cretaceous clay at Glen Cove, L. I.

FIGS. 6, 7, 8. Spicules from Lloyd's Neck, L. I.

FIG. 9. Spicule fragment? Farmingdale, L. I.

FIG. 10. *Diatoma hyemale.* Glen Cove, L. I.

FIG. 11. *Navicula viridis*, Kutz. Lloyd's Neck, L. I.

FIG. 12. *Cymbella cuspidata*, Kutz. Lloyd's Neck, L. I.

FIG. 13. *Campyloneis Grevillei*, var. *Regalis.* Lloyd's Neck, L. I

FIG. 14. *Cocconema parvum*, W. Smith. Northport, L. I.

FIG. 15. *Triceratium trifoliatum.* Lloyd's Neck, L. I.

FIG. 16. *Eunotia monodon*, Ehr. Lloyd's Neck, L. I.

FIG. 17. *Navicula lata*, Breb. Lloyd's Neck, L. I.

FIG. 18. *Encyonema ventricosum*, Kutz. Lloyd's Neck, L. I.

FIG. 19. *Synedra affinis*, K. B. Lloyd's Neck, L. I.

FIG. 20. *Fragilaria construans*, Grun. Lloyd's Neck, L. I.

FIG. 21. *Gomphonema capitatum*, Ehr. Lloyd's Neck, L. L.

FIG. 22. *Epithema turgida* (Ehr.) Kutz. Lloyd's Neck, L. I.

FIG. 23. *Navicula cocconeiformis*, Greg. Lloyd's Neck, L. I.

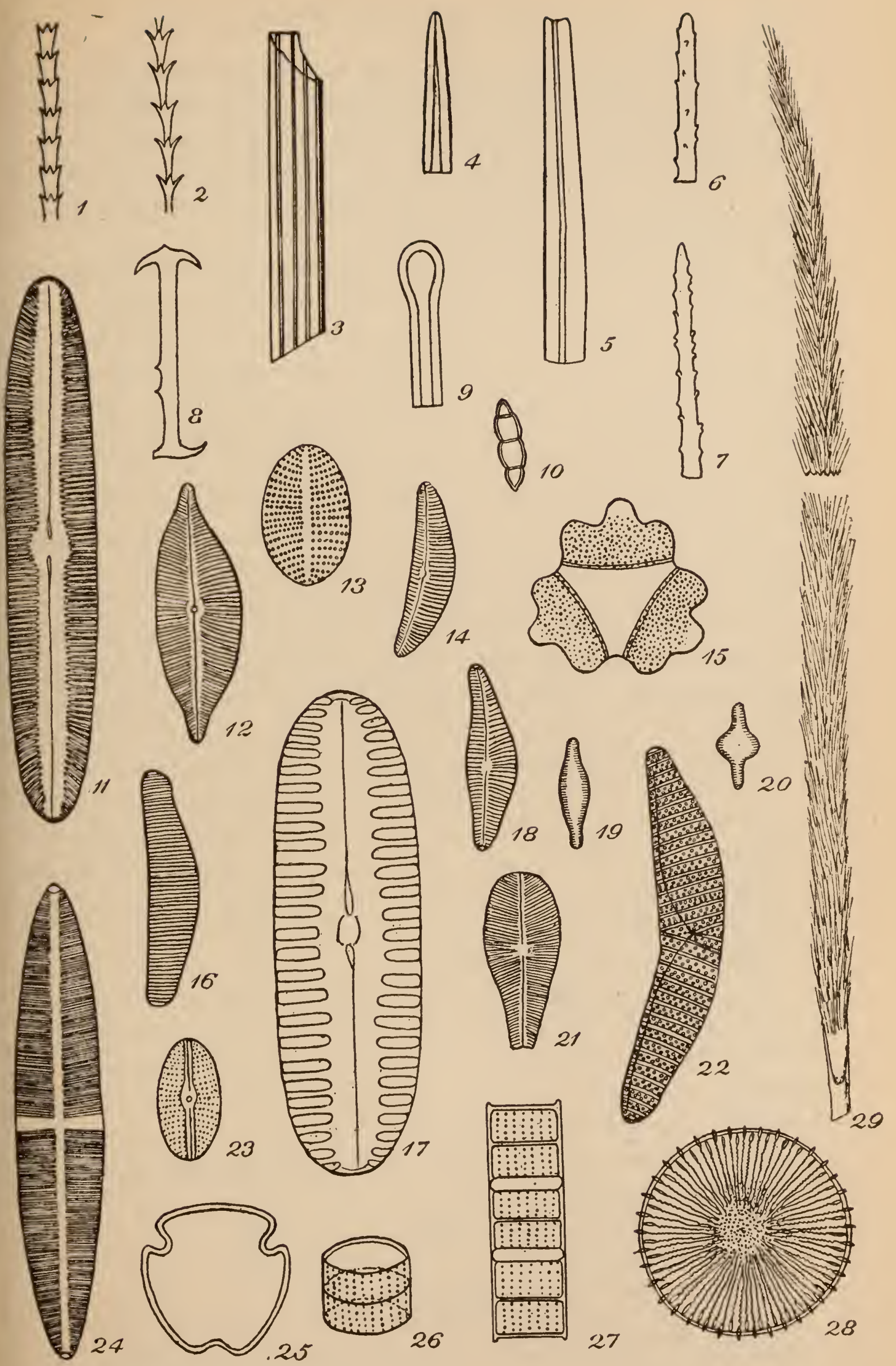
FIG. 24. *Stauroneis Phœnecenteron*, Ehr. Lloyd's Neck, L. I.

FIG. 25. From clay at Northport, L. I.

FIGS. 26, 27. *Melosira granulata* (Ehr.) Ralfs. Lloyd's Neck and Glen Cove, L. I.

FIG. 28. *Stephanodiscus Niagaræ*, Ehr. Lloyd's Neck and Glen Cove, L. I.

FIG. 29. From clay at Oyster Bay.



C.T. Ries. del.

Concretions are abundant in the clay on Center Island and West Neck. Those found at the latter locality are disc-shaped, while those found on Center Island are more or less botryoidal.

Silicified yellow gravel fossils have been found by the writer in the sands on West Neck,* and more were subsequently found in other localities by Mr. Hollick.†

On Little Neck, in Northport Bay, is an extensive deposit of stoneware clay and fire sand, which has been worked for a number of years. The clay is stratified, the layers being separated by laminæ of sand. In color the material varies from black to brown and yellow, and it becomes sandy in its upper portion. There is a dip of 15° S. E. due to a slipping of the clay bank. Overlying the clay is cross-bedded fine sand and gravel, the latter containing much coarse material near the surface. Very little till covers the whole. Much fine, white fire sand occurs in portions of the bank. A careful examination of the section showed a brownish-black seam of the clay, two feet thick, containing numerous fragments of plant remains, of which a number were sufficiently well preserved to determine the Cretaceous age of the clay beyond doubt. The species were identified for me by Mr. Hollick as follows:

Protaeoides daphnogenoides, Heer.
Paliurus integrifolia, Hollick.
Laurus angusta, Heer.
Myrsine sp.
Williamsonia sp.
Celastrophyllum sp.
Paliurus sp.

The latter resembles *Paliurus Columbi* (Heer); a Tertiary species (Fl. Foss, Arct. I, 122, pl. XVII, Fig. 2d,) but is much smaller and very probably a new species. The above species are the same as those found in the middle cretaceous clays of Staten Island, N. Y., and Perth Amboy, N. J.

Three species of diatoms, all fresh water forms, were also discovered in this clay.

Melosira granulata, (Ehr.) Ralfs.
Diatoma hyemale, K. B.
Cocconema parvum, W. Smith.

*Trans N. Y. Acad. Sci., XII.
† Trans. N. Y. Acad. Sci. Vol. XIII.

The occurrence of these diatoms is a matter of great interest. While diatoms are abundant in the Tertiary, their only known occurrence in the Cretaceous, is the chalk* which is upper Cretaceous. This being the case, their occurrence at Northport extends the known geological range of diatoms.

At Fresh Pond the clay crops out along the shore for distance of half a mile. It is brownish and red in color, the red being more sandy. Sand and gravel overlies it, and at Sammis' yard the sand, which is stained by limonite, shows a fine anticlinal fold.

One of the most interesting clay banks is that on Fisher's Island. The clay is of a reddish color similar to that on West Neck and Center Island, and in its original condition was horizontally stratified and overlain by 20 to 30 feet of laminated sand. But the whole deposit has been disturbed by the ice sheet passing over it, and the layers have been much crumpled to a depth of about 30 feet, while below this they are undisturbed. The till overlying it is in places 30 feet thick and contains large bowlders.

Dr. Merrill mentions the presence on Gardiner's Island,† of extensive beds of brick clay together with their associated sand beds, (they are not being worked,) and notes the occurrence of a fossiliferous stratum.

Clay is also said to outcrop near Sag Harbor and around the shore of Hog Neck in Peconic Bay.

Between Southold and Greenport are several deposits of a red glacial clay which is being used for brick. The clay contains angular stone fragments and runs from 50 to 60 feet in thickness. About one and a half miles east of Southold is a bed of mottled blue pottery clay which has been used for a number of years in making flower pots. The depth of this deposit is not known.

At West Deer Park is a clay bank of unique appearance. In July 1892 the section showed

	Yellow gravel	6 feet
Containing concretions	Flesh colored clay	6 "
Containing concretions	Red clay	1 "
	Black clay with pyrite	4 "
	Black sandy clay	4 "
	Red sandy clay	3 "
	Total thickness	20 "

*Nicholson, Manual of Palaeontology, II.

†Previously cited.

Lenticular masses of gray sand are sometimes found in the black clay. The black clay also contains furstules of *Melosira granulata*, (Ehr.) Ralfs, and numbers of a jointed yellowish brown hair, resembling those of a crustacean. The black clay burns to a white brick. About four miles west of this locality near Farmingdale the section in Myers' clay pit is

Sand and gravel	6 feet
Red sandy clay	6 "
Yellow and red sand, wavy lamination	2 "
Reddish yellow clay	6 "
Reddish blue clay	20 "
Micaceous sand, cross-bedded	.. "
Total thickness	40 "

About one-quarter mile south of Myers' brick yard is that of Stewart. The section at this locality (now obliterated) as given by Dr. Merrill is *

Surface stratum yellow micaceous clay	35 feet
Reddish and sandy clay	5 "
Blue black sandy clay with nodules of white pyrites	25 "
White sand	.. "
Total thickness	65 "

A local deposit of grayish blue sandy clay occurs at E. Williston. It varies in depth from six to 20 feet and is underlain by sand. On my last visit to this locality I found a number of stems and leaf fragments in the clay but none of them sufficiently well preserved for identification.

There is still some doubt as to the exact conditions under which the beds of clay and gravel which form the greater portion of Long Island were deposited, but it is probable that the clays represent shallow water marine deposits of Cretaceous and Tertiary age. The overlying sands and gravels have in most instances a cross-bedded structure, with a south dip, and were probably deposited by swift currents as stated by Dr. Merrill.

The age of the clays is still largely a matter of speculation, and will probably remain so in many cases unless palæontologic evidence is forthcoming. Those on Gardiner's Island are quite

*Geology of L. I, Ann. N. Y. Acad. of Sci., Nov. 1884.

recent, as shown by the contained fossils, and the clay on Little Neck near Northport is Cretaceous as previously noted. The proof of the age of the Glen Cove clay is not absolute.

Cretaceous leaves in fragments of ferruginous sandstone have been found along the north shore of Long Island from Great Neck to Montauk Point,* but they are usually much worn and scratched and have evidently been transported from some distant source. The clays at Center Island, West Neck, Fresh Pond and Fisher Island are very similar in appearance and composition, are very probably of the same age, possibly Tertiary,† but we lack palæontologic or stratigraphic evidence. At West Neck the clay underlies the yellow gravel and the latter is covered by the drift, so that is pre-pleistocene.

The theory has been put forth that the Cretaceous formation on Long Island would be found north of a line joining the southern border of the Cretaceous formation of New Jersey and Martha's Vineyard,‡ and that outcrops south of this might be Tertiary; in view, however, of determining the clay at Little Neck near Northport to be Cretaceous, we must abandon this theory.

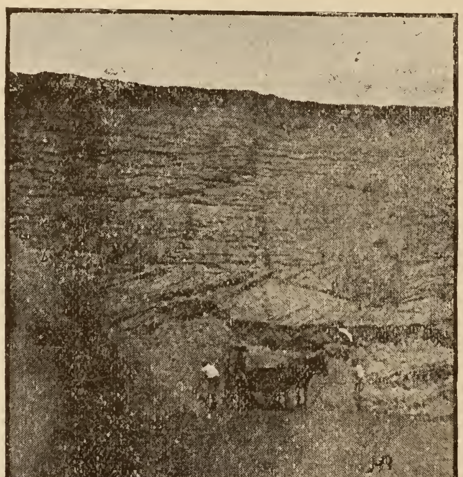
Folded clays, West Neck, L. I.

An interesting phenomenon is the tilting and crumpling of the strata on the north shore of Long Island. This disturbance is especially well shown on West Neck and was considered by Dr. Merrill to be due to the pressure of the advancing ice sheet,§ which excavated the deep narrow bays and pushed the

* A. Hollick, Notes on Geology of North Shore of Long Island, Trans. N. Y. Acad. Sci., XIII.
† This idea is also expressed by Dr. Merrill.
‡ A. Hollick, Notes on Geology of North Shore of Long Island, Trans. N. Y. Acad Sci. XIII.
§ Geology of Long Island, Ann. N. Y. Acad. Sci. 1884.

excavated material into high hills at their head. Dr. Merrill's views have been recently corroborated in a paper on "The deformation of portions of the Atlantic coast plain," by A. Hollick,* who, in disputing the possible orogenic origin of these

Sand and Gravel West Shore of Hempstead Harbor.



Stratified Sands and Gravels at Port Washington.

folds, calls attention to the fact that they are found only along the line of the moraine, and that the beds are disturbed only to a certain depth. The disturbance is well shown at Glen Cove,

* Trans. N. Y. Acad. Sci., XIV.

West Neck, Fresh Pond and on Fisher's and Gardiner's islands. It is important, however, not to confound tilting of the layers, due to slipping, as is the case on Little Neck near Northport, with that produced by the ice-thrust.

Both Dana and Merrill consider Long Island Sound to be of preglacial origin; the former calls attention to a channel in the southern part of the sound, which probably was that of a river draining Connecticut in preglacial times, and which emptied into Peconic bay. The latter points to the absence of till along the north shore of Long Island where the sound is wide, as evidence of the fact that most of the drift was dropped into the sound by the ice in its passage across it.

On the other hand Hollick* considers that Long Island Sound was dry land until the glacial period, and that the continental glacier upon its arrival on the Connecticut shore plowed up the material from the space now occupied by the sound and pushed it ahead to form the range of hills along the northern part of Long Island. It seems to the writer however that the facts do not support this theory. If we suppose the northern range of hills to be composed of material pushed up out of the area now occupied by the sound, it should everywhere show signs of disturbance. This it does not do. The high hills of sand and gravel at Port Washington for example show no signs of disturbance.

Mention should be made of a yellow gravel formation. This is found almost everywhere on Long Island, and sections in the railway cuttings frequently show a thickness of 30 or 40 feet.

Staten Island clays

The clays of Staten Island are chiefly Cretaceous, as proven by the fossils found in them. (A. Hollick, Trans. N. Y. Acad. Sci., vol. XI.) The chief outcrops are at Kreischerville, Green Ridge and Arrochar. Besides the clay there are several "kaolin" deposits.

In many instances the clays and overlying yellow gravels have been much disturbed by the passage of the ice over them, and in some cases the sections show overthrown anticlines, as on the fingerboard road at Clifton.

* Notes on Geology of North Shore of Long Island, Trans. N. Y. Acad. Sci., XIII.

Mr W. Kreischer informed me that the clay at Kreischerville occurs in isolated masses or pockets in the yellow gravel and sands. If such is the case, and if these beds, as is usually supposed, are a continuation of the New Jersey ones, they must be explained as follows: Either the original beds have been torn

Overthrown anticline of Yellow Gravel, Fingerboard Road, Clifton, S. I.

apart by the ice which bore down on them, or else they have been deeply eroded by the currents which deposited the overlying sands and gravels.

The writer favors this latter view.

A boring made on the site of Kreischer's fire brick factory showed

Sand and soil	30	feet.
Blue clay	90	"
White sand	2	"
Sand and clay alternating	78	"
Total thickness	200	"

Next to the church at Kreischerville is a bank of stratified sand standing some 40 feet back from the road. It appears to have been dug away considerably, but Mr Kreischer informed me that there was once a large mass of clay at this spot which was surrounded by the sand. To the north of this near the shore is a bank of blue stoneware clay overlain by yellow laminated sand, and southeast of the church is a similar bank, but the clay is of a more sandy nature. A third opening is opposite Kilmeyer's hotel at Kreischerville, and from this a yellow mottled fire clay is obtained. This latter bed is overlain by about 20 feet of sand and yellow gravel and underlain by a white sand.

A fourth opening on the shore is in a blue clay. It has always been an interesting question as to what extent Staten Island was underlain by the Cretaceous formation, and the following record

Clay Pit, Kreischerville, N. Y.
(Yellow gravel over Cretaceous clay.)

of a well bored for Bachman's brewery at Annandale, S. I., seems to throw some light on the subject:

At a depth of 200 feet a bed of yellow gravel containing shells was struck. The gravel was 36 feet in thickness and beneath it was a bed of clay 10 feet thick. This latter was of a white and blue color and was said to resemble a fine pottery clay.

The above may very possibly be some of the Cretaceous clay overlain by the yellow gravel. Borings made at various points along the shore of Arthur's Kill, between Kreischer's factory and Wood & Keenan's brickyard, penetrated a blue clay at a depth of three or four feet. This latter is no doubt of very recent origin.

At the Anderson Brick Company's pit near Green Ridge, the lower clay, which is of a black color, shows signs of disturbance, and slicken sided surfaces are common. The upper portions of the bank are of blue and gray colors, and at one spot there is a thick seam of lignite. The clay is not sufficiently refractory for fire brick. Fragmentary plant remains were found by the writer in this pit, but they are not nearly so perfect as those found in the fire clay pit at Kreischerville, and which have been figured and described in minute detail by Mr. Arthur Hollick of Columbia College, New York City.

Spicules have been observed in the fire clay at Kreischerville, Staten Island. In the kaolin found near Kreischerville were discovered a number of diatoms, which Dr. Ward informs me are either *Cocconeis placentula*, Ehr., or *Cocconeis pediculus*, Ehr. Their occurrence is also of great interest, as these kaolins are known to be middle Cretaceous beyond doubt.

Stony glacial clays occur also underlying the flats at Green Ridge, Staten Island.

One mile and a quarter northeast of Kreischer's fire brick factory an excavation has been made for obtaining a micaceous kaolin. About 15 feet of it are exposed. A quarter mile north of this locality is the pit of the Staten Island Kaolin Co. The kaolin is evidently a continuation of that exposed in Kreischer's pit, but is apparently not as thick. The deposit has suffered disturbance by the ice sheet and the layers are intermixed with the till. At the northeast side of the excavation a bluish sandy clay containing fragments of lignite is found to underlie the kaolin.

As the Cretaceous clays, kaolins and yellow gravels are a continuation of the belt extending across New Jersey, the history of their deposition is the same.*

The following analysis of kaolin from Campbell's pit on Staten Island, is given in the New Jersey clay report cited above:

Silicic acid and sand	92.70
Al_2O_3 and F_2O_3	5.70
H_2O	.70
K_2O	.35
	99.45

*Report on clays, N. J. Geol Surv [illegible]8

General remarks on clay

Clay is a hydrated silicate of alumina, having the formula $Al_2O_3, 2SiO_2 + 2H_2O$, or silica 46.3 per cent., alumina 39.8 per cent., water 13.9 per cent. This is the mineral kaolinite, and it generally results from the decomposition of granite or other feldspathic rocks. The three essential component minerals of granite are quartz, feldspar and mica, and of the feldspars, orthoclase or the potash feldspar is most commonly present. The surface waters in percolating through the rocks attack the feldspar and leach out the potash as carbonate, or possibly as a silicate if the amount of carbonic acid is small. This breaking up of the feldspar destroys the bond for the quartz and mica and the rock begins to crumble. As a further result of the leaching some silica is set free and left in a hydrated condition. The alumina of the feldspar, the hydrated silica, and some water unite forming kaolinite, the basis of all clays. A deposit of this kind formed in place is a residual clay and its purity is largely influenced by the composition of the parent rock and mechanical conditions, both of which vary. Usually many accessory minerals are present, and destroy the purity of the clay or kaolin. In the general erosion of the land the kaolin together with other minerals composing the rocks are washed into the lakes or ocean, the coarser material transported by the streams being dropped at their mouths to form deltas, while the fine aluminous mud settles in the quieter waters forming a bed of clay. Such deposits of clay are called "sedimentary" to distinguish them from the "residual" ones.

Beds of clay of vast extent are thus deposited in the ocean. With further deposition they become buried far beneath the ocean floor, where subjected to the action of dynamic agencies such as heat and pressure these beds of clay become converted to shale. With subsequent elevation of the sea bottom, and erosion of the new land surface the shale becomes exposed as we now find it over a large portion of the state. The disintegrated outcrops of shale have often been used for brickmaking, having been mistaken for deposits of sedimentary clay. Much aluminous rock flour was produced from the erosion of the shales by the North American ice sheet. This was held in suspension by the glacial streams and finally deposited as beds of clay in the numerous lakes which occupied the valleys during the early Pleistocene period The erosion of the sandstones has added to the grittiness of the clays. The extensive deposits of plastic clay found on Long Island were elevated above sea level within probably a comparatively short time after their deposition.

Pure clay is of a white color and is very rare. The purest clays known are the China clays, which have about the theoretical composition of kaolinite.

Clays suitable for the manufacture of common brick are by no means uncommon. The impurities in them often run quite high, still in many cases they make a most excellent common brick. The use of a clay for one thing or another is largely determined by the impurities. The clay should be plastic, work easily and burn to a good red color, giving a hard ringing product.

Plasticity is the property which clay has of forming a pasty mass when mixed with water, and changing to a hard mass when subjected to a high heat. Burned clay if ground and mixed with water is not plastic; in fact clay loses its plasticity when the water of combination is driven off. This property of clay is largely due to the kaolinite base which occurs in the form of minute hexagonal tablets.

Dry kaolin is not plastic, and water seems therefore to likewise influence plasticity. Prof. G. H. Cook found that it was also influenced by the degree of fineness of the kaolin. In clays which are very slightly plastic the plates of kaolinite were found to be collected in bunches, and a subsequent thorough grinding in order to break up these aggregates increased the plasticity.

A tough plastic clay is termed by the brickmakers "fat;" on the other hand a clay of loose texture and possessing little plasticity is said to be "lean" or "poor."

Sand consisting of quartz, feldspar or mica destroys the plasticity of clay and is one of the commonest impurities. The others are lithium, titanium, iron, lime, magnesia and the alkalies potash and soda. Sulphur is sometimes present, it having been found in some of the Hudson River clays.

Page* states that "the admixture of a proportion of siliceous sand, which results in a combination containing as much as 90

* Economic Geology, p. 186.

per cent. silica is not incompatible with the formation of a good brick. Uncombined silica, if not in excess, is beneficial, as it preserves the form at high temperatures; in excess it destroys cohesion and makes the brick brittle and weak. Fire clays should not contain over three to four per cent. of fusible impurities.

The fusibility of a clay usually increases with the amount of impurities present. Richter* found that potash rendered a clay more fusible than any of the other impurities; iron is said to come next, then lime and lastly magnesia. Phosphates also increase the fusibility of clay slightly.

Iron is usually present in clay in the form of a lower oxide, and in burning is converted to a higher one, coloring the brick red. According to Seger† the shade of color produced by iron is influenced by the amount of iron oxide present, the chemical composition of the clay, and the mechanical division of the coloring substance, the degree of burning, and whether the fires of the kiln are reducing or oxidizing. The intensity of the coloration increases with the amount of peroxide of iron from four to eight per cent. From this up to 21 per cent. no change in the color was noticed.

Carbonate of lime counteracts the color produced by iron due to the formation of a light colored double silicate of iron and lime. This fact is often made use of in the manufacture of cream-colored brick, a certain proportion of lime being added to the clay. Clays rich in carbonate of lime burn yellow in a reducing atmosphere. If there is an excess of lime the bricks get flesh colored in the oxidizing flame.

If iron is present in the form of sulphate it usually decomposes at the point of fusion, giving a lower oxide which fluxes and produces a distortion of the brick. A reducing flame is detrimental to the formation of sulphate.

It has been stated that a clay containing over three per cent. of lime is not fit for making brick, but this limit is too low, as clays with five and six per cent. of lime will often make a very good product and the celebrated Milwaukee brick have 23 per cent.

* Brickmaker, Oct. 1892.

† Brickmaker, Oct. 1892.

Magnesia also tends to prevent the development of a red color in bricks.

A white or light-colored brick is sometimes produced if the clay contains a large amount of organic matter which will reduce the iron. Efflorescence is due to the dissolving of the sulphates of magnesia and the alkalies by permeating water, and their deposition on the face of the brick when the water evaporates.

A similar whitish coloring noticed on brick freshly burnt may be due to the reduction of the iron by smoke from the arch fires.

Titanium and lithium are never present in quantity. The latter occurs as titanic acid. Lithium occurs in the clay in a similar form and its presence was first detected in the Cretaceous clays of New Jersey.

Clays weigh 110 to 125 pounds per cubic foot. They have a specific gravity of from 1.75 to 2.00.

Clays may be divided into three kinds:

1 Clay. Mostly alumina and silica in varying proportions, with a small percentage of salts of iron, lime, magnesia, potash, etc.

2 Loams or sandy clays.

3 Marls. Clays containing a large amount of lime.

The refractoriness of a clay is not alone dependent on its composition but is also influenced by its density and fineness of grain.* When two clays are of the same density and fineness, their refractoriness is inversely proportional to the detrimental impurities present, when the latter are equated as to their proper fluxing values. This Professor Wheeler calls the "Fusibility factor" and deduces the formula:

$$F.\ F. = \frac{N}{D+D'} \text{ (A.)}$$

N being the sum of the non-detrimentals or total silica, alumina, titanic acid, water, moisture and carbonic acid gas.

D = sum of detrimental impurities as iron, lime, magnesia, alkalies, sulphuric acid and sulphur.

D′ = sum of the alkalies. This latter is added because the alkalies have about twice the fluxing power of the other detrimentals. The effect of FeO is not considered as it is quickly

* H. A. Wheeler, "Calculation of the Fusibility of Clays." Eng. and Min. Jour., March 10, 1894.

changed to Fe_2O_3 when the clay is heated. This formula gives a good comparative value of the refractoriness of two similar clays whose specific gravity does not differ by more than .2.

When the clays to be compared differ in fineness, the formula (A.) is modified by the constant C.:

$$F.\,F. = \frac{N}{D + D' + C} \quad \text{(B.)}$$

C = 1 when the clay is coarse grained and sp. gr. over 2.25.
C = 2 when the clay is coarse grained and sp. gr. 2.00–2.25.
C = 3 when the clay is coarse grained and sp. gr. 1.75–2.00.
C = 2 when the clay is fine grained and sp. gr. is over 2.25.
C = 3 when the clay is fine grained and sp. gr. 2.00–2.25.
C = 4 when the clay is fine grained and sp. gr. 1.75–2.25.

The value of C is to be considered only approximate.

The temperature of fusion of a clay is usually determined by means of a pyrometer. Two kinds have been more or less used for this purpose, viz., the Lunette pyrometer and Le Chatelier's thermo-electric pyrometer, which is far more accurate. These pyrometers have also been used to determine the temperature of kilns.

Method of analyzing clays

By Dr. H. T. Vulte.

One grain of the dried and finely pulverized clay is fused in a platinum crucible with five to 10 times its weight of a mixture of 11 parts of dry sodium carbonate and 14 parts of dry potassium carbonate, the amount of fusion mixture necessary depending on the more or less refractory character of the clay. The fusion is transferred to a porcelain casserole, dissolved in water, and the solution acidified with hydrochloric acid; the solution is then evaporated to dryness, and the casserole with its contents placed in a drying oven at 105° to 110° C., and allowed to remain until all the hydrochloric acid is expelled. The silica present is thus rendered insoluble. Hydrochloric acid and water are now added; the casserole is warmed for a few minutes on the water bath and the solution filtered, the silica being washed with hot water until the washings are free from chlorine. The silica is then ignited and weighed, and as it is likely to retain small quantities of alumina, it is treated with hydrofluoric and sulphuric acids and heated, the silica being thus volatilized as silicon tetra fluoride. The residue from this treatment is weighed, and its weight added to that of the alumina subsequently found.

If the original fusion of the clay showed little or no green color, the filtrate from the silica is treated with a slight excess of ammonia, and the solution boiled for a short time to expel the excess. The solution is then filtered, the precipitate dissolved in dilute hydrochloric acid, and reprecipitated in the same way; filtered out, washed and then ignited and weighed, giving the amount of alumina and iron (as Fe_2O_3) present. The combined filtrates from the iron and alumina, which should be concentrated to about 200cc., are heated to boiling and about 25cc. of sat. sol. of ammonium oxalate added, and the boiling continued for two or three minutes longer, when the heat is removed and sufficient ammonia added to render the solution strongly alkaline. The precipitate is allowed to settle, and the supernatant liquid decanted off as closely as possible through a filter; hydrochloric acid is then added to the precipitate to dissolve it, and then sufficient ammonia to reprecipitate it. It is then washed on to the filter; washed; ignited with sulphuric acid, and weighed as calcium sulphate. The filtrate receives a further addition of ammonia and of hydrodisodic phosphate, is well stirred, allowed to stand for some hours in the cold, when the magnesium precipitate is filtered out, washed with ammonia, ignited and weighed.

In case manganese is present, the filtrate from the silica is neutralized as closely as possible, sodium acetate solution added, the solution diluted largely, and boiled for about a minute and filtered as rapidly as possible, the precipitate washed with boiling water, redissolved in dilute hydrochloric acid and reprecipitated in the same way, washed, ignited and weighed as Fe_2O_3 and Al_2O_3. The combined filtrates from the iron and alumina are evaporated to about 300cc., bromine water added and the solution boiled when the manganese is precipitated as MnO_2. This is filtered out, dissolved in a little dilute hydrochloric acid, a solution of microcosmic salt added, the solution heated to boiling and then ammonia added to exact neutrality, any excess of ammonia being removed by heating on the water bath. The precipitate of manganese ammonium phosphate is filtered out, ignited and weighed as $Mn_2P_2O_7$. The filtrate from the manganese precipitation is acidified with hydrochloric acid, boiled for a short time, and then treated in the same way as when manganese was absent, for the determination of lime and magnesia.

For the determination of alkalies one grain of clay is mixed by grinding in an agate mortar with one grain of granular ammonium chloride and eight grains of pure calcium carbonate, the mixture transferred to a platinum crucible with a well-fitting lid and slowly heated to decompose the ammonium chloride, then heated to redness and the bottom of the crucible kept at a bright red for about an hour. The contents of the crucible are transferred to a porcelain casserole with about 80cc. of water and heated to boiling; this is then filtered and to the filtrate after evaporation to small bulk about one and one half grams pure ammonium carbonate added and the solution heated nearly to boiling and filtered into a platinum dish, evaporated nearly to dryness, a little more ammonium carbonate added and the evaporation finished on the water bath. If the last addition of ammonium carbonate produced a precipitate the residue in the dish is dissolved in a little water and filtered into another platinum dish where it is evaporated into dryness and ammonia salts driven out by heat. The residue is dissolved in water filtered into a weighed platinum dish, evaporated, dried and weighed as $NaCl + KCl$. If the last addition of ammonium carbonate failed to produce a precipitate the transfer to another dish may be dispensed with and the ammonia salts driven off at once.

Prospecting and exploiting

In prospecting for clay the topography is often of much help. In the northern and western portions of the state the clay is generally found in the bottoms of broad valleys. An example of this is the Genesee Valley. Again at other localities the clay is found underlying terraces along the sides of the valleys as in the Hudson valley and along Lake Champlain. Deposits of a similar character will be found along the Delaware and Susquehanna Rivers. A terrace however does not necessarily indicate the presence of clay, for some of the Hudson valley terraces are underlain by till.

On Long Island for example the clay is found almost entirely along the north shore; it no doubt underlies most of the island, but on the southern side there is in most instances such a covering of sand as to make it useless. The presence of clay can often be detected in railroad cuttings, in the sides of gullies or ravines. In many instances however the occurrence of clay is only suspected, and then borings must be made with an auger to determine its presence. As a deposit of clay is seldom of uniform thickness throughout its extent, a sufficient number of borings should be made in order to fully determine this point; a bed of clay may be 40 feet deep at one point and thin out to five or six feet within a distance of 15. The writer has seen several instances in which expensive plants have been erected and come to a speedy end simply because the clay gave out, whereas the disaster might have been avoided by previous exploitation. Another important point to determine is the presence of sand for molding and tempering. Many of the clays in this state can not be made into brick without the addition of sand. Along the Hudson River and on Long Island tempering sand is a much needed article, but fortunately it is near at hand. With molding sand it is different, for wherever soft mud machines are used it is necessary. Very often it can be obtained from some neighboring hill, but sometimes it has to be brought long distances.

The presence of a large deposit of clay is not the only fact necessary to be determined. The question next arises, is the material available for the purpose for which it is to be used, and what sort of machinery will be the best suited to work it. By far the best way is to take several barrels of clay and have it made into the desired product by different methods. There are brickyards where this can be done, or even the manufacturers of different machines offer to do this at their works. Crushing a lump of clay between the fingers or tasting it will give some idea of grittiness, but it is impossible to tell by this method the quality of the clay or its availability for one purpose or another.

Having determined by boring or otherwise the extent and thickness of the clay at the locality where the brickyard is to be established, the next step is to strip a portion of the surface to a sufficient depth to expose the clay.

The amount of stripping to be done varies. On Long Island it is sometimes as much as 20 or 30 feet. Along the Hudson valley it varies from a foot or two of loam, or three or four feet of sand up to 15 or 20 feet. In both these regions the sand can be used for tempering, though the quantity stripped is far in excess of the demand. At some points in the Hudson valley the surface is covered with scrubby trees which are troublesome to remove. In the northern and western portions of the state, there is at most places only a foot or two of soil covering the clay.

When a yard is first started, the stripping, whatever its character, can be used for filling.

Natural drainage is always an extremely desirable thing, for having to keep the clay pit clear of water only adds to the cost of production. Neighboring streams and springs are often a constant source of annoyance, especially if the clay deposit is situated in a valley. They are chiefly troublesome when the sand bed, which often underlies the clay, is struck and allows the water to run in and flood the workings.

Working clay

Having uncovered the clay several methods are employed to work it.

1. The clay is dug at any convenient spot in the bank, usually at the base, working inward; thus in the case of a high bank eventually leaving quite a steep face. The bank is apt to slide sooner or later and the men begin again at the base of the slip and work inward. There is one disadvantage in this method and that is that the several qualities of clay, if it be in strata, become mixed, which is not desirable in all cases. It has, however, the advantage in the case of a bank of clay of making the haulage all on one level. Of course, in this method, haulage by cart is the most convenient. Costs 25–30c. per 1000 brick for about 500 feet of lead.

2. A second method, but one rarely used, is to loosen the clay by means of plows and bring it to the yard by scraper, provided of course the clay bank adjoins the yard. Very few yards employ this method. It costs about 20c. per 1000 brick to plow the clay and

bring it down with scrapers. To this must be added the price of getting the clay from the heaps to the molding machines, a distance of about 50 feet. In plowing clay the bank is usually worked at an angle of about 30 degrees. This method has no especial advantage. The clay is broken up more and exposed to the

Loading clay on cars.

weather for several days, but as far as I am aware this does not add materially to the quality of the brick when the molding is done in soft mud machines, which are used at all the yards digging their clay by plows.

3. *Working in benches.*— This method is the one most commonly used where the bank is over 25 feet high. The benches are six to eight feet wide and seven to nine feet high. Roads lead up to the separate benches, and each bench is worked in advance of the lower one.

Where the clay has streaks of quicksand the roads have to be planked. If the bank is below tide level there is the additional expense of pumping. This method is of importance along the Hudson River where many of the clay banks are of considerable height, and the use of benches often prevents a slide of the clay.

4. *Steam shovel.*— Although this method of mining has been successfully practised at many western localities the only place in this state where it has been tried is Croton Landing in the Hudson valley. These clays do not as a rule stand well with a

vertical face, and as a result the bank slid, burying the shovel. Where the clay bank contains several different layers of clay, which are mixed together for making brick, the steam shovel is a good thing, as it digs from bottom to top of the bank each time.

5. *Dredging.*— This method like the preceding is only practised at one locality, viz., Croton Point. The dredged clay is dropped into hoppers, which, when full, are run up inclined planes on shore and dumped. Costs 12–15c. per 1000 delivered on shore; then 12c. for haulage to ring pits.

6. *Undermining.*— Many brick manufacturers use this method of mining their clay, especially when the latter is tough. Wedges are driven in on the upper surface a foot or two from the edge; at the same time the face is undermined by picking to a distance of two or three feet. It is not advisable to work a

Shale bank covered by a shed.

bank over 20 feet high by this means, and in almost any case it is a rather dangerous method to employ.

7. *Blasting* is very often resorted to in banks of tough clay and always in the case of a shale bank. A small charge of dynamite usually suffices to bring down a large quantity of the material.

Haulage.— The brick manufacturer generally locates his plant near the supply of clay, so that the haulage distance is from 100 to 300 feet. Within these limits it is economical to use one-horse carts, but above 300 or 400 feet there are other means of haulage which will generally be found cheaper. There are exceptions where carts are used for hauling long distances; for instance, at Port Ewen on the Hudson the clay is carted 900 feet in some cases, and at Haverstraw some of the firms bring their clay a distance of a quarter of a mile in one-horse carts.

Cars.— As a rule where the haulage distance exceeds 500 feet cars are used. They are run on tracks and drawn by horses; if possible the track is laid down grade from the bank to the yard. Sometimes the loaded cars are run down to the yard by gravity, the horses being only required to draw them back when empty. Cost 10c. per cubic yard for about 500 feet lead.

Locomotive haulage.— This is a cheap method where the scale of operations warrants it; that is to say, for a yard having an annual capacity of 15,000,000 or upwards. The cost by this method is about 5c. or 7c. per 1000 brick (about one and one quarter to one and one half cubic yards of clay being reckoned to a thousand brick) for a distance of 600 or 800 feet. It is necessary, of course, to have cars filled with clay ready for the engine as soon as the empty ones are drawn back; otherwise the expense would become great if the engine had to spend much time waiting. The cost given above does not include wear and tear on plant.

Wire rope haulage.— A few yards use this method where the haulage distance is small; the winding drum is placed under the machine shed near the pug mill or crushers; side or bottom dumping cars are used.

Gravity planes may also be mentioned, but they are less used than they might be.

General remarks on bricks

Three kinds of brick are manufactured in New York, viz.: Common, front and paving brick.

Common brick. These constitute nine tenths of the clay products manufactured in the state. The following are the characteristics of a good building brick.

1. It should have plane surfaces, parallel sides, and sharp edges and angles. The regularity of form depends largely on

the clay from which the brick is made and the method of drying and burning.

2. It should be of fine compact and uniform texture, quite hard and give a clear ringing sound. The compactness and uniformity of texture, which greatly influence the durability, depends mainly on the method of moulding. Hand machines produce brick of homogeneous character. Tempered clay bricks are denser interiorly. Dry clay machines produce a thoroughly homogeneous and dense brick it is claimed.

3. It should not absorb over 10 or 15 per cent. of water. A simple method of testing this is to place the brick for 24 hours in a bucket of water, weighing it before and after immersion. The increase of weight is the amount of water absorbed. This applies only to hard burned bricks. A salmon or green brick will absorb much more.

4. It should have a specific gravity of 20 or more.

5. It should have a crushing strength of not less than 3000 pounds per square inch.

The manner of making crushing tests is described under the head of paving brick.

Building brick may be divided into three kinds, arch, red and salmon.

Common bricks run quite uniform in size. There is a difference of perhaps three sixteenths inch between a brick made in a new mold, and one made in a mold which has been used one or two seasons. The dimensions of an average sized common brick are about two and one quarter by three and three quarters by eight and one quarter inches. We give below a table of the sizes of common brick manufactured in this state together with the amount of water they absorbed when soaked for 24 hours.

	Size of brick.	Weight Before Soaking		Weight After Soaking.		Percentage of water absorbed	
		Lbs.	Ozs.	Lbs.	Ozs.		
East Williston	....	4	$1\frac{1}{2}$	4	6	6.7	Soft mud.
Southold	$2\frac{1}{8} \times 3\frac{3}{8} \times 7\frac{1}{2}$	3	$12\frac{1}{2}$	4	3	10.7	Soft mud.
Farmingdale	$2\frac{3}{16} \times 3\frac{1}{2} \times 7\frac{5}{8}$	3	$11\frac{1}{2}$	3	$15\frac{1}{2}$	7.0	Soft mud.
Croton, W. A. U	$2\frac{5}{16} \times 3\frac{5}{8} \times 8\frac{3}{16}$	4	6	5	$\frac{1}{2}$	15.4	Soft mud.
Haverstraw	$2\frac{3}{16} \times 3\frac{7}{16} \times 7\frac{7}{8}$	3	11	....	....	......	Soft mud.
Syracuse	$2\frac{2}{8} \times 3\frac{13}{16} \times 7\frac{6}{8}$	....	....	....	....	......	Soft mud.
Warners	$2\frac{3}{16} \times 3\frac{7}{8} \times 8\frac{3}{16}$	5	11	5	17	6.3	Stiff mud.
Canandaigua	$2\frac{3}{8} \times 4 \times 8$	5	$\frac{1}{2}$	6	$4\frac{1}{2}$	24.8	Dry clay.
Rome	$2\frac{3}{16} \times 3\frac{3}{8} \times 7\frac{6}{8}$	3	8	4	$1\frac{1}{2}$	17.9	Common.
Rome	$2 \times 3\frac{15}{16} \times 7\frac{13}{16}$	4	3	4	5	2.9	Stiff mud.
Owasco	$2\frac{1}{2} \times 4\frac{1}{4} \times 8\frac{3}{4}$	5	$\frac{1}{2}$	5	14	16.7	Repressed.
Saratoga	$2\frac{3}{16} \times 3\frac{3}{4} \times 2\frac{3}{16}$	4	$2\frac{1}{2}$	4	$8\frac{1}{2}$	9.0	Soft mud.
Buffalo	$2\frac{1}{4} \times 3\frac{1}{4} \times 8\frac{1}{8}$	4	$13\frac{1}{2}$	....	....	......	Soft mud.
Dunkirk	$2\frac{3}{16} \times 3\frac{11}{16} \times 7\frac{3}{16}$	4	$3\frac{1}{2}$	4	14	15.5	Soft mud.
Jamestown	$2\frac{1}{2} \times 4 \times 8\frac{1}{4}$	4	11	5	$5\frac{1}{2}$	14.0	Soft mud.
Hornellsville	$2\frac{3}{8} \times 4\frac{1}{8} \times 8\frac{3}{8}$	7	2	7	4	1.7	Stiff mud.
Newfield (yellow)	$2\frac{3}{16} \times 3\frac{7}{8} \times 7\frac{13}{16}$	5	$5\frac{1}{2}$	5	7	2.9	Stiff mud.
Newfield (cream)	$2\frac{3}{16} \times 4\frac{1}{10} \times 8\frac{1}{4}$	5	8	6	$5\frac{1}{2}$	15.3	Stiff mud.
Jewettville	$2\frac{3}{8} \times 4 \times 8\frac{1}{4}$	5	$11\frac{1}{2}$	6	1	5.4	Dry clay.

Permeability.—On account of the peculiar construction of the Croton aqueduct there are several points at which a considerable pressure is exerted on the bricks and a consequent permeation of the water through them. A number of tests have been made by A. W. Hale, engineer on the aqueduct, and a full description of the apparatus and method used is given in pp. 17 and 28, Eng. Record, 1890. The bricks tested were the Anchor brand of Croton Landing, N.Y. It was found that with 80 pounds pressure per square inch, the average percolation through a brick two and three eighths inches thick, was equal to 12 and 3-12 cubic inches per square inch of surface, per hour. The maximum percolation was 40.44, and minimum was 4.02 cubic inches. From these experiments Mr. Hale drew the following conclusions.

That the percolation through a brick under constant pressure, diminishes as the pressure is prolonged.

That the diminution of percolation under constant pressure is less and less rapid as the flow is continued and finally becomes constant.

Paving brick

The paving brick industry, although in its infancy, gives indication of rapid growth in the near future. In the western states many cities are paving their streets with brick. In this state brick pavements have been introduced in the following cities, Binghamton, Lockport, Buffalo, Rochester, Syracuse, Troy, Watertown, Ithaca, Corning, Elmira, Dunkirk, Jamestown, Tonawanda and Niagara Falls. There are only four factories in New York state which furnish paving brick, and up to the present time many of the pavers used in the state have been obtained from West Virginia and Ohio. It was formerly thought that only fire clays should be used in the manufacture of this product, but this idea is being abandoned, for there are many clays which are refractory enough for a fire brick which makes most excellent pavers.

In order to make a good paving brick the clay should be one which will hold its shape at a heat sufficiently high to cause thorough "vitrification", (as brickmakers call it.) It should shrink evenly in burning. It should be tough but not brittle, and withstand abrasion. It should also withstand considerable pressure;

10,000 to 12,000 pounds per square inch are probably sufficient. It should be homogeneous throughout. It should be dense and not absorb over two or at the most three per cent. of water.

In the manufacture of paving brick, the clay must be thoroughly prepared before being molded. Some clays can be ground, screened and pugged as soon as taken from the bank, while others have to be weathered or soaked before crushing. The machine used for molding depends on the clay. Some clays make a first-class paving brick by the dry press process, while others give the best quality with a soft mud machine. In any case the green brick should be as dense as possible. After molding, the bricks are dried in tunnels. The drying should not be hurried. Burning is usually done in down draft kilns. The kiln should not be too high in order to avoid the bricks in the lower part of it being crushed out of shape by the weight of those above, at the time the fires are hottest. In burning, the fires are raised till temperature of vitrification is reached, and they are held at this temperature for from 24 to 48 hours. Cooling is done very slowly, thus annealing the brick. The term "vitrification" is a misnomer. To vitrify a brick would be to convert it into a glass in which state it would be brittle and useless. What takes place is that the bricks are raised to a temperature sufficient to flux the potash, lime and iron with the silica and give a dense brick, and it is in order to thoroughly accomplish this, that the brick is kept for 24 or more hours at the point of fluxing or "vitrification."

Testing paving brick

1. Absorption. To determine the amount of water which a paver will absorb, it is soaked in water for 20 hours and weighed before and after. The increase in weight is the amount of water absorbed.

2. Abrasion. The bricks are weighed and then put in a rattler together with foundry shot and the rattler revolved for several hours at 52 revolutions per minute. The bricks are again weighed, the loss being due to abrasion.

Another method of making this test is to grind the brick on a horizontal stone, 14 feet in diameter and making 28 revolutions a minute. This is kept up for eight hours, the brick of course being weighed before and after.

3. Crushing tests. The brick to be tested is put on edge between the two plates of a crushing machine. The amount of pressure is noted at which the brick cracks, and also that at which it crushes. Before testing, the two sides of the brick on which the pressure is exerted should be ground perfectly smooth and be made exactly parallel. To further insure an even surface some material, such as paper or cardboard or plaster of paris, is put between the surface of the brick and plate of the machine. The following experiments made by Prof. I. O. Baker* show that for the same brick the results obtained vary with the method of preparing the surface. The bricks tested by him were prepared in the following manner:

1. Grinding as nearly flat as possible on convex side of emery stone and crushing between self-adjusting, parallel cast iron plates.
2. Removing the irregularities of surface and crushing between blotting paper.
3. Removing the irregularities of surface and crushing between straw boards.
4. Removing irregularities, coating with plaster of paris and placing under slight pressure until set (12–24 hrs.), and then crushing.
5. Coating with plaster of paris which was afterward ground down on a sand paper disk, to the surface of the brick so as to leave a minimum thickness with a perfectly flat surface and then crushing.

After a number of experiments no great difference was found between the first three, but difficulties connected with the last two rendered them worthless. With a uniform grade of brick the first three methods gave 7000 to 9000 pounds as crushing strength of cubes. Some samples of the same lot of brick were prepared on rubbing bed at marble works, and the strength of these carefully prepared cubes ranged from 16,000 to 21,000 pounds per square inch, showing that a very small difference in flatness of surface makes a great difference in the apparent strength.

* Clayworker, June, 1892.

Trautwine states that cracking and splitting usually commences under about one half the crushing load.

Front brick

Up to a few years ago in order to obtain a smooth, sharp-edged brick such as could be used for the outside of walls, the roofing of archways and other conspicuous places, the brick was first molded in an ordinary soft mud machine, or what was considered better, molded by hand. This green brick was then allowed to dry for a few hours and then put in a repressing machine. At the present day a smooth and sharp-edged "front" brick can be molded and made of sufficiently good appearance in one operation. The modern dry clay brick machine will do this. Repressing machines, however, are still extensively used. They are operated by hand power and one brick is treated at a time. Repressing machines run by steam power have recently been introduced and will undoubtedly be found to be more economical for those who have much use for this class of machines and work quicker than the hand power ones. As far as the writer is aware only one firm in this state, the Corning Brick Co., is at present using steam power repressing machines. Hand represses are in use at several localities. At the yard of T. B. Campbell at Newfield, near Ithaca, the bricks are first made on a wire cut machine and then repressed. W. W. Parry of Rome, N. Y., uses a similar method. The Hornellsville Brick Co. repress their paving brick. Some firms make a front brick on a soft mud machine and do not repress them. These latter machines do not, however, always exert sufficient pressure to produce a dense brick such as is required for fronts of buildings.

As stated above, a repressed brick should have smooth faces, sharp edges and square corners. For this class of product a clay is needed which will burn to a hard brick, having a good color and one which will also retain its shape and size fairly well in burning. The clay should be thoroughly pugged before molding, and very often better results are obtained by mixing two or more clays. Pressed brick usually take a longer time to burn and on account of their greater density have to be dried very slowly and carefully.

Method of manufacture

Bricks are usually made by one of the following three processes :

Soft mud
Stiff mud or wire cut
Dry clay

The processes are not wholly distinct from each other, for there are machines that may be used as well in connection with one as the other. For instance, in preparing the clay for molding in a stiff mud machine, we may use either a pug mill or a pan crusher, though the latter belongs preferably to the dry clay process. Whatever be the method, the manufacture of clay into brick involves the following steps, preparation, molding, drying, burning, and below is a classified arrangement of the stages in the process of brickmaking and machines used.

Methods

Mining the clay	1. Digging by pick or shovel at any portion of bank 2. Bench working 3. Undermining 4. Steam shovel 5. Plows and scrapers 6. Dredging

Machines used

Haulage	Carts	
	Cars on tracks, drawn by horses	
	Steam	
	Wire rope planes	Self-acting Steam power
Preparing or tempering	Barrel sieves	
	Roll crushers	
	Soak pits	
	Ring "	
	Pug mills	
	Pan crushers	Wet pans Dry pans

- Molding
  - Soft mud machines
    - Hand power
    - Horse "
    - Steam "
  - Stiff " "
    - Auger
    - Plunger
  - Dry clay
- Drying
  - Open yards, sundried
  - Covered yards, air dried
  - Pallets
  - Tunnels heated by
    - Steam pipes circulating within
    - Hot blast
    - Hot air from coal fire through flues underneath
- Burning kilns
  - Down draft
    - Rectangular
    - Circular
      - One or more chimneys according to make
  - Up draft
    - Scovekilns
    - Clamps

Soft mud process

Preparation of the clay.—This step in the manufacture of clay products is of great importance, and on it success or failure often depend. No fixed rule can be laid down for the preparation of all clays. Two clays may have a similar chemical composition and yet their physical condition may be such as to necessitate entirely different modes of treatment. A particular clay may give the finest quality brick by the soft mud process, while if molded in a dry clay machine it will produce a brick that is absolutely worthless. There are clays on the other hand which make a good brick by several methods. In any case, however, whatever the method or the clay, it should be prepared, and the more thoroughly this is done the better. Many advocate weathering the clay. This will break up the clay and thereby lessen somewhat the expense of mixing but does not add to the quality of the finished product.

In the soft mud process the clay is usually prepared either in soak pits, ring pits or pug mills.

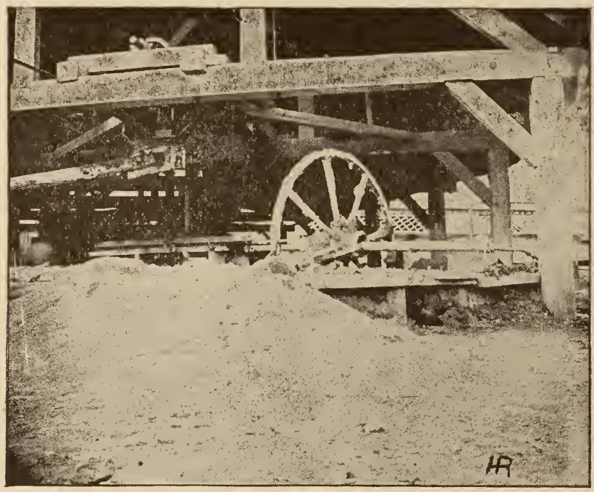
Hematite is often added to the brick to give it a nice red color. It is either added to the clay while it is being tempered in the pug mill or else the powdered hematite is mixed with the molding sand. The former way is undoubtedly the best, for in the handling and rubbing which a brick gets before it is finally placed in a wall, much of the molding sand is rubbed off and with it the hematite.

Soak pits.—These are the most primitive machines at present used for the preparation of clays. It consists of a rectangular pit about five feet deep and six feet square. The Long Island ones are usually rectangular in shape. Into this the clay and sand are dumped, water poured on and the mass allowed to soak over night, so as to thoroughly soften it. The following morning the softened material is shoveled into the machine. Two men — pit shovelers — do this, and it is highly important that they be men of intelligence and attend to their work, seeing that the right proportions of clay and sand are shoveled into the machine. From one third to one quarter is the amount of sand added. The operation of mixing the clay and sand is called tempering; the addition of sand is in most cases not necessary, as the majority of clays have sufficient of it admixed naturally. The object of the addition of sand is to counteract the effect of the alumina, by preventing a too great and uneven shrinkage of the brick. Coal dust is also added by some manufacturers and the advantage derived by its use will be mentioned under the head of burning.

When soak pits are used, two men dig the clay in the afternoon at the bank, while a third man levels off the material as it is dumped into the pit and also adds the requisite amount of water. He is called the temperer. In the morning the two diggers of the previous afternoon shovel the clay from the soak pit into the machine.

In many large brickyards separate gangs of men do the pit shoveling and digging of the clay.

Ringpits.—These temper the clay more thoroughly than soak pits, but are not so extensively used, possibly because it costs a trifle more to operate them. A ringpit, as its name implies, is circular, 25 to 30 feet in diameter, three feet deep and lined with boards or brick. In this there revolves an iron wheel, six feet in diameter and so geared that it travels from the center to the circumference of the pit and then toward the center again. In this manner the clay is thoroughly broken up and mixed with the sand and coal dust, if this latter be added. The pitfull is



Ring pit for tempering clay

tempered in about six hours, and a pit holds sufficient for about 30,000 brick. The tempering is usually done in the afternoon so as to have it ready for the next morning. When the tempering is finished, a board is attached by ropes to the wheel and dragged round the pit a few times to smooth the surface of the clay; a thin crust forms on the surface and prevents the moisture in the underlying material from evaporating.

With ring pits there is a similar arrangement as with soak pits, the only difference being that the temperer previously mentioned is generally employed in the morning to wheel the clay from the ring pit to the molding machine.

As a rule there are two ring pits to a machine, so that while the clay is being shoveled from one pit to the machine, the other pit is tempering clay for the next day, or two pits and two machines are used, but each pit in this case holds enough material for the daily use of two machines.

Pug mill.—This machine, like the ring pit just described, is used for thoroughly mixing the clay, or clay and sand as the case may be, before introducing it into the machine. It consists essentially of a semi-cylindrical trough, six to 10 feet long, in which there revolves a shaft, bearing knives set spirally around it, or a worm screw six or more inches wide. The material is put in at one end, and the knives or thread mix it up. At the same time it is worked along to the other end of the trough from which it is discharged into the machine. The pug mill may be closed or open; the former is better as there is a more uniform pressure on the clay while it is being tempered, and a more thorough mixing results. Water is also added from a faucet at the upper end of the trough until the clay is in the right condition. The angle of the knives with relation to the shaft can be changed so that the clay can be moved along slower or faster as it is desired. The trough of the pug mill is of iron or wood, usually the former. A pug mill, according to its size, will in 10 hours temper clay enough for from 25,000 to 60,000 brick. Pug mills take up less room than ring pits and do not require as much power to operate them. They will also, if desired, discharge the clay directly into the molding machine. They are used chiefly with stiff mud machines.

Molding.—Having prepared the clay by one means or another, according to its character, and somewhat according to the machine to be used, the next step is to mold it into bricks. The old-fashioned method of molding bricks by hand is rapidly dying out, yet every now and then we come across a yard where it is still in vogue. In New York the soft mud process is the most used. There are a number of different types of machines but the fundamental principal of them all is the same. A soft mud machine consists essentially of an upright box of wood or iron and generally of a rectangular shape. In this is a vertical shaft bearing several knives horizontally. Attached to the bottom of the shaft is a device such as a curved arm, which forces the clay into the press box. The molds are put in at the rear of the machine and fed forward underneath the press box automatically. The empty mold sliding into place shoves out the filled one. A boy sands the molds before placing them in the machine in order to prevent the clay from sticking. The clay is fed to the machine at the upper end of the box. Often there is a pug mill attached to the machine. In all these machines the material gets an additional amount of mixing by the knives on the vertical shaft. In fact many brick manufacturers consider that the soft mud machine tempers the clay sufficiently to enable them to dispense with a pug mill or ring pit and use the old-fashioned soak pit. That they can make a very fair common brick thus is not disputed, but it is certain that with a thorough tempering of the clay, a better brick would be obtained in most cases. There is one type of machine, the Adams, used by several manufacturers on the Hudson River, which does not temper the clay, but simply forces it into the press box. Some form of tempering machine must, therefore, be used in connection with it. These soft mud machines have a capacity of about 5000 brick per hour, six being molded at a time.

Steam power is generally used to run the machines, but some of the smaller yards use horse power; this, of course, is much slower and not economical except for a yard of a small capacity. Some soft mud machines are more powerful than others, and indeed this is necessary. For instance a brick dried on pallets needs a much greater pressure applied to it, and has to be molded from stiffer material than one dried in the sun in the yard.

Four men are required to tend the machine. A "molder" who scrapes off the top of the mold as it is delivered from the machine and watches the consistency of the tempered clay, to see that it keeps uniform; a "mold lander" who takes the mold from the delivery table and places it on the truck; a "sander" who sands the molds before putting them in the machine, and a boy to watch the machine and stop it when necessary. Besides this there are four "truckmen" who wheel the bricks from the machine to the yard where they are dumped on the drying floor by two "mold setters." In the afternoon these men are emp oyed in hacking the bricks and wheeling the dry ones to the kiln.

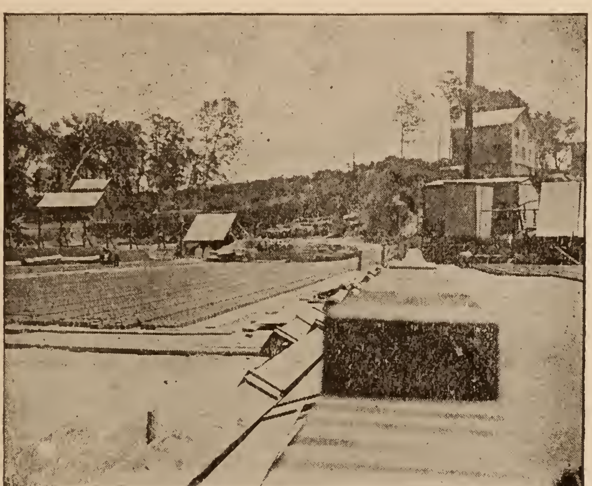
Drying — In New York State bricks made by the soft mud process are usually spread out on floors or set on pallets to dry. A few yards use tunnel dryers, but as these are more extensively used in connection with the stiff mud process they will be described there.

Drying should not be hurried. Bricks dried too quickly are apt to crack. They should also be well dried before setting in the kiln, and if this is not done the product is very apt to be poor.

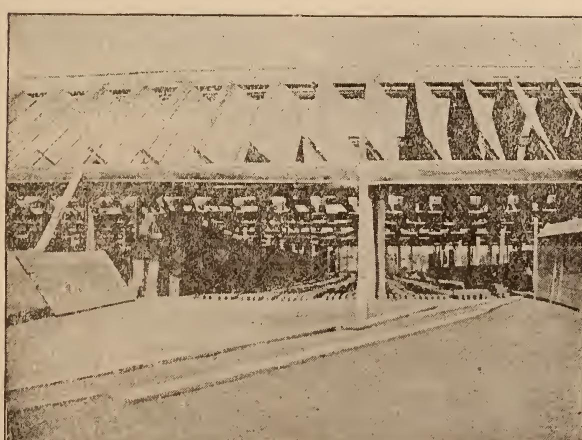
Bricks made by the soft mud process are usually dried in one of three ways viz.:

1. Open yards
2. Pallet yards
3. Covered yards

The first method is the most used, the second next and the third least. In the first method the bricks are spread out on a hard

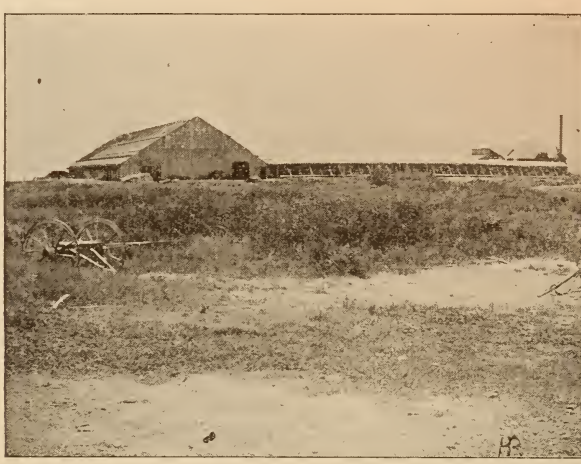


View of open yard.



Covered yard.

floor, in the open air. This floor, which is about 200 feet long, is of brick, with a thin covering of sand, and is the "yard" proper. At one end of it are the molding machines, at the other end the kiln sheds. The yard usually drains toward one end, or from the center toward both. After a day's production has been spread out the boy who tended the machine in the morning goes along the rows and stamps them with a piece of board set on the end of a long handle. This is termed "spatting." After this the bricks are turned on edge by another boy who goes along the



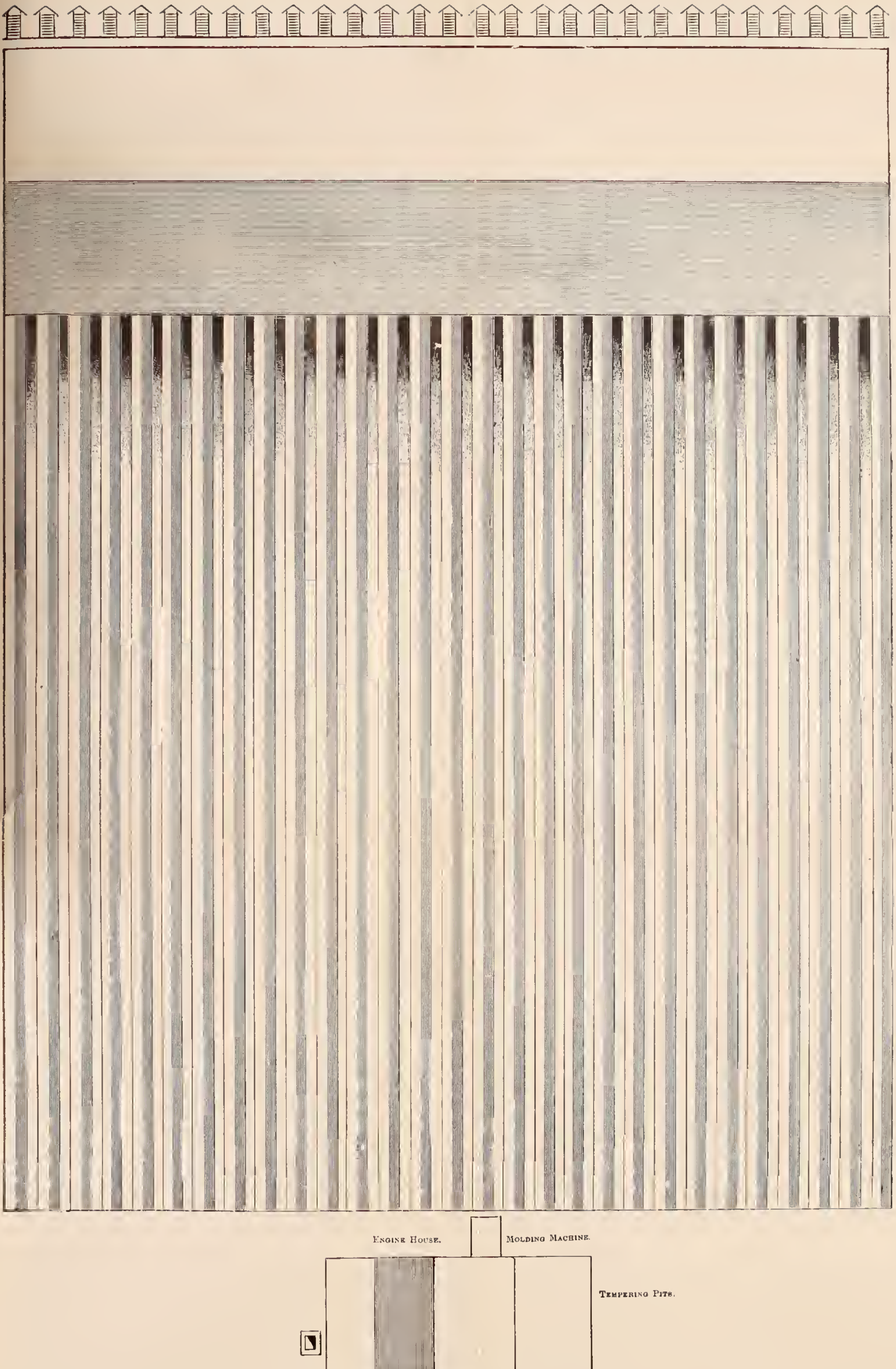
General view of brickyard, kiln sheds and drying rack.

rows with a special tool, turning six bricks at a time. The next morning, if the weather has been pleasant, the bricks are "hacked," that is to say they are piled on each other in a double row 11 to 15 courses high along the sides of the yard and left till sufficiently dry to put in the kiln and burn. In case of rain the hacks are covered with planking.

The disadvantage of open yards is that the bricks are exposed to the rain, and if a shower comes while they are spread out on the yard, they become "washed," getting a rough, uneven surface. Washed brick are quite as strong as unwashed ones, but they bring 50 to 75 cents less a thousand. The washed brick amount to about 15 per cent. of the total production. *

Covered yards.—These differ from the former simply in the addition of a roof. This roof is in hinged sections, which on pleasant days can be opened upwards, allowing the sunlight to enter, and closed to prevent washing of the brick in case of rain. Washed bricks are of course avoided by this method of drying,

* Quite recently washed brick have been employed for the fronts of buildings. They give a unique effect.



PLAN OF PALLET YARD.

but the bricks do not dry so fast, and, therefore, more drying room is needed for a yard of the same capacity. There is also the expense of erecting the sectional covering.

Pallet driers.— By this method the bricks are dumped directly on "pallets" as they come from the machine. These

Pallet racks.

latter are pieces of board long enough to hold six bricks. The pallets are then set on racks or cribs until the bricks are sufficiently dry to be set up in the kiln. There are both advantages and disadvantages to this method. As the bricks can not be spattered to keep them in proper shape, they must be firm enough to retain this themselves, consequently the clay must be molded stiffer, and to do this we must have strong machinery. Furthermore, a molding sand must be used which will allow the brick to slip readily from the mold, as it has been forced in tighter than a brick which is to be dried on an open yard. There is, of course, the expense of setting up the racks, but on the other hand the capacity of the yard is increased, the brick, though drying slower, are not subjected to a sudden drying, such as the sun of a hot summer's day is apt to give, and, therefore, perhaps warp or crack the brick. The brick are only subjected to one handling between machine and kiln. Some manufacturers claim that it is cheaper to make bricks on a pallet yard. A machine called a "pallet-squarer" has been invented by Mr. Swain of the Croton Brick Co. which is said to fulfil the functions of a spatter (*See* detailed account of yards). All clays are not sufficiently strong to permit drying on pallets.

Burning.—This is one of the most important steps in the whole process of manufacture. Nine tenths of the manufacturers who make common bricks by the soft mud process, burn them in temporary, up-draft kilns, or scove kilns, as they are properly called. The other one tenth use an up-draft kiln which differs from the preceding in having permanent walls. The following description of burning applies directly to scove kilns, but the principle, whether it be a temporary or stationary up-draft kiln, is practically the same. When the bricks are thoroughly dry, they are set up and burnt in "arches," several of which go to make up a kiln. The number of bricks in an arch varies from 35,000 to 40,000. An arch is about 40 courses high, and about 15 arches make up a kiln. The open portion of the arch is about 14 courses high, and the bricks above the arch are set three one way and then three on top at right angles. They are kept slightly separated by putting small pieces of clay in between them. The first row of brick on top of the arch is called the tie course, and the first 14 courses, including the tie course, above the arch are called the "lower bench," and the rest of the courses above are called the "upper bench." When the arch and lower and upper benches have been set, brick are laid flat over the top of the kiln; this is the "raw platting," and then on top of this is laid burnt bricks at right angles to those of the raw platting; this is the "burnt platting." Hanging from the roof of the kiln shed at the same level are a number of bricks which serve as a guide for height in building the kiln. A wall of two thicknesses of "double-coal" brick is put around the outside of the kiln, scoving the kiln it is called, and this is "daubed" over with mud. The daub is to prevent any air entering except through the doors. These latter consist of an iron frame about 14 inches high, with an iron plate to close the opening; the frames are set in the courses of double-coal brick, at the bottom of the arch on both sides of the kiln. Double-coal brick have six or seven times as much coal dust in them as others, and are used for placing around the outside of the kilns. The combustion of the coal in them, the manufacturer claims, supplies the necessary amount of heat to the outer portion of the kilns which are not sufficiently heated by the arch fires. Double-coal bricks sell for about $2.50 per 1000, and usually bear some distinguishing stamp, but they are not as strong as the other brick. It takes two setters and four wheelers about one day to set an arch of 35,000 brick; two men will daub the outside of a 15 arch kiln in one day.

Having "walled-up" the kiln with double-coal brick and daubed it over, the next step is to start the fires and burn the bricks. The principle of the process is essentially the same, whether wood, coal or oil are used as fuel.

First, every alternate brick of the "burnt platting" is stood on end to allow the "water smoke" or steam to escape as quickly as possible. A fire is then started in the mouth of each arch. When coal is used the fire is started on the windward side of the kiln so as to allow the smoke to blow through the arches.

The fire is also started from the other end of the arch, and the two fires are then built up slowly till they meet in the middle. The time of crossing the fires varies; with machine-made bricks the fires should not be crossed as quickly as with hand-made ones. Along the Hudson the time of crossing is from 40 to 60 hours. The steam should escape evenly all around the top, and the upper limit of the fire should follow directly on it, the steam acting as a blanket, and its lower limit should be even. It is the duty of the foreman to watch the burning carefully, and increase or ease up the steam in any one arch, according as it is coming off too slowly or too rapidly. The fires are increased until the "water smoke" changes to a bluish black smoke, and at this point the fire can be seen at night time coming from the top of the kiln. The kiln is now "hot" and the bricks commence to shrink or "settle" and all the platting is turned down. Up to this point care must be used to gradually increase the heat. The bricks now get their heaviest heat, and the oxides of iron are changed to the anhydrous peroxide, giving the bricks their red color. If the heat in the arches is too great, the bricks run, stick together or become distorted and cracked. After the firing has been done the doors are all closed and plastered over to prevent any air from entering.

If the bricks are put into the kiln before they are sufficiently dried, or if they are heated too quickly, they are liable to crack.

In the case of coal, grates have to be put in a few inches above the level of the floor, and for oil, burners are needed.

After a kiln of bricks has been burned the ends of the arch bricks are often black, caused by the particles of dust and carbon which have been carried upward sticking to the brick when they were in a soft condition, due to the high degree of heat.

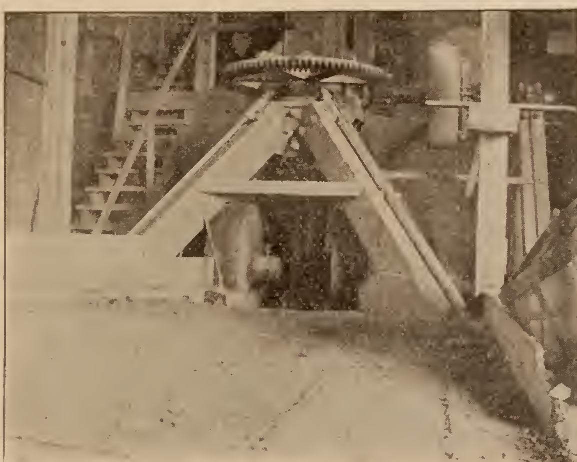
As to the action of the coal dust in the brick. At first while the brick contains water, there is no access for the air to the particles of coal. However, as the firing proceeds, the water is driven off leaving the brick porous, allowing the air to enter for the combustion of the coal. Particles of lime and lumps of clay cause a splitting of the brick. Insufficiently burnt bricks are called "pale" and sell for $3.75 per 1000.

The kilns take several days to cool, and, when cool, the bricks are put on wheelbarrows, and taken to the freight cars, or barges, and then shipped to the market. If the kiln shed is not situated along the dock, the barrows are put on a car, which is run down a track to the scow. The time of burning is from five to seven days with wood and four to five days with oil. The cost of burning with wood is 60 to 75 cents per 1000 brick, and with coal the cost of burning is 40 to 50 cents per 1000. Burning with wood is the cheapest method as far as implements are concerned. With coal there is the cost of grates and with oil there is a royalty of $160 to be paid on every burner. The latter is, however, the cheapest method as regards the price of fuel. The great majority of the yards along the Hudson use wood, a few use coal and two or three use oil. With coal and oil the heat can be better regulated than with wood. Another important point is the amount of pale brick produced. Most of the yards in New York burn their bricks in scove kilns. In these there is sometimes a loss of as much as 50,000 to 75,000 in a clamp of 500,000 bricks, while in a permanent kiln such as the Wingard or similar, the amount of pale brick is said to be not over 25,000 usually. Again in the case of permanent kilns, it takes no more, if not less, time to set the bricks and there is less daubing to be done. Regarding the amount of labor required in burning, one man is supposed to tend three arches.

Stiff mud process

This is so called from the fact that the clay is molded quite stiff, being forced from the machine in the form of a hard bar which is cut up into brick.

The clay is sometimes prepared in pug mills which have been previously described, but pan crushers are mostly used for this purpose in New York.



Pan crusher.

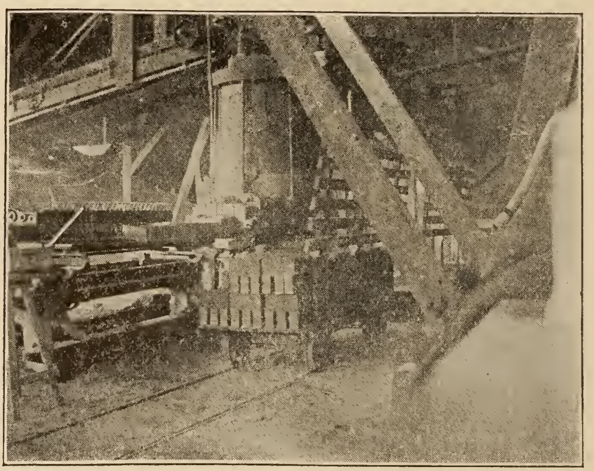
Pan crushers.— Of these there are two classes, viz : Dry pan crushers and wet pan crushers. The former pulverizes the material as it comes from the bank, the latter tempers it with water. In either case the crushers consist of a circular pan in which there are two iron wheels revolving on a horizontal axis. They are made to revolve by friction against the pan which is rotated by steam power. In a dry pan the bottom is perforated and the wheels weigh 2000 to 5000 pounds each. The wet pan has a solid bottom, in which there is a door through which the material can escape when sufficiently tempered.

A good dry pan will grind 100 tons in 10 hours through one-eighth inch screens.*

Two scrapers are placed in front of the rollers to throw the material in their path. In a wet pan water is added to the clay

* E. Orton, Jr., Clay Working Industries of Ohio, 1893, p. 142.

and when a charge is sufficiently tempered it is removed either through a door in the bottom of the pan, or else by means of a shovel attached to a long pole and pivoted on an upright support. Wet pans are more expensive than pug mills and require more power to operate, and they do not temper the material as evenly. They are, however, better adapted for tough and shaly clays.

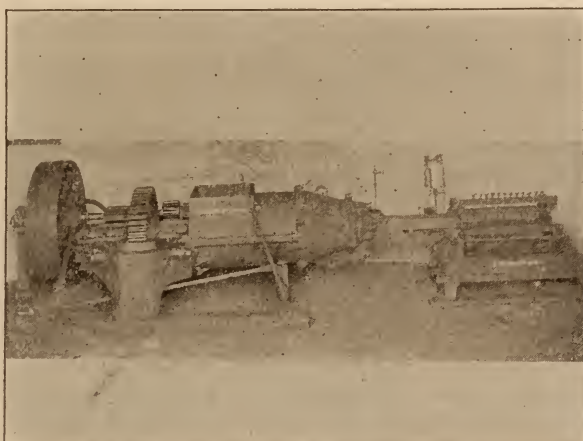


Stiff mud, wirecut machine.

Stiff mud or wirecut machines.— Their name indicates the nature of the process. The clay is tempered quite stiff, and charged into the machine from which it is forced in the form of a rectangular bar whose cross section has the same area as the greatest plane surface or end of the brick. The bar of clay as it issues from the machine is received on the cutting table, and is cut up into brick either by means of a series of parallel wires set in a frame which slides across the cutting table, in which case the machine stops when the bar has issued a certain length, or else the bar of clay issues continuously, and is cut up by means of wires on a revolving frame. The former method is usually employed in connection with the plunger type of machine and the latter with the auger type.

The plunger machine consists of a large iron cylinder into which the clay is charged, and from this it is forced out through the die.

The auger machine consists of a cylinder with a conical end. In this is a horizontal shaft bearing a screw or knife blades so set that their action will force the clay forward. At the forward end of the shaft is an iron screw which forces the clay out through the die. The clay is fed at the large end of the cylinder. It will thus be seen that the clay undergoes a large amount of compression and



Auger machine.

that considerable power is required to force it through the die. Auger machines are either end cut or side cut according as the area of the cross section of the bar is the same as the end or side of a brick. The great objection to this form of brick machine is the spirally laminated character which the brick has, owing to the manner in which the clay is forced through the die. Nevertheless this machine is extensively used at the present day, especially in the manufacture of paving brick. It has a large capacity, 60,000 brick being not an unusual output for 10 hours. The capacity of the auger machine is often increased by causing two streams of clay to issue from it and certain machines are said to have produced 150,000 brick per day. Plunger machines have a capacity of 25,000 to 30,000 per day.

The green bricks are usually piled on cars and these are run into heated tunnels to dry. If soft mud bricks are dried in tunnels then the cars must have racks on which to set the pallets bearing the bricks. Stiff mud bricks can, however, be set on each other setting the bricks of two successive courses at right angles to each other. Each car carries about 360 brick. Tracks are laid from the machines through the tunnels to the kilns. The tracks are laid in two directions only, at right angles to each other, and turn tables are placed at the points where tracks intersect. The tunnels are built of brick or wood. They are about five feet high and four feet wide. Several methods

Tunnel dryers.

are used to heat the tunnels. There may be a fireplace at one end and a system of parallel flues under the tunnel to conduct the heat. A second method is to use steam heat, the pipes being laid along underneath the floor of each tunnel or along the sides. Exhaust steam is used in the day time and live steam during the night. Another method is to heat the tunnel by a hot blast. In a good dryer the natural draft should be sufficient to draw the air through the tunnels. Six or more of these drying tunnels are usually set side by side. Artificial drying takes from 24 to 36 hours. The green brick are put in at the end nearest the machine and the cars with the dry ones drawn out at the opposite end. It is of importance that the capacity of the dryers should not exceed that of the kilns. Artificial dryers have the advantage of permitting a plant to be run all winter. The cost of flue dryers is set at 25 cents a thousand brick with coal at $2.50 per ton.

Scove kilns, clamps or down-draft kilns are used for burning the product. The principle of burning is much the same in all three, although many manufacturers claim that the burning can be better regulated in clamps and down-draft kilns, while others claim the opposite. In the latter the bricks in the upper portion of the kiln receive the greatest amount of heat, whereas in a

Down-draft kiln.

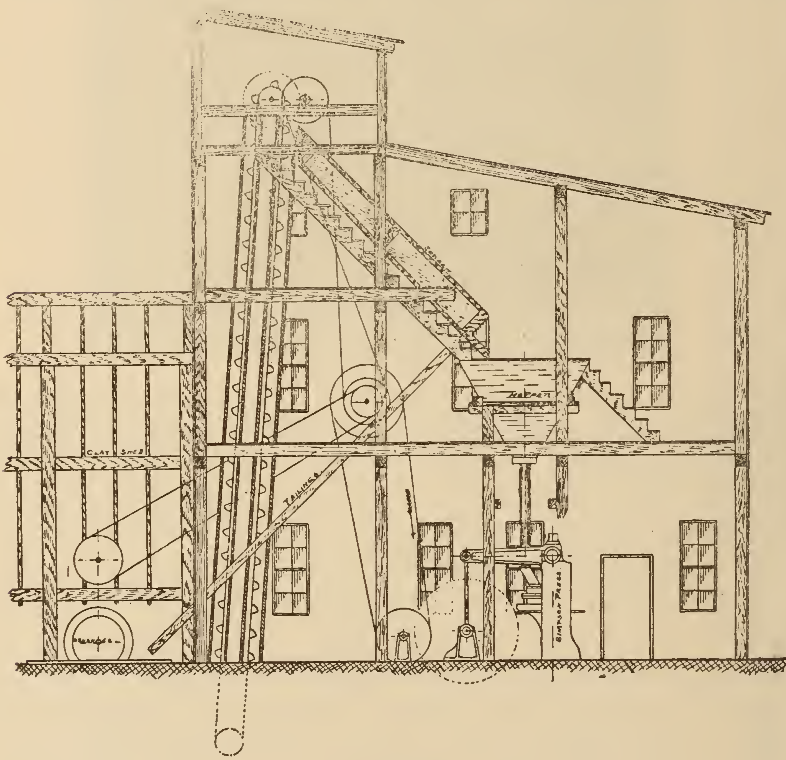
scove kiln or clamp the arch bricks, which have to bear the weight of the overlying bricks, are heated the most and often become crushed out of shape. Regarding the rectangular and circular down-draft kilns, the latter are bound easier than the rectangular ones, this being of course necessary in order to prevent a bulging of the walls during burning.

Roll crushers.— This type of machine is extensively used in the preparation of tough or stony clays. They consist of two or four steel rolls, which revolve at different velocities. They are usually enclosed and the clay is charged into a hopper above them. The crushed material passing out below is received on a traveling belt and carried to the pug mill. Crushers are objected to by many on the ground that they make the clay flaky, in which condition it does not make a good brick. Subsequent pugging, however, usually does away with this. By many manufacturers rolls are used as a means of breaking up the stones and thus avoid drying the clay and screening it. There is no special objection to this unless the pebbles are limestone and then they should not be allowed to enter the brick. Several forms of machines have been invented which, it is claimed, break up the clay and separate the pebbles at the same time.

Barrel sieves are sometimes used to get rid of pebbles in the clay. In this case the clay has to be first dried and broken up.

Dry clay process

The introduction of this method in the United States dates back 15 or 20 years only, it having been first introduced at Louisville, Ky. In New York it has not been in use over five



Dry clay plant.

years, and there are only five machines in use in the state. The clay after being dug is usually stored in sheds to dry. When ready for use it is taken out and charged into the disintegrator or dry pan, preferably the latter. Dry pans have been described in connection with the stiff mud process; as to disintegrators the

New York brickmakers use a Steadman. It consists of a cylindrical flat box about three feet in diameter, within which two concentric wheels with iron arms revolve at a high rate of speed; the clay being thrown around between these is quickly broken up. If the clay is charged in too moist a condition it will not be thoroughly pulverized, at the same time it must not be charged too dry and thereby prevent the particles in the green brick adhering together. After passing from the disintegrator the powdered clay is carried by an elevator to the upper story where it is discharged onto a long screen inclined at an angle of about 45 degrees. The material which has been ground fine enough passes through the sieve and down into the hopper over the molding machine. The tailings fall into a hopper at the lower end of the sieve and are carried back to the disintegrator.

Now comes the molding, the manner in which it is done characterizing the process. The molding machine consists of a massive frame of forged steel about eight feet high. Three feet up from the ground is the delivery table, sunk into which is the press box. Connected with the hopper above the machine by means of two canvas tubes is the charger. This latter slides back and forth on the table. It is filled on the backward stroke and on its forward stroke lets the clay fall into the mold box. The charger then recedes to be refilled and at the same time a plunger comes down pressing the clay into the mold. As the upper plunger descends a lower plunger which forms the bottom of the mold moves upward, so that the clay receives pressure from above and below. The upper plunger then rises, and the lower plunger ascends until the lower surface of the brick is even with the table. Again the charger comes forward, shoving the green brick forward on the table, the lower plunger drops and the mold box is once more filled with clay. The faces of the mold are of hard steel heated by steam to prevent adherence of the clay. Air holes are also made in the dies, but are apt to become clogged up. The pressure from above is applied by a toggle-joint arrangement, and it is claimed by the manufacturers of the Boyd dry clay presses that the pressure exerted on each brick is 150 tons. One to six bricks can be molded at a time, according to capacity of machine. On a four-brick machine about 20,000 are molded in a day. As the molded brick are shoved forward on the table by the charger they are placed on cars and either taken to drying chambers or set directly in the kiln The green brick require great care in handling as they are very tender. Drying must be done very slowly to prevent cracking. Burning is usually done in down-draft kilns. The manner of burning does not differ essentially from that followed for other makes of brick. By setting directly in the kiln without previous drying it takes longer to water smoke. This in any case should be done very slowly and the burning should not be pushed until water smoking is entirely finished. It is claimed by some that one sixth to one quarter more fuel is required to burn dry clay bricks than those made by other processes.

The type of kiln used varies.

Cost of production

This item varies considerably depending on a variety of circumstances, such as the method of manufacture employed, cost of labor, locality, etc.

Brick manufacturers are generally unwilling to give information on this subject, and the figures given, therefore, can only be considered approximate.

The use of improved machinery and methods will often lower the cost of production considerably, but this generally requires a much greater outlay of capital than seems to be in most instances available.

By the hand power method the cost of manufacture is $3.75 to $4.00 per 1000 delivered at the yard. On Long Island where the soft mud process is almost exclusively used the cost is said to be $3.00 per 1000 delivered at the yard. Hudson river manufacturers quote the cost at $5.00 per 1000 delivered in New York city; this figure includes $1.25 for transportation and 25 cents per 1000 for commission.

The brick yard is usually owned by the manufacturer but the clay bank is worked on one of the following bases:

1 The manufacturer owns the bank. This is by far the best and most profitable arrangement.

2 The brickmaker pays a certain rental, usually nine or 10 per cent.

3 The owner of the clay bank gets so much per 1000 brick. At Haverstraw this varies, for instance, from 25 cents to $1.25 per 1000. With this arrangement the manufacturer is bound to a certain amount of production.

Of the three methods for manufacturing brick, the soft mud process is the cheapest as far as first cost of plant is concerned, but it is probably not the cheapest to operate, as more labor is required. The other two methods used, the stiff mud and dry clay, require considerable outlay of capital. Less labor is required for operating either of the last-mentioned plants. The actual cost of production by either of these methods I have not been able to obtain. It is doubtful if the dry clay process is the cheapest, as the manufacturers of this class of machinery claim, for the economy gained, due to the shortness of the method, is probably counterbalanced by the increased time of burning and consequently greater amount of fuel used. With the soft mud process one man per 1000 brick is what the manufacturer figures, that is, if the yard has a capacity of 50,000 per day, a force of 50 hands is required to operate the yard.

As regards fuel, for instance, a saving of 30 cents can easily be made by using coal instead of wood, and gas is considered about 25 cents cheaper per 1000 than coal. Further economy may be made by the use of the proper class of machinery for haulage. Carts can usually be used economically up to 400 feet, beyond this it will usually pay to lay tracks and use cars hauled by horses. Above 600 feet steam haulage has been found economical. Self-acting planes and cable haulage have been used to advantage in a few instances.

Detailed account of brick yards

As the brick yards are scattered all over the state, a division of them into groups for convenience is more or less arbitrary. However, the following classification has been made.

Brick yards of eastern New York
" " " central New York from Schenectady to Buffalo
" " " Oswego, Jefferson and St. Lawrence counties
" " " southern New York
" " " Long Island
" " " Staten Island

Most of the bricks manufactured are sold in local markets. The greatest proportion of the Hudson river ones, as well as some of those made on Long Island and Staten Island are sold in New York city. Other large markets are Buffalo, Rochester, Syracuse and Albany.

Croton Landing, Westchester Co. There are three yards, all situated on Croton Point and having a yearly capacity of 61,000,000 brick. The yards of the Anchor Brick Co. are situated at the base of the point, a short distance south of the station and along the railroad track. One yard is situated a few feet above river level, the other 90 feet above it on a delta terrace. The clay deposit adjoins this yard. It is basin-shaped, and varies in depth from 40 to 70 feet. The clay is mostly blue, and is underlain by hard pan, the pebbles of which are cemented by clay stained with limonite. The present excavation is about 40 feet deep; the bottom of it is 40 feet above mean tide. Borings show an additional depth of 35 feet in the center, and the engineer who made them calculates that at their present rate of manufacture there is sufficient material in sight for 15 more years. The stripping amounts to about 10 feet of loamy clay and sand. Streaks of gravel are not uncommon in the clay.

The deposit is worked in benches having a long working face and these benches converge to one point at the eastern end of the pit, from which a single track is laid up to the tempering machine. Tracks are also laid along the benches, and as the working face recedes the tracks are shifted with crowbars. The cars are brought down to the working face by gravity, or a small engine which is chiefly used to draw them to the tempering pits. A temporary track is laid over the ring pits, upon which the cars can be run to facilitate dumping. Those cars containing clay for the lower yard are run on to a self-acting inclined plane, and on this the empty cars, and tempering sand for the upper yard are also brought up. The tempering sand is dug by a steam shovel, at the base of the terrace escarpment. The bricks are dried on covered yards and burnt in a special type of kiln. It consists of two walls of best quality brick, about 15 feet high and 14 inches thick. The lower portion containing the doors are two feet thick, and the two walls are about 20 feet apart. The two ends have to be walled up with double coal bricks after the kiln is filled. Coal is the fuel used. The bricks when burnt are loaded on cars and run down to the dock, those from the upper yard going on the gravity plane. The tempering sand is discharged by the shovel into small cars which are drawn up an incline to the top of a framework and dumped, the sand falling through a series of screens into cars below.

The Croton Brick Co. has two yards; an open and a pallet yard. They obtain all their clay from the river with a scoop dredge. It is dumped into cars on a scow, which when full, are run up an inclined plane on the shore and dumped. The clay is thus exposed to the weather for several months before it is used. It costs about 15 cents per cubic yard to deliver the clay on shore and 10 cents per cubic yard to haul it to the pits. Tempering sand is obtained from the escarpment of the delta terrace just south of the yard. At the pallet yard they use a hand machine to square the green bricks on the racks. It consists of two plates of steel, attached to which at right angles and on the same side of the plates, are 12 smaller ones, the height of a brick. Attached to the large plates are two handles. The two large plates slide back and forth on each other and so that the small plates can be brought together. This machine is set on six bricks at a time and by moving the handles the plates press against the brick, squaring the corners. It is said a boy can square a pitful of brick (35,000) in a day. The molding machines have an endless chain with buckets attached to them for feeding the sand. This leaves only the clay to be shoveled into the machine, and the feeding of the two uniformly and continuously gives a more evenly tempered mixture. It will be seen in this case that no soak pit or ring pit is used and the molding machine does all the mixing. The molding sand is dried by spreading it out on the kiln floor, it being claimed that it dries quicker this way than if it were banked up against the kiln as is commonly done.

The W. A. Underhill brick yards are situated midway between the base and end of Croton Pt. They have two yards, both covered ones. The brick made at this yard are sold mostly for fronts, selling for $14 a 1000. The clay bank lies between the two yards; it has a height of 40 feet above mean tide and extends 15 feet below it. At this last-mentioned depth the blue clay stops and is followed by two feet of yellow clay, several inches of quicksand and through which spring water enters and finally hardpan. There is a stripping of fine sand, which varies from 10 to 20 feet in thickness. Some portions of this sand are found to make a better brick when mixed with the clay than others. The clay is mined in benches, and narrow tracks are laid along the working face. Side dump cars are used to haul the clay, being run in trains of three, drawn by four mules. The tracks are laid around the ring pits, so that the clay may be easily discharged into them.

Below are given two partial analyses of clay from this bank:

	Upper Blue clay.	Lower Blue clay.
Silica	62.30	57.74
Alumina	14.663	26.31*
Peroxide of iron	9.2	4.6
Lime	3.98	2.93
Magnesia	1.05	1.4

Crugers, Montrose and Verplank, Westchester Co.—These three localities lie so connected and their clay banks are so similar that they are best described together. The clay is extremely variable in depth, due to the great irregularity of the face of the underlying rocks; it is both blue and yellow. No special method is used in mining the clay, it being dug at any convenient spot till the underlying rock is reached and then the bank is attacked at another point. At Montrose and Crugers the clay is overlain in places by a moderately fine sand and gravel, crossbedded in places. The clay varies from six to 50 feet in thickness. It extends in places to an altitude of 90 feet, as at McConnell and O'Brien's bank, while at others as McGuire's bank it only reaches a height of six feet above mean tide. At this latter locality the clay is overlain by 10 feet of sand and coarse gravel and has been excavated to 10 feet below mean tide.

A partial analysis of the buff clay from McConnell and O'Brien clay bank at Verplank is given below:

Silica	50.92
Alumina	26.87*
Peroxide of iron	4.90
Lime	2.52
Magnesia	1.56

* Alumina is probably too high.—*H. Ries.*

King and Lynch's yard is situated on George Point near Montrose. The bank is about 700 feet distant, and the clay is hauled in cars drawn by horses. At most of the yards the haulage is down grade. Fisher's clay bank at Crugers is overlain by two feet of loam. This is used to supply part of the tempering material and the rest is obtained from Jones' Point. At the yards on Verplank Point horse power is chiefly used to operate the machinery. Most of the yards at this locality obtain their clay from the pits of the Hudson River Brick Co. This clay bank is worked in benches. The haulage distance is about one half mile. It is done either in carts or else in cars run on tracks and drawn by horses.

Along the New York Central Railroad tracks a short distance south of Montrose station are the yards of C. Hyatt and J. Morton. Mr. Morton also has a covered yard on Verplank Point where front brick are made. Their banks are practically a continuation of each other. The clay is both blue and yellow and is overlain by several feet of coarse sand. Hyatt uses steam power and Morton horse power to run his machinery. The bricks are loaded on cars and shipped to various points along the Central Railroad.

Peekskill, Westchester Co. Bonner & Cole's brick yard lies between the river and the railroad about three quarters of a mile south of Peekskill. The clay lies below tide level. It is claimed that borings have shown a thickness of 50 feet. There is on the average a stripping of five feet of gravel and cobble stones.

South of this yard are two others, viz., Oldfield Brothers and the Bonner Brick Co. Their clay is similar to Bonner & Cole's, but rises to a greater height above tide level.

Haverstraw, Rockland Co., is one of the great brick manufacturing centers of New York state, there being forty-two brick yards, with a yearly capacity of 238,000,000 bricks. The yards are situated in a line along the river stretching from the lower end of Haverstraw Village northward around Grassy Point, to Stony Point. A few of them are situated along Minisceongo Creek. Most of the yards along the river are digging their clay below tide level. At the south end of the village a dam was built at an expense of $30,000, reclaiming thereby 12 acres of clay land from the river. This last-mentioned bed of clay is underlain by till and modified drift, from which tempering sand is obtained. The clay within this enclosure has been excavated to a depth of 20 feet below mean tide. In the pits of the Excelsior Brick Co. they have reached a depth of 35 feet below river level; in Donnelly & Son's pit, 45 feet, and west of Washburn's yard, 40 feet. A pipe well was sunk from mean tide level 100 feet through blue clay, in the Excelsior Co.'s clay, and at this depth struck bed rock or a large bowlder.

The clay in these pits is rather sandy on top, but is said to improve with the depth. It is mostly blue. Streaks of quicksand are always liable to be encountered. In those pits situated along the river and to the rear of the yards, there is no expense of stripping unless the excavation is widened, but there are two important items of expense, viz.: pumps to keep the water out of the pits, and the maintenance of corduroy roads leadingd own into the pits. The clay is dug at any convenient point within the excavation and hauled in carts to the yard. About one quarter mile west of the river, where the terrace is 40 to 50 feet high, clay is being dug from the escarpment to supply the yards of J. D. Shankey, Buckley & Carroll, Phil. Goldrick, R. Malley, and J. Brennan. Some of the yards situated on Minisceongo Creek have to haul their clay 400 to 500 yards. Where the clay is obtained from the terrace escarpment there is in most cases a stripping of from six to 10 feet of sand and gravel. This is screened and used for tempering. The Excelsior Co. has tried to use clay dredged from the river, but gave it up after one season's trial for reasons unknown. Most of the brickmakers at Haverstraw temper their clay in soak pits and burn their bricks with wood. They all use open yards for drying except the Diamond Brick Co. which has recently put in a tunnel drier. The Excelsior Co. have a covered yard and Bennett, Rowan & Scott used pallet dryers. At most of the yards the barges can be brought to within a few feet of the kilns, and those yards not situated directly on the water, put the barrows loaded with brick on flat cars and run them down to the dock.

Stony Point, Rockland Co. This is practically a part of Haverstraw. There are four yards here. They obtain their clay from one large shallow excavation on the west side of the West Shore Railroad track and 500 feet north of Stony Point railroad station. The clay has to be carted from 100 to 300 yards, and when the excavation is widened there is a stripping of three to six feet of sand and cobblestones. Corduroy roads have also to be used. The four yards are situated along the water front. One of them, Riley & Clark, uses stationary kilns. Riley & Rose have a covered yard, the other three firms dry their bricks on open yards. The clay bank is owned by T. Tompkins & Son.

The following are some tests of Haverstraw brick made by M. Abbott at the time the East River bridge was being completed. No packing was put between the brick and plate of testing machine.

		Crushing strength per square inch. P unds.
Whole brick tested on end	Maximum	3060
	Minimum	1600
	Average	2065
Half brick tested on flat side	Maximum	4153
	Minimum	2669
	Average	3371
Half brick tested on edge	Maximum	6400
	Minimum	2900
	Average	4612

Had the surfaces been ground parallel and cardboard or blotting paper been put between the face of the brick and plate of machine, higher results would have no doubt been obtained.

Thiells, Rockland Co. About two miles south from Haverstraw and half way between the stations of Ivy Leaf and Thiells, on the New York and New Jersey Railroad, is the brick yard of Felter & Mather. The clay deposit is basin-shaped, about 15 feet thick, as determined by boring, and has a slightly elliptical outline The clay is chiefly of a blue color, the upper portion being weathered to yellow. It is overlain by a few feet of drift containing small bowlders and underlain by similar material. The tempering sand is obtained from a bank on the opposite side of the railroad track about 1000 feet from the yard. Tempering is done in ring pits; the bricks are molded in soft mud machines and dried on an open yard. Burning is done in scove kilns. The product is shipped to various towns along the line of the railroad in New Jersey.

Cold Spring, Putnam Co. A brick yard was in operation north of this town for a number of years, but has been shut down on account of the clay giving out.

Storm King, Dutchess Co. About 1000 feet north of the station is a clay deposit, chiefly yellow clay. It is worked by Mosher Bros. The bank has slid considerably; it has a vertical height of 50 to 60 feet.

Cornwall on Hudson, Orange Co. C. A. & A. P. Hedges are the only brick manufacturers here. Their yard is situated on the West Shore Railroad about a mile north of Cornwall station. They have 27 acres of clay land. Blue and yellow clay are found in the bank, the main portion of which is covered by delta deposits of Moodna River. The clay layers are much compressed in places, making it difficult to excavate and necessitating the use of picks. The bank is worked in benches and the clay has to be hauled about 300 feet to the machines. The stripped sand can be used for tempering. Many bricks are shipped to points on the New York, Ontario and Western Railroad.

New Windsor, Orange Co. There are six yards here. They obtain their clay from the escarpment of a terrace 110 feet high. Their clay is both blue and yellow. Streaks of quicksand occur in the blue. The yellow is dry and tough, and has to be worked by undermining. In thickness the clay varies from 20 to 60 feet; the layers are in many places contorted, and in some cases the stratification has been obliterated. Overlying the clay is gravel and sand; the latter is used for tempering. Most of the New Windsor clay permits the addition of very little water in tempering. Ring pits and Adam machines are used at these yards. The yards are all situated along the river and ship their product on barges or by the West Shore Railroad.

Dutchess Junction, Dutchess Co. There are several brick manufacturing firms having yards along the river south of Dutchess Junction (*see* table No. 1). They obtain their clay from the escarpment of an 80-foot terrace which extends from a short distance north of Storm King to Dutchess Junction. The clay has a fairly uniform thickness; the upper four to eight feet are yellow, the rest blue. The greatest thickness of clay known for this locality is at Aldridge Bros.' yard, where a well was sunk 65 feet through the clay, which added to the height of the bank (65 feet), gives us a total thickness of 130 feet at this point. The clay is usually covered by gravel, and by sand in some cases sufficiently fine to be used for tempering or even molding. It is worked in benches, and the haulage distance is 200 to 300 feet. At Timoney's clay bank there is some extra labor in stripping the scrub oaks and other bushes which cover the surface of the terrace.

Fishkill, Dutchess Co. Harris & Ginley's yard is situated about one quarter mile below the town The clay bank is leased from the New England Railroad Company. It was formerly quite thick, but clay having been dug for 50 years but a small portion of the bank remains. The clay has a maximum thickness of 45 feet. Streaks of quicksand occur throughout the clay; it is underlain by hardpan and shale.

The other yards at this locality are situated along the river from a point about one half mile above Fishkill up to Low Point station. One of the yards is just north of Low Point. The most southern one is that of Aldridge & Sherman, with 600 feet water front. The clay land of these two firms belongs to the W. E. Verplank estate. Next on the north are the works of the Brockway Brick Co., with 1200 feet of water front. This firm owns its clay bank. The bricks are dried on pallets. The next two yards belonging to Lahey Bros., (650 feet water front) and Dinan & Butler (475 feet water front), respectively, lease their clay bank from the W. E. Verplank estate. Dinan & Butler have a pallet yard. The five above-named firms obtain their clay just east of the yards from the escarpment of a 90-foot terrace; it is both blue and yellow and overlain by four to six feet of loam, sand and gravel. A short distance north of Dinan & Butler's yard is that of J. V. Meade. About 20 feet of clay are exposed in the bank, which adjoins the yard. The clay is overlain by four to six feet of sand and cobblestones. The sand is screened and used for tempering.

C. G. Griggs & Co.'s brick yard is located along the river about one half mile north of Low Point station. An opening has been made for clay about 800 feet east of the yard; the clay as exposed at present is 20 feet thick and overlain by two feet of loam. One hundred feet farther east, and at a slightly higher level, sand for tempering has been dug to a depth of eight feet without finding clay. The clay is hauled in carts to the yard.

Roseton, Orange Co. There is a remnant of a terrace at this locality 120 feet high. From this J. J. Jova and Rose & Co. obtain their clay. The former has 80 acres, the latter 40. The clay is mostly blue and rises to a height of 100 feet above the river. At Jova's upper yard it is underlain by limestone and overlain by sand. On top of the clay at his lower yard are 10 to 15 feet of sand and gravel.

A well was sunk from river level at Jova's and passed through the following:

Blue clay..	80 feet.
Quicksand..............................	25 "
Loose sand and gravel	75 "
	180 feet.

Adding to the above section 100 feet of clay above river level gives us a total thickness of 180 feet of clay. At Rose & Co.'s yard, which adjoins Jova's on the south, a well was sunk 135 feet through blue clay, it is claimed. Adding to this 108 feet of clay above mean tide gives us a bed of clay 243 feet thick. The terrace which the clay underlies at Roseton extends back from the river several hundred feet into a reëntrant angle of the hill. The clay contains little sand and is worked in benches. Carts are used to haul the clay. South of Roseton station is a bank of sand of alternating yellow and grayish black layers, which has been used for tempering, but is said not to give as good results as that on Jover's premises.

Port Ewen, Ulster Co. S. D. Coykendall's yard lies near the junction of Rondout Creek and Hudson River. The bank is just west of the yard. There is a considerable stripping of fine sand and the clay slides quite easily. It is dug at any convenient point of the bank. The overlying sand can be used for tempering and molding. Oil is used for burning the bricks. A short distance farther south along the river is J. Kline's yard. He obtains his clay from various points in the terrace escarpment and in some cases hauls it nearly a quarter mile. Mr Kline has made borings at various points along the river and the terrace and in the escarpment in the vicinity of his yard and claims that at none of them has he found over 18 feet of clay. Beneath it was hardpan. This would seem to indicate that the central mass of the embankment is rock, overlain by hardpan, and that on this the clay is laid down. In many places the clay is covered by 10 to 20 feet of fine stratified sand.

The following is an analysis of the blue clay near Rondout which is used for the manufacture of cement:

Silica	57.8
Peroxide of iron and alumina	22.6
Lime	4.85
Magnesia	2.07
Water and alkalies	12.68
	100.00

East Kingston, Ulster Co. There are eight brick manufacturing firms at this locality, viz.: Streeter & Hendrix, D. S. Manchester, Brigham Bros., C. A. Schultz, A. S. Staples, R. Maine & Co., Terry Bros. and W. Hutton. They all obtain their clay from the terrace escarpment which extends from Glasco to Rondout. (For thickness of clay see table.) At Street & Hendrix's yard the clay lies some 300 yards from the river. They obtain their tempering sand from Wilbur. Manchester's bank is similar. At Brigham Bros.' yard the clay is yellow, being weathered clear through to its base. It has a thickness of 10 feet and rests on an uneven ridge of shale. On account of its toughness it is worked by undermining, as is the case with other yards along here where clay is being dug. C. A. Schultz has an exposure of clay 80 feet thick, overlaid in spots by sand that can be used for tempering. Next on the south is A. S. Staples' yard. The bank has been excavated to a lower level than the preceding one. The clay is underlain by hardpan. R. Maine & Co. have five acres of clay land. The terrace here is quite narrow. At Terry Bros'. yard the clay, which is mostly blue, has been excavated sufficiently to expose the limestone against which the terrace lies. At Hutton's yard the blue clay is exposed from eight feet above mean tide, to 110 feet above it; overlying this is 10 feet of yellow clay and then 15 feet of sand. It will be seen from the limits quoted above and in the table, that the thickness of the clay between Glasco and Rondout varies considerably, amounting to 120 feet in places, while in others it is not over 15 or 20 feet. This is due to the great irregularity of the underlying rock surface.

Smith's Dock, Ulster Co. The only yard here is that of Theo. Brousseau. He has about 90 acres of clay land. The clay, which is mined with plow and scrapers, is obtained from the terrace east of the yard. It is mostly blue and covered by a few feet of loam. The yard lies some 700 feet from the river and the bricks are carted down to the dock. Brousseau's property extends west to the West Shore Railroad and the farms north and south of him are underlain by clay.

Malden, Ulster Co. The clay at Cooney & Farrell's yard to the north of the village is mostly yellow, and lies 10 to 20 feet thick on the upturned edges of the Hudson River shales. This yard was started in 1891.

Glasco, Ulster Co. Washburn Bros. This firm is one of the largest producers along the river having a yearly capacity of 50,000,000. They have about 150 acres of land, a large part of it being situated along the river. Their clay is mostly blue and rises in a bank to the height of 130 feet. It has been excavated to eight feet above mean tide. The upper 10 feet is yellow sand; a thin strip of yellow clay separates it from the red. The lower third of the bank is somewhat sandy, and the best results are obtained by a mixture of the upper and lower portions of the clay. Both pallets and open yards are used for drying; the former at the yard situated on the terrace. A short distance below Washburn Bros. is F. M. Van Dusen's yard. The clay is blue 70 feet thick and is underlain by shale whose surface is glaciated. Several feet of loam overlie the clay. Tempering sand is brought from Wilbur on Rondout creek. J. Porter's yard adjoins Van Dusen on the south. The clay lies on a ridge of shale which rises steeply from the shore to a height of 60 feet. The brick yard is at the foot of the cliff and was started in 1891. Plows and scrapers are used to mine the clay which is of a yellow color, and overlaid by three feet of loam. Carts are used for hauling the clay. About a mile below this are the yards of C. H. Littlefield, A. Rose & Co. and D. C. Overbaugh. The three are close together. A ridge of shale rises steeply from the river and behind this the clay lies. The terrace here is 150 feet high, and borings which have been made show a depth of as much as 60 feet (see table). The clay is quite dry, and mostly yellow. It is worked by picks and undermining. Carts haul it to the edge of the cliff, where it is sent down shutes to the tempering pits. The drying is done on pallets at Rose's yard.

Arlington, Dutchess Co. Flagler & Allen. The clay deposit which is yellow is situated a half mile east of Poughkeepsie and has an extent of about 40 acres of clay, it averages from six to eight feet in depth. This is easily worked, there being only a stripping of six inches of sod. Underneath the yellow is considerable blue clay, of which the yellow is of course the weathered portion. The clay is tempered in soak pits and about 20,000 brick are made daily. The machinery is run by horse power. Repressed brick are also made. The clay burns a cherry red.

H. R. Rose's brickyard is also situated at this town and about three miles east of the Hudson river. The clay deposit, which has an extent of 60 acres, is yellow in color and eight feet thick. A blue clay is said to underlie the yellow. The bricks are molded in soft mud machines operated by horse power.

Barrytown, Dutchess Co. There are deposits of clay along the river at this locality but they are not being worked. The following is an analysis of them:

Silica	59.81
Peroxide of iron and alumina	22.00
Lime	4.35
Magnesia	2.29
Moisture	.37
Combined water and organic matter	7.89
Alkalies, not determined	.....
	96.71

Catskill, Greene Co. Alexander McLean's yard is situated on Water St. east of the wagon bridge. He has 12 acres of clay land. The clay is mostly blue with yellow and red on top, and is about 90 feet thick.

A partial analysis of the blue clay is as follows:

Silica	50.60
Alumina	21.00
Peroxide of iron	7.35
Lime	3.75
Magnesia	.96

The upper portion of the clay bank is a tough material and has to be worked with a pick. A gray black sand of the same structure and appearance as that at Coeymans underlies the clay. At this locality it contains too much lime, however, to use it for tempering. Mr. McLean has to bring his tempering sand from Jones' Point at the cost of 40 cents a cubic yard. The manufacture of drain tile, hollow brick and sewer pipe has been attempted with this clay, but was given up it is said for financial reasons. Ferier & Golden's yard is situated on the opposite side of the street from McLean's, and their clay bank is practically a continuation of his. Their tempering sand is carted from near the West Shore Railroad station, a distance of about three quarters of a mile. The bricks are burnt with wood, though petroleum was used for a while successfully, it is claimed. The bricks are run down to the dock on cars. Lying along the creek north of the bridge is the Derbyshire Brick Co.'s yard. Most of the drying is done under sheds. The clay is both blue and yellow and is dug in a rather steep face causing it to slide often. The blue has been excavated to 38 feet from tide level, and its upper limit is 82 feet above tide; over this is 12 feet of yellow clay and three feet of loam. The tempering sand is obtained about half a mile from the works As at the preceding yard the bricks are loaded on cars at the kiln and run down to the dock.

Hudson, Columbia Co. There are three yards at this town. J. Fitzgerald's Sons' yard is situated in a reëntrant curve of the shore, and about 300 yards east of it is the yard of Arkison Bros. The former is no longer in operation. Both these firms obtain their clay from different faces of the same hill. The clay, which is fairly dry, is mined with plows and scrapers. It is blue and yellow, from 70 to 80 feet thick, overlaid by two feet of loam, and underlain by grayish black sand.

W. E. Bartlett's brick yard is also situated along the shore, about one quarter mile north of Hudson. The clay is similar to that farther down at Fitzgerald's. Scrubby pines cover the surface at this locality. The bank is worked in benches. Ring pits are used for tempering.

Stuyvesant, Columbia Co. Walsh Bros. have two yards situated along the river midway between Stuyvesant and Coxsackie. All the clay thus far mined is yellow in color, very tough and unstratified. It is worked by picks and carted down to the yards. The bank which is 30 feet in height is located on the hillside some 500 feet east of the yard. It is probably underlain by the sand and gravel which crops out in the terrace escarpment behind the yard, and which is used for tempering.

Coxsackie, Greene Co. There is only one yard here, that of F. W. Noble. It is situated at an elevation of 100 feet above the river, and about a quarter mile north of the village. The clay bank adjoins the yard and is 35 feet high. Both blue and yellow clay are used. Shale underlies it. The clay is quite dry and is broken up by undermining. Soak pits are used for tempering. There is an exposure of blue clay in the terrace escarpment south of Coxsackie.

Athens, Greene Co. Of the three yards at this locality, situated about half a mile north of the village and adjoining each other, only two are running. The most southern one is that of William Ryder, situated 80 feet above tide level and about 500 feet from the river. Mr. Ryder owns 12 acres of clay land. The clay which has not been excavated below the level of the yard runs up to 125 feet above mean tide, and is both blue and yellow with about six feet of loam covering. A well was sunk 18 feet below the level of the yard, without reaching bottom. The clay is mined by plows and scrapers. The upper six feet of loam are mixed with the clay. The bricks when taken from the kilns are sent on cars down to the shore, where they are loaded on barges for shipment to New York City. Adjoining this yard on the north is that of Mr. Porter, not being worked. A few hundred feet north of this, on the south side of Murder Creek, is the yard of I. R. Porter. Although the yard is situated near the shore the water is not deep enough for the brick barges, and the bricks have to be carted some 200 yards to the dock. The clay bank adjoins the yard and is mined by plows and scrapers. Horse-power machines are used.

Coeymans Landing, Albany Co. There are two brick yards at this town; they lie north of the town along the river shore and adjoin each other. The one nearest town belongs to Sutton & Suderly, and is worked by them and four other parties. Their clay is obtained from the bank west of the yard. It is both blue and yellow, chiefly the former, with streaks of fine sand.

The following partial analysis has been made of Sutton & Suderly's clay:

Silica	51.10
Alumina	17.65
Peroxide of iron	6.47
Lime	7.45
Magnesia	.87

Being of a soft nature the clay is dug with shovels at any convenient point at the base of the bank, which is 120 feet in height. A charge of dynamite is usually exploded in the bank in the spring, thus bringing down a large mass of clay to a level with the yard. The clay does not have to be hauled more than 150 feet to the machines. A drive-pipe well sunk near the owners' barn on top of the terrace (140 feet above mean tide) some 300 feet back from the river, showed 70 feet of clay and 60 feet of sand. The sand underlying the clay is of a grayish black color, consisting chiefly of grains of quartz and shale, the latter predominating.* Grains of garnet and feldspar, and large pebbles of quartz are scattered through it. The sand after being screened is used for tempering. The upper limit of the underlying sand varies, at the north end of the property rising to within a few feet of the terrace level, while some 300 feet south of this the clay has been excavated to 15 feet above mean tide without striking sand.

Adjoining Sutton & Suderly on the north is the brick works of Corwin & Cullough, sublet by them to T. Finnegan and Delaney

* This underlying material is much faulted owing to the pressure of the clay above it.

& Lavender. The clay, which is obtained just west of the yard has been excavated to seven feet above mean tide and bottom not yet reached. It contains several veins of fine sand. Both yellow and blue clay are present. At the south end of the yard the escarpment of the terrace is drift containing small bowlders. The tempering sand is obtained from this bank.

There are outcrops of clay on the land of Mr. Bronk, to the north of Corwin & Cullough's yard; also on the Lawson property to east of the white iron bridge crossing Coeymans Creek. This latter locality lies some 800 feet from the river, and would be somewhat more expensive to work. Again, on Main st., just south of the residence of Miss Wolf, there is an exposure of clay on the hillside some 400 feet from the river.

Albany, Albany Co. There are several yards situated on the outskirts of the city. The clay banks, which are all of the same nature, belong to the Hudson River estuary formation, being stratified and blue or gray in color with the upper portions weathered yellow or red. M. H. Bender's yard is on Delaware avenue near Dove St. He manufactures common pressed brick and drain tile. The upper loamy clay can only be used for common brick; the lower blue and some of the yellow are used for the other products. Auger machines are used for better grade brick and the tile, and the latter are made in several sizes. Scove kilns are used for burning the brick and down-draft kilns for the tile. These latter kilns hold 60,000 small size tiles or 35,000 assorted size. It takes three wheelers and two setters two and a half days to fill the kiln and burning occupies four days. The tiles after molding are first dried on shelves under a closed shed.

Adjoining Bender's yard are those of J. Babcock, E. Smith, J. C. Moore and D. H. Stanwix. They make common brick chiefly, and their clay banks are the same as Bender's. They are all open yards.

T. McCarthy's yard is situated on First Avenue. The clay bank is about 15 feet thick and covers an area of about 10 acres. It is chiefly blue. The stripping is a light soil and sand underlies the clay. The bricks are manufactured by the soft mud process.

Alfred Hunter's yard is situated on Van Woert street near Pearl. The clay is blue with yellow on top. About 40 feet of clay is at present exposed. There are only a few inches of soil to be stripped. The bottom has not yet been reached. Ring pits and soft mud machines are used and the bricks are dried in the sun. Burning is done in scove kilns. Albany and vicinity consume most of the product.

The brick yard of M. Roberts is on Swan street between Ten-Broeck and Colonie. The clay is blue in color and about 25 feet thick. It is overlain by a loose soil; the bottom has not yet been reached. Soft mud machines operated by steam power are used; the bricks are dried on open yards and burned in scove kilns. Albany consumes the product.

Greenbush, Rensselaer Co. Mrs. T. Rigney's yard is at East Greenbush on the east side of the Boston and Albany railroad. The clay, which is blue and yellow, has a thickness of about 90 feet. Loam overlies the clay; the bottom has not yet been reached. The machinery is run by horse power. Greenbush and New York city are the chief markets for the product.

Troy, Rensselaer Co. Alex. Ferguson's brick yard is situated on Hoosick above First street. The clay bank is about 40 feet high and runs in an east and west direction; it is deeply incised at either end by two streams. The clay, as is common to these Hudson estuary deposits, is stratified, yellow in the upper portion and blue clay in the lower. The blue contains some quicksand. A stronger and better colored brick is made from the tough upper clay, but it shrinks considerably in burning. On the other hand the blue clay makes a smoother but not as strong brick, but one of more even shape. Underlying the clay is slate rock which has been used for building purposes.

J. B. Roberts' bank is about 20 feet in thickness. The clay, which is mostly yellow, is covered with a foot of loam and underlain by gravel. Capacity, two million.

Cohoes, Albany Co. J. E. Murray. Yard situated between Crescent and Cohoes, on west side of Erie canal. The clay is chiefly blue, the upper few feet being yellow. It rises in a bank to 50 feet height. It is underlain by rock and there is a slight covering of loam. The bricks are molded by steam-power machines, and dried in the sun. The product is sold in Cohoes and vicinity. J. E. Murray also operates the brick yard formerly belonging to N. Gardonas.

J. Baeby. The clay bank is about 40 feet high, 400 feet long and about 250 feet from the yard. Mr. Baeby has about 40 acres of clay land. The clay is yellow on top and blue beneath. It is covered by about four inches soil and underlain by gravel. One yard is operated by horse, the other by steam power.

Lansingburgh, Rensselaer Co. T. F. Morissey has a horse-power yard situated along the Old Turnpike near the railroad. The clay bank is 75 feet high, there being about six acres of clay land. The upper third of the bank is red, the lower two thirds blue. About 30 feet of sand underlie the clay.

Crescent, Saratoga Co. Newton Bros. have a bank of clay 30 feet thick, the upper six feet being gray, the rest blue. There is a stripping of two to four feet of sand, which can be used for tempering. The blue and yellow clay, together with a certain portion of sand, are tempered in the pug mill. The bricks are molded on a Martin soft mud machine and dried on pallets for about five days. Burning is done in scove kilns and the product is loaded onto the Erie canal boats at the yard.

Mechanicsville Brick Co., Saratoga Co. The brick yard is situated on the Champlain Canal in the town of Half Moon, about a mile south of Mechanicsville. The clay bank is 50 feet high. The upper 10 feet are yellow and under this is blue clay; the latter is underlain by sand. The bank adjoins the yard and is worked in benches; the clay is hauled in carts to the ring pits. Soft mud machines are used, the brick are dried on pallets and burned in clamps.

Saratoga, C. L. Williams. The yard is situated about one mile from the town, 600 feet from the Delaware and Hudson Railroad. Mr Williams has about 50 acres of clay land, the clay running six feet thick. It is blue, with the upper portion of it weathered to yellow. There is a stripping of about one foot of loam. The clay is put through a crusher first; it is then pugged and molded. The bricks are dried on pallets, the racks having a capacity of 260,000. Wood is used for burning, being obtained from a lot of 200 acres near the yard. The product is chiefly used locally.

The other brick yard at Saratoga is owned by Mr. D. Davidson. It is situated at the outskirts of the town, just west of Judge Hilton's yard. The clay bank, which is about 28 feet thick, is about 150 feet from the yard; it is stratified, the layers being from one to eight inches thick and separated by thin laminæ of sand. The clay is of a light brown color, being underlain by calciferous limestone and overlain by a foot of soil. Mr. Davidson has 22 acres of clay land. Tempering is done in ring pits and the clay is molded in a soft mud machine. Drying is done in an open yard, and burning in scove kilns. The fuel used is hard wood.

Hoosick Falls, Rensselaer Co. John Dolin's clay bank is about 40 feet high and has an extent of six acres. It is used for making building brick. The product is consumed in the vicinity.

Middle Granville, Washington Co. J. H. Pepper is the only manufacturer at this locality. His clay bank is 45 feet high, and 2000 feet long. The clay is blue, and scattered through it are some streaks of sand. A bed of gray sand 20 feet in thickness underlies the clay and is in turn underlain by slate.

Plattsburg, Clinton Co. There are several yards here. That of J. Ouimet lies at the north end of the town. It is an open yard and the bricks are made by hand power. The clay which is hard and tough is of a yellowish brown and red color and is mined with plows.

Charles Vaughn's yard is similar to the preceding, and is at the south end of the town. The clay is 20 feet thick.

Gilliland and Day's yard is situated on Indian Bay, six miles south of Plattsburg. The bricks are also molded by hand power.

All these yards sell most of their brick at Plattsburg.

The following is an analysis of the clay at J. Ouimet's brick yard:

Silica	65.14
Alumina	13.38
Peroxide of iron	7.65
Lime	2.18
Magnesia	2.36
Alkalies	8.51
	99.22

Gouverneur, St Lawrence Co. The brick yard of G. R. Thompson is situated east of village and on the eastern bank of the Osgewatchie river. The clay bank rises to a height of 10 feet above the river and the section exposed is:

Sand	4 feet
Gray clay	8 "
Blue "	6 "
	18 "

A Martin soft mud brick machine is used and the bricks are dried under sheds. The product finds a ready sale on the local market.

A pallet yard has recently been started at this locality.

Carthage, Jefferson Co. Wrape & Peck. The brick yard and clay pit are situated in the Black River Valley near the town of Carthage. The clay deposit which is several hundred acres in extent and about five feet thick is of a gray color with streaks of brown. The bricks are molded in wet mud machines and put in steam dryers. Local market consumes most of the product.

Potsdam. D. W. Finnimore's brick yard is situated a few rods outside of the village limits. The clay is of a blue color and six to eight feet deep. It is overlain by one to two feet of dark sandy soil and underlain by gravel. The yard is equipped with a Quaker soft mud machine, and a Kells & Son's dry press machine. The product is used locally.

Watertown, Jefferson Co. At the north end of the town on Main street are the works of the Watertown Pressed Brick Co. They have about 20 acres of clay, red in color, horizontally stratified and averaging about 20 feet in thickness. It is underlain by Trenton limestone. The tempering sand has to be carted nearly three miles. Analysis of the clay shows:

Silica	64.39
Alumina	14.40
Peroxide of iron	5.00
Lime	3.60
Magnesia	1.31
Alkalies	4.66
Water and organic matter	6.64
	100.00

The clay is rather tough. It is loaded on cars which are drawn by cable some 75 feet, up into the machine shed where it is dumped into a disintegrator. It next goes to the pug mill for tempering, and is molded in a Martin machine. Drying is done on pallets and burning in scove kilns, the latter occupying about seven days. The consumption is chiefly local.

Ogdensburg, St Lawrence Co. Paige Bros.' yard is on Cedar cor. Canton st. at southwest end of town. The clay is of a deep blue color, the upper 10 feet being somewhat sandy. It has been bored to a depth of 60 feet in places, but this depth is not constant, and in spots the underlying limestone rises to within a few feet of the surface. The sand for tempering has to be brought two miles. The following is an analysis of the clay:

Silica	49.20
Alumina	17.47
Peroxide of iron	6.23
Lime	7.86
Magnesia	4.87
Alkalies	9.82
	95.45

Only common brick are made. Soft mud machines are used. Drying is done in the sun and burning in scove kilns. The bricks have been largely used in the consumption of the asylum buildings at Ogdensburg.

Madrid, St Lawrence co. Three miles north of the depot is the brick yard of Robert Watson. The clay is of a blue color and about 20 feet thick. The section is

Yellow sand	3 feet
Blue clay	20 "

The bottom has not yet been struck. Horse power is used for operating the machinery. The clay has to be tempered with sand. Drying is done on pallets or in the sun. Burning takes about one week. The consumption is local.

Raymondville, St Lawrence Co. Coats Bros.' works are at Raymondville, about seven miles north of Norwood. The clay bank lies on the east side of the Racket River. It is about 25 feet in thickness and there is a covering of 12 feet of fine sand. The clay is rather tough and requires an admixture about one-third sand for making brick. An abundance of unworked clay is still in sight.

St Johnsville, Montgomery Co. J. S. Smith is the only brick manufacturer in this town. The clay bank is 60 feet high, and the following is the section involved:

Loam	1 foot
Fine sand	7 feet
Dark building sand	3 "
Gray clay	1 foot
Quicksand	4 feet
Hardpan	1 foot
Blue clay	75 feet
Total thickness	92 feet

Only common brick are manufactured.

Fonda, Montgomery Co. W. Davenport's brick yard is about one mile west of the village on the north side of the N. Y. C. R. R. The clay bank lies to the north of the yard, is 12 feet high, and yellow in color. The brick are molded in soft mud machines operated by horse power, dried on open yards and burnt in scove kilns. The product is sold in Montgomery county. Drain tile are also manufactured.

Dolgeville, Herkimer Co. A. C. Kyser has a bed of clay about 50 acres in extent, and 30 feet thick. He manufactures ordinary building brick, which are consumed by the local market.

The clay is tempered in a pug mill with the addition of a certain amount of sand, and passes thence to a Quaker soft mud machine. Drying is done on an open yard, and the bricks are burned in a scove kiln. This latter operation takes five to eight days.

South Trenton, Oneida Co. H. L. Garrett has manufactured brick at this locality for 45 years. His clay bed is several acres in extent and about four feet thick. The clay is blue below and yellow and red in the upper portion of the bed, due to weathering. It is slightly stratified. Underlying the clay is slate.

Amsterdam, Montgomery Co. H. C. Grimes' brick yard is located on Florida Ave. The clay deposit underlies a tract of about 20 acres, and the section is as follows:

Soil	1-3 feet
Yellow clay	6 "
Blue clay	...

Common bricks are manufactured.

The clay is first passed through a Cotts disintegrator and is then molded on a soft mud machine. Drying is done on pallets. This yard has been in operation for 16 years.

Gloversville, Fulton Co. H. McDuffie's brick yard is situated on the outskirts of the town. The clay, which is of a dark brown color, is in a bed two and a half feet thick. It is underlain by hardpan and overlain by a thin soil. The bricks are made by the soft mud process, being molded in horse-power machines.

W. A. Stoutner. His clay bank is about three feet thick, underlain by hardpan and overlain by a few inches of soil. The clay is reddish brown and burns to a red color. The brick are made on a Peekskill hand-power machine. The brickmaking season at Gloversville runs from about the middle of May to the end of September.

Ilion, Herkimer Co. S. E. Coe. Brick yard situated along the Erie Canal, with the West Shore Railroad crossing the property. Mr. Coe has about 10 acres of clay land, the clay running in depth from eight to 15 feet. It is of three different colors, black, gray and blue. The latter makes the stronger brick. No stripping to be done except a few feet of black soil.

Rome, N. Y., Oneida Co. W. Armstrong's yard is located on the edge of the town and along the Rome and Clinton branch of the New York, Ontario and Western Railroad. The clay deposit is about 25 acres in extent and the clay is of a dark gray color and seven to 10 feet deep. The bricks are molded in soft mud machines.

W. W. Parry. Yard located near the town; the clay is obtained from the flats bordering the Mohawk river, and the bed of it is from six to nine feet deep. It is underlain by gravel, which rises to near the surface in many places. A light loam covers the clay. For making brick the clay is mixed from top to bottom.

Both soft and stiff mud machines are used and burning is done in scove kilns.

Deerfield, Oneida Co. G. F. Weaver's Sons' yard is located on the Mohawk river about one quarter mile from the New York Central Railroad depot. Their clay deposit is about 40 acres in extent, and has been worked to a depth of 10 feet.

South Bay. C. Stephens has a brick and tile works at this town. The clay deposit is from 20 to 25 feet deep and underlies a tract of 800 acres bordering on Oneida Lake. Underlying the clay is a fine and closely cemented blue gravel. The Elmira, Cortland and Northern Railroad passes through the property. Chiefly drain tile are manufactured. These works were established in the spring of 1891.

Canastota, Madison Co. M. Ballou has a brick yard at this locality.

Syracuse, Onondaga Co. At the northeast end of the town is an extensive deposit of clay, underlying the low lands at the end of Onondaga Lake. It is worked by several brick manufacturers. The yards are mostly on Seventh North St. The first is that of T. Nolan, a horse-power yard; adjoining him is the yard of Preston Bros., also a horse-power yard. Next comes F. H. Kennedy, at whose yard the bricks are molded by hand. C. H. Merrick have a steam-power yard on S. Salina, and farther out on the Cicero plankroad are the brick works of J. Brophy.

The clay is stratified, red above and blue below. In the center of the flat land it runs seven to 10 feet deep, while at the edges it thins out to two feet. It is underlain by sand and gravel.

New York Paving Brick Co. This company has its works at Geddes near Syracuse and obtains its clay from a point called Three Rivers on the Syracuse and Oswego Railroad. The clay deposit is said to be 35 feet thick, and horizontally stratified. It is blue with the upper portions weathered to red. The brick factory is situated along the Erie Canal and the clay is brought by boat and stored in heaps, which in winter are covered to prevent freezing. Two Penfield soft mud machines with pug mills attached are used for molding. Drying is done in tunnels heated by coal fires. The green brick are nine inches long, but when burnt shrink to seven and one half inches. Both rectangular and cylindrical down-draft kilns are used. In addition to paving, a square tile, for linings, seven by seven inches and two inches thick is being manufactured. These, it is claimed, were placed for seven weeks in the acid vats at the Solvay works and were unaffected. The following tests were made on these bricks at the Watertown, Mass., arsenal:

	Cracked at	Crushed at
	Pounds.	*Pounds per sq. in.*
No. 1	91,000	29,060
No. 2	93,400	28,530
No. 3	119,000	20,060
No. 4	167,000	23,500

The bricks are said to absorb on 1.49 per cent. moisture, which is very little.

Warners, Onondaga Co. The Onondaga Vitrified Pressed Brick Co This yard uses both shale and clay. The works are situated about half a mile east of Warners along the West Shore track.

Analyses of the shale have been made and are given below:

COMPOSITION.	Calcareous layer in shale bank	A green brick. Being a mixture of the different shales.	Red Shale.	Blue Shale.	Clay.
Silica	25.40	54.25	52.30	57.79	45.35
Alumina	9.46	16.89	18.85	16.15	12.19
Peroxide of iron	2.24	5.81	6.55	5.20	4.41
Lime	22.81	4.34	3.36	2.73	10.99
Magnesia	10.39	5.21	4.49	4.67	6.38
Carbonic acid	20.96	4.30	3.04	3.42	7.24
Potash	.95	2.95	4.65	4.11	3.26
Soda	.....	.83	1.35	1.22	1.14
Water and organ matter	7.60	5.01	5.30	4.50	8.90
Oxide of manganese	.....	.....	Trace.	Trace	.....
Total	99.81	99.59	99.88	99.79	99.86

Analyst, Dr H. Froehling, Richmond, Va.

The samples were all dried at 212° F.

It may be of interest in this connection to give the composition of some other clays found at Warners, and which are used in the manufacture of cement. The following are only partial analyse

Silica	45.12	43.19	46.00	41.78	41.70	44.00
Oxide of iron and alumina	13.79	14.62	25.02	16.09	18.24	17.33
Lime	12.91	12.36	7.13	12.40	12.71	11.74
Magnesia	7.21	7.05	3.67	5.83	6.02	6.83

These last analyses would indicate a rather fusible clay. The clay used by the Onondaga Co. is dug in the field adjoining the works. It is a pinkish color, stratified and runs about 15 feet in depth. The shale used belongs to the Salina formation and is obtained from the hillside about 1000 feet from the yard. It is of various shades of red, green and some gray, and disintegrates very rapidly. The whole mass is traversed by numerous seams so that a small blast brings down a large portion of the bank in small fragments. Tracks are laid from the brick yard up to the working face, the base of which is 35 feet higher than the yard. The loaded cars are run down to the dry pans by gravity and hauled back when emptied by a horse. Carts are used to haul the clay. Dry pans grind the shale and about one quarter clay and three quarters shale are mixed in a wet pan. A man shovels the mixture onto an endless belt which carries it to the molding machine. The yard is fitted with both a plunger and auger stiff mud machine, the former being side cut, the latter end cut. The green bricks are placed on cars and run into the drying tunnels. These are of brick, heated by coal fires, the heat passing through flues under the tunnel. Round kilns are used for the burning which takes about five days. The kilns have a capacity of about 60,000. Soft coal is used for burning.

The company manufactures paving brick, hollow brick and terra cotta lumber for fire proofing.

Baldwinsville, Onondaga Co. Seneca River Brick Co. The works are four miles west of Baldwinsville on the south bank of the Seneca River. Their clay bed is six acres in extent. It is blue clay weathered to red in the upper portion and the blue is stratified. Gravel underlies the clay. The red clay is chiefly used as it burns a better colored brick than the blue. The dry press process is used and the bricks are burnt in kilns of the Flood type. These are both up and down draft. They are 18 by 54 feet and have 20-inch walls, which are lined with fire brick from the doors up. There are four fireplaces on each of the long sides and between these is a series of smaller ones connected with a set of flues opening into the lower part of the kiln to give an up draft. Wood fires are started in these smaller fireplaces for water smoking. The larger openings connecting with individual pockets on the inner wall of the kiln lead the fire into the upper portions first whence it passes downward through the kiln and off through a large flue at the bottom. Water smoking takes 10 days and burning eight days. The whole time for burning, water smoking and cooling taking about three weeks. The molded bricks are set directly in the kiln on coming from the machine.

Oswego Falls. W. D. Edgarton. The brick yard is situated on the Syracuse and Oswego railroad, 11 miles from Oswego. The clay varies from three to five feet in thickness and is yellow. It is underlain by gravel. A few inches soil has to be stripped. The lower portions of the clay make the better brick. Soft mud machines are used and both common and repressed brick are made.

Weedsport, Cayuga Co. There is a brick yard at this locality belonging to Mrs. C. S. Gilette, but it is not in operation.

Auburn, Cayuga Co. John Harvey's brick yard is situated on the outskirts of the town.

Owasco, Cayuga Co. A. Lester has a brick and tile yard near the village. It is described under the head of drain tile.

Seneca Falls, Seneca Co. There is only one brick yard at this locality, that of F. Siegfried. His clay bed is about 12 feet thick, the upper seven feet being used for brick and the lower five feet for tile. Gravel underlies the clay and there is a covering of a few inches of soil. The machinery is run by horse power and the product is sold locally.

Geneva, Cayuga Co. Five firms manufacture brick in this locality. They are W. G. Dove, C. Bennett, Goodwin & Delamater, Mrs. Baldwin, The Torrey Park Land Co. The last-mentioned company began operations in the spring of 1892; their brick yard is some distance from the town.

Lyons, Wayne Co. The clay bed of F. Borck is about eight feet deep. The upper portion of the deposit is yellow, the rest is blue. Quicksand underlies the latter. Soft mud machines are used to mold the brick.

Canandaigua, Ontario Co. Burke & Mead's * works are about three quarters of a mile southwest of the station; their property adjoins the N. Y. C. R. R. track. The clay deposit, which covers several acres, is basin-shaped and has a known depth of at least 20 feet. It is of a blue color, weathered to red above, and on top of it is about a foot of peat. The clay after being dug in the fall is stored under shed until spring when it is molded by dry press machine. The brick are set directly in the kiln. Water smoking is done with wood and subsequent firing with oil. The blue clay burns buff and the other clay a red, so that by mixing the two a speckled brick is obtained. This firm has not been in operation very long.

The clay is quite siliceous, as the following analysis shows, and is similar in composition to the red terra cotta clay at Glens Falls. The composition is as follows:

Silica	62.23
Alumina	16.01
Peroxide of iron	6 96
Lime	1.24
Magnesia	2.21
Alkalies	5.08
	93.73

Rochester, Monroe Co. The Rochester Brick and Tile Manufacturing Co. is located on Monroe St. at the eastern end of the city. Adjoining this is the German Brick and Tile Co. The

* Since this report was written the firm name has been changed to "Empire Pressed Brick Co."

clay is reddish in color, four to five feet thick and underlain by hardpan. Lime pebbles occur in the lower portions. Molding sand is obtained from a neighboring esker.

The following is an analysis of this clay:

Silica	50.55
Alumina	15.46
Peroxide of iron	4.38
Lime	10.95
Magnesia	3.35
Alkalies	6.30
	90.99

Maplewood, Monroe Co. Robert Gay's yard lies along the N. Y. C. R. R. His clay is very similar to the preceding, but somewhat lighter colored. It is underlain by quicksand. This clay is used at Rochester to mix with Jersey fire clay in the manufacture of sewer pipe.

Clarkson, Monroe Co. M. Parker's brick plant is on northern side of the ridge road, at Clarkson, one mile north of Brockport. The clay is a shallow loamy deposit, and is owned by J. Sigler. The yard is an open one and both brick and drain tile are made. The molding sand is obtained from near the depot at Brockport. Product consumed locally.

Albion, Orleans Co. There is a small yard about a mile north of the town but nothing is known concerning it.

Lockport. The Lockport Brick Co.'s yard is at the northeast end of the town. The upper portion of the clay is being used. It is red in color, due to weathering. The clay is molded as taken from bank, the bricks are dried on pallets and burnt in scove kilns. Product used locally.

La Salle, Niagara Co. Tompkins & Smith run a small yard at this locality. Clay is very similar to that at Tonawanda. It is underlain by hardpan. Rolls are used to crush the lime pebbles in the clay before molding it. The product is marketed in the vicinity.

Tonawanda, Niagara Co. To the southeast of the town is the brick plant of Martin Riesterer. The clay is of a red color passing downward into blue and has a thickness of about five feet. Only common brick are manufactured, and the consumption is chiefly local. The burning is done with coal.

Lancaster, Erie Co. There are two yards here, the Buffalo Star Brick Co., near the Erie depot, and the Lancaster Brick Co. about two miles farther out. In the former's bank the clay is of a blue color below and weathered to red on top. Limestone pebbles are common in the clay, and for the purpose of separating them, the clay is stored in sheds to dry during the winter and passed through a barrel sieve before being used the following spring and summer. Plows are used to mine the clay, and coke and coal are used to burn the brick in stationary kilns with one fire per arch.

The bank of the Lancaster Brick Co. is similar to the one just mentioned showing:

8 feet red clay
1–2 feet blue clay
4 feet gray "
Rock

Limestone pebbles are also present and the clay after drying is screened. The bricks are burned in stationary kilns, coke being used for the water smoking and coal for the subsequent firing.

Buffalo, Erie Co. At East Buffalo is an extensive series of flats underlain by red clay which varies in depth from six to 20 feet. The following firms situated chiefly on Clinton St. use the clay for making brick: Chas. Berrick & Sons, Brush Bros., H. Dietschler & Son, F. Haake, L. Kirkover, Schusler & Co., G. W. Schmidt. Their combined production in 1892 was 65,000,000 brick. The clay is said to rest on the underlying rock.

The following is an analysis of it:

Silica	57.36
Alumina	16.20
Peroxide of iron	4.55
Lime	5.34
Magnesia	3.90
Alkalies	6.98
	94.33

Pebbles of limestone are scattered through it in places, and at a few spots several feet of yellow sand, suitable for molding or tempering, covers the clay. Below the limit of weathering the clay is blue and does not give as nice a colored brick as the red. The addition of tempering sand is not considered necessary. Soak pits and soft mud machines are used. All the yards dry their brick on pallets and burn them in stationary kilns, using coal fuel. One fire is made to burn one, two or three arches, according to the construction of the kiln. The burning takes nine days. Buffalo and its vicinity consume a large portion of the product.

Situated at the north end of Buffalo are the works of the Adams Brick & Terra Cotta Co. They have but recently commenced operations, and their chief product is brick and drain tile. The clay deposit is of the same general character as that of East Buffalo, having two to six feet of red clay on top, and below this blue, to a depth of 25 to 40 feet. Much of the blue can be used for coarser grades of pottery. A soft mud machine is used for common bricks, and a plunger stiff mud machine for tile and front brick.

They also have a dry press machine for making front brick. A. Steadman disintegrator is used in connection with this latter. The common brick are dried on pallets, the front brick in chambers. Burning is done in down-draft kilns and scove kilns. The latter are 40 by 15 feet, a smaller size than is customary. Five to six days is required for burning. This is a comparatively short period, and is partly due to size of kiln and partly to earthing. Parting sand from the iron foundry is used for molding.

Jewettville, Erie Co. Brush & Smith have recently started a brick yard at this locality. It is situated along the B. R. & P. R. R. track, about a quarter mile northwest of the station. The material used is Hamilton shale. It is of a grayish color and is easily worked. An opening has been made next to the yard and at the same level. A black, gritty shale crops out farther up on the hill, but this has not yet been used. The shale is loaded on cars and run into the machine shed, where it is crushed in a dry pan and then molded in a dry clay machine; drying is done in tunnels and burning in stationary up-draft.

Spring Brook, Erie Co. There are extensive deposits of clay and shale at Spring Brook, on the land of E. B. Northrup, but they are not being worked.

Evans, Erie Co. Wm. Bolton has a horse-power yard here. The clay is a local deposit, chiefly blue in color, and the lower portions are stratified. It is underlain by sand and hardpan. The yard is run in accordance with the local demand for brick.

Dnnkirk, Chautauqua Co. Wm. Hilton's yard is situated in the valley, about one mile west of the town. The clay deposit is about 20 feet thick, and is underlain by rock. The upper six feet are yellow and below this is blue. Stones are found scattered through the clay and have to be separated. The yellow clay gives a better colored brick, while the blue clay shrinks more, but is said to give a harder product. The blue clay obtained from the main clay bank has to be tempered with sand; it has not been much used up to the present, however. Rolls are used to crush the stones and the clay is tempered in a pug mill. Mr. Hilton uses a soft mud machine of his own manufacture. The brick are dried on pallets, and the burning, which takes eight to 11 days, is done in scove kilns. Coke is used for watersmoking and coal for subsequent firing. Most of the brick are used in the vicinity.

Jamestown, Chautauqua Co. Two yards are in operation four miles east of this locality. Those of C. A. Morley and M. J. Mecusker & Son. They are about four miles east of Jamestown. The two yards adjoin each other, and the deposit of clay worked by them is of considerable size. In addition to brick, Mecusker & Son make drain tile and hollow brick. The clay deposit is basin-shaped. A boring near the water-works showed:

Yellow sand	4	feet
Quicksand	6	inches
Yellow clay	5	feet
Blue clay	70	"
Hard pan	?	

Randolph, Cattaraugus Co. J. Turner owns a brick clay deposit at this town, but has ceased working it.

Hornellsville, Steuben Co. The Hornellsville Brick & Tile Co. has its works at the north end of the town and have only been running one season. They use a Devonian shale for making brick, and have turned their attention thus far to paving brick. The shale is mined about a mile from the works. It contains several thin layers of sandstone which can not be used. The process as followed here consists of grinding the shale in a dry pan, molding in stiff mud side cut machine and then repressing. Drying takes about 24 hours, and is done in chambers heated by a hot blast. Burning is done in down-draft cupola kilns and takes seven to 10 days. The paving brick are in extensive use in Elmira.

An analysis of this clay made by C. Richardson in the office of the engineering commissioners, at Washington, showed:

Silica	64.45
Alumina	17.77
Peroxide of iron	7.04
Lime	.58
Magnesia	1.85
Potash	2.52
Soda	1.95
Insol. in acid	88.74

W. H. Signor owns the other yard at Hornellsville. His clay bank is owned by M. Adsit. It is a shallow deposit, not over seven feet thick and underlain by quicksand, this latter allowing the inflow of water from the neighboring stream. The bricks are molded by an auger machine, dried in the sun and burnt in scove kilns, the burning occupying about seven days.

Alfred, Steuben Co. Rock Cut Clay Co. This is another yard using a shale, which is in the same geological horizon as that at Hornellsville. The works are on the Erie R. R. a few hundred yards south of the station. They have but recently commenced operations. A dry clay brick is being made. A peculiarity in the dry clay process as practised here, is that the clay is molded a trifle damp, it being thought that this will preserve the corners.

of the brick better. To dampen the ground clay it is discharged from the hopper into a long box of square cross section in which a worm screw revolves. The axis of the screw is hollow and has nipples which project into the tube three fourths inch so that if any of the steam which is injected to dampen the clay condenses it will not escape into the clay. The shale used is mined near the yard and hauled in carts to the dry pan.

Big Flats, Chemung Co. Near the village is an extensive bed of clay owned by J. R. Lowe. It underlies an area of about 50 acres. Excavations have been carried to a depth of 15 feet without reaching the bottom of the deposit. The clay is of a bluish gray color. Mr. Lowe manufactures drain tile only and most of these are for private use.

Horseheads, Chemung Co. R. G. Eisenhardt has a clay deposit 100 acres in extent, and having an average thickness of about 20 feet. There is a covering of about 10 inches of soil. Underlying the clay is sand and gravel. Both the yard and clay bed are situated on a high terrace.

Breesport, Chemung Co. About one and a half miles south of the town are the yards of the Empire State Brick Co., Locy Bros. and P. M. C. Townsend. The bank from which they obtain their clay lies along the eastern side of the valley. It is about one half mile long and has a height of 50 feet. It is chiefly of a bluish color and is stratified in places.

We give herewith the analysis of the clay:

Silica	52.48
Alumina	16.78
Peroxide of iron	6.79
Lime	6.63
Magnesia	3.59
Alkalies	7.16
	93.43

At Locy's yard where borings show the clay to be 30 feet thick, a red clay also occurs. Yellow sand overlies the clay at several points and can be used for molding. The yards of Locy Bros. and Townsend are open ones. At the Empire State Co.'s yard tunnel driers are used, the clay being mixed in a wet pan and then discharged through an opening in the floor of the latter on to an endless belt which carries it up to the molding machine. The brick are burnt in scove kilns.

Spencer, Tioga Co. W. H. Bostwick's yard is about one mile south of the village. The clay which is dug in a field adjoining the works, is a tough reddish material four to six feet thick. It is underlain by sand and gravel. The bricks are dried on pallets and burned in stationary up-draft kilns.

Newfield, Tompkins Co. F. C. Campbell's brick yard is about one mile north of the station along the Lehigh Valley Railroad. Adjoining the yard is the clay bank which rises to a height of about 50 feet. The clay is of a bluish color, the upper portions containing more sand.

An analysis of this clay showed

Silica	51.30
Alumina	12.21
Peroxide of iron	3.32
Lime	11.63
Magnesia	4.73
Alkalies	4.33
Organic matter	1.50
	89.02

Notwithstanding the high percentage of lime which gives the brick its cream color, a very strong product is produced. Covering the clay is several feet of yellowish stratified sand. Lime pebbles occur in the clay and a special apparatus is used to extract them. It consists of a large shallow circular pan in which a number of small wheels revolve on a shaft. The bottom of the pan is perforated. The clay is thus ground and passes through the bottom of the pan, while the stones are not crushed. The bricks are molded on stiff mud machines and repressed on a hand-power machine. Chamber dryers are used and burning done in down-draft kilns or scove kilns. The clay burns to a whitish brick; further burning at a higher heat gives a hard yellow brick, which is smaller, but sold for paving purposes. The following is a report of tests made on these brick in the laboratory at Cornell University: "All the bricks were tested on edge, as used for purpose of paving. The sides were dressed to parallel planes on an emery wheel, so as to get uniform bearing over every part. Single layers of thick paper were placed between the brick and the machine.

	No. 1.	No. 2.	No. 3.	No. 4.
Wt. of brk. in lbs.....	4.86	5.14	5.1	5.00
Dimensions	$7\frac{3}{4}\times3\frac{5}{8}\times2\frac{3}{16}$	$8\times3\frac{7}{8}\times2\frac{5}{16}$	$8\times4\times2\frac{2}{19}$	$7\frac{3}{4}\times3\frac{3}{4}\times2\frac{5}{16}$
Cubical contents......	61.35 cu. in.	70.7	74.	67.20
Area strained..... ...	16.95 sq. in.	18.5	18.5	17.92
Height of column.....	$3\frac{5}{8}$	$3\frac{7}{8}$	4.	$3\frac{3}{4}$
Total stress				
First crack...........	208000	84000	56000	48000
Splinters fly..........	250000	....	133000	108000
Crushed	254000	172000	180000	141200
Stress per square inch				
First crack...........	12230	4580	3508	2600
Splinters fly..........	14800	....	8362	6000
Crushed	14990	9300	10909	7880
Color of brick........	Lt. cream	Lt. cream	Lt. cream	Lt. cream
	Homogen. columnar.	Black vitrified.	Homogeneous.	Homogeneous.
Fracture				
Position of 1st fracture	One corner	Central ..	Central ..	At one end.
Direction of fracture ..	Vertical..	Diagonal.	Vertical..	Vertical.
Kind of brick	Repressed	Common.	Common .	Common T. of soil.
Sp. gr...............	2.18	2.01	1.91	2.07
Wt. per cu. ft........	136.9	125.6	118.8	129.0

The repressed brick shows great strength; more than sandstone and four fifths that of granite. The best results of pressed brick usually show 6000 to 10,000 pounds per square inch.

Homer, Cortland Co. The brick yard at this locality belongs to Horace Hall of Cortlandt. His clay bed underlies the flat lands near the village of Homer, and is from three to five feet thick. Quicksand underlies the clay and overlying it is a dark soil two to six inches thick. The clay is of a bluish color.

Binghamton, Broome Co. There are two yards at this town, viz.: Wells & Brigham and the Ogden Brick Co. Their clay beds are similar, both being shallow deposits six to eight feet thick, underlain by sand and gravel. The former of the two is a pallet yard, the other uses a tunnel dryer. Their product is consumed locally.

Brookfield, Madison Co. The Brookfield Brick Co. is the only firm manufacturing brick at this locality.

Oneonta, Otsego Co. Two firms are manufacturing brick at this locality, J. Denton & Son, and Crandall & Marble. The works of this latter firm is situated on the Albany and Susquehanna Railroad near the village of Oneonta. Two kinds of clay are used; one of them from a bank five to 20 feet in thickness, the other from a surface deposit three to five feet in depth. This latter bed is underlain by sand. The product is consumed by the local market.

Goshen, Orange Co. P. Hayne has a clay deposit 55 feet deep, underlain by black gravel. There is a slight stripping of sod. Both drain tile and brick are made from the clay.

Florida, Orange Co. W. H. Vernon's brick yard and clay deposit are situated in the valley near the town. The clay bed is 10 feet thick, blue in color and tough. The upper three feet are weathered to a red clay and make a better brick. The blue is of sufficient purity for making pottery. Underneath the clay is sand and hardpan.

Oakland Valley, Sullivan Co. Mr. O. B. Wheeler of Middletown, N. Y., has an extensive clay deposit here. There are about 125 acres of clay land lying between the Navesink River and the West Shore Railroad. The clay is found not only in the valley but is also exposed in numerous cuttings on the hillside. At the former spot a depth of 46 feet has been proven by boring and at the latter 17 feet. In many places the clay crops out; at others it is covered by one to three feet of loam. An analysis of the clay made by Prof. Draper of the New York City University shows:

Silica	37.50
Peroxide of iron and alumina	54.00
Magnesia and lime	3.50
Moisture	5.00
	100.00

It will be seen from the above that the clay runs high in iron, which would apparently make it fusible; however it is found to stand a high heat, according to a report made on it by Dr. N. L. Britton, of Columbia college. About one eighth sand had to be added to the clay for brick or tile ware. The sand, which is of a bright yellow color, is in banks along the Navesink River near the clay beds. This clay is also said to be available for paint. Oakland Valley is about 12 miles from Port Jervis.

New Paltz, Ulster Co. New Paltz Brick Co. Their brick yard is located on the outskirts of the town and near the Wallkill Valley Railroad, with which it is connected by a switch. The clay deposit is yellow, red and blue in color, and varies in depth from 15 to 50 feet. It underlies a tract of six acres. The separation of the clay in four to eight inch layers facilitates the digging of it. There is a thin stratum of overlying sand which has to be first stripped. Soft mud machines operated by horse power are used for molding.

Warwick, Orange Co. Although there are no brick yards in this vicinity, still extensive deposits of clay are undoubtedly present. A sample of clay from the Drowned Lands, lying along the Wallkill River in Orange Co., was analyzed in the laboratory of the N. J. Geol. Surv. with the following results:

Silicic acid in combination	28.9
Quartz	22.9
Silicic acid free	1.2
Titanic acid	0.5
Oxide of alumina	23.1
Peroxide of iron	7.2
Lime	0.7
Magnesia	2.6
Potash	4.1
Water	9.7
	100.9

The clay is said to exist in large quantity, forming a thick layer at this point in the alluvial district of the Drowned Lands, and underlying much of the black muck surface of this district.

The specimen sent was thoroughly air dried and was slate gray in color, and showed a little fine gritty sand. It contains too much oxide of iron and potash for any refractory or fine materials. Washing out the fine sand might enable it to be used in some styles of paper facing. It is most interesting as the basis of a valuable, enduring and fertile soil, and if properly drained it would be unsurpassed for tillage or pasturage; and as such it furnishes another argument for the drainage of this tract of drowned lands.

Brick yards

East Williston, Queens Co. W. & J. Post have two yards at this locality. Their clay pit is in a field some 5(0 feet west of the yard on the land of H. M. Willis. The clay has been excavated to a depth of about 15 feet. It is chiefly a bluish clay and can be easily dug. The clay is extremely siliceous as the following analysis shows, but the percentage of lime, magnesia and iron is low:

Silica	69.73
Alumina	16.42
Peroxide of iron	2.58
Lime	1.66
Magnesia	0.69
Alkalies	6.27
	97.35

Carts are used to haul it to the yard. Pumps have to be used to keep out the water which comes up through the underlying sand. The clay is tempered without the addition of sand in ring pits run by horse power. The bricks are dried either on the open yard or on pallets and burnt in scove kilns with wood. They are shipped on the L. I. R. R., which passes by the yard.

Oyster Bay, Queens Co. An extensive deposit of clay s being worked on Center Island, in Oyster Bay, by Dunn, Dolan & Co. They manufacture common brick. The bank adjoins the yard, and the clay, which is in thin layers, separated by fine laminæ of sand, is of a bluish color in the lower portions of the deposit and brownish above. The brown clay is more sandy, and there are six or eight feet of it. Over the brown is a less gritty and tougher clay, which runs nearly to the surface. The total height of the bank is about 25 feet, but the front is broken up into several wide benches. Springs issue from several sandy spots in the blue clay. In making the brick the different grades of clay are mixed together, and a certain proportion of sand, and also some coal dust added. Ring pits are used for tempering. The brick are dried on an open yard and burned in scove kilns. They settle eight to ten inches in burning.

West Neck, Suffolk Co. The clay at this locality rises in a bank to a height of over 100 feet. There are three yards but only two of them are active. Both are along the east shore of Cold Spring Harbor. The most southern one belongs to Dr. Jones. The clay in this bank is of a red and brown color, there being about 25 feet of the latter at the bottom and above it is the red which is of a more sandy nature. There is an upper covering of 15 or 20 feet of yellow gravel and sand, which after screening is used for tempering. This latter is done in ring pits. All the machinery is run by horse power. The bricks are dried on an open yard and burnt in scove kilns. The product is loaded on schooners and sent to New England and New York City. The lower brown clay has been used for coarser grades of pottery, and its composition is given below:

Silica	61.01
Alumina	19.23
Peroxide of iron	5.43
Lime	0.96
Magnesia	1.88
Alkalies	4.60
	93.11

Adjoining Jones' yard is that of Crossman Brothers. It is leased by Wm. Hammond. The clay in his bank is similar to that of Jones'. The yard is also an open one, steam power being used for running the machines and the tempering is done in rectangular pits.

Fresh Pond, Suffolk Co. This locality is about four miles east of Northport on the north shore of the island. There are two yards, about a mile apart. The most eastern one belongs to G. Longbottom. It is situated some 500 feet from the shore and about 50 feet above Long Island Sound. The clay bank is about 200 feet west of the yard and at the same level. A section in the summer of 1892 showed

Sand and gravel	4 feet
Red sandy clay	8 "
Red clay	6 "

The overlying sand and gravel is stratified and dips east. It is screened for tempering. Carts are used for hauling the clay to the machines. Molding sand is obtained from Hackensack. The clay and sand are shoveled directly into a vertical pug mill, from which they pass to the molding machine. Coal dust is also added in tempering. The product is loaded on cars. run down to schooners at the dock and shipped to Connecticut. Adjoining Longbottom's yard is the inactive plant of Provost.

About a mile west of Longbottom's and situated along the shore is the yard of R. Sammis. His land extends 2000 feet along the shore and the whole of that distance the clay crops out from underneath the sands and gravels. The lower portion of the clay is a bluish red, the upper, red in color and somewhat more gritty. The clay is rather tough but not so dry as Longbottom's. The carting is done along the shore, and the overlying sands which are highly stained with iron are used for tempering. A cutting has been made in the cliff just east of the yard for tempering sand. The bricks are burnt with wood.

Greenport, Suffolk Co. The works of the Long Island Brick Co. are some two miles west of Greenport on the shore of Pike's cove, opposite Shelter Island. Their clay is a glacial deposit of red color, rather tough and contains numerous stones. Mr. Sage, the owner, claims a depth of 64 feet for the deposit in places. Several openings have been made in it, one of them 24 feet deep. It is said to thin out to the east of the yard, where it is found to be underlain by hardpan. It is undermined, the working face being about eight feet high and the clay is hauled to the machines in carts. It is tempered in soak pits, with the addition of one third its volume of sand. Hematite is also added in order to produce a good color in burning. The bricks are dried on pallets or on open yards. They are burnt in scove kilns, loaded on schooners and shipped largely to Connecticut. Many also go to points on Long Island.

Southold, Suffolk Co. Two miles east of the village is C. L. Sanford's yard. The clay is similar to Sage's. Mr. Sanford has about 29 acres of clay. It is worked chiefly by undermining, the working face being about 10 feet in height. In places gravel is scattered through it, but in others it is very free from stones. Borings have shown a depth of 65 feet of clay. The clay and coal dust are put into rectangular soak pits and from these are shoveled into the machine, the tempering sand not being added until then. The drying is done on pallets, whose total capacity is 154,000. Most of the product goes to Connecticut by schooner.

Below is given an analysis of the clay:

Silica	59.05
Alumina	22.11
Peroxide of iron	6.54
Lime	2.19
Magnesia	2.64
Alkalies	6.22
	98.75

Fisher Island, Suffolk Co. The extensive deposit of clay at this locality is worked by the Fisher Island Brick Manufacturing Co., whose plant has a capacity of about 15,000,000. The yards are situated on the north shore of the island between Clay Point and Hawk's Neck Point. About 1500 feet from the shore is the bank of clay, which is of a reddish color and thinly stratified, the layers of clay being separated by very thin ones of sand. In most places, however, the mass has been disturbed by glacial movements. There is a stripping of 20 or 30 feet of a whitish sand, the finer portions of which can be used for tempering. Their present working face is 30 feet above tide at its base, and the clay, it is claimed, has a depth of 40 feet at least below this, as shown by borings. A sample from the upper half of the bank showed the following composition:

Silica	53.77
Alumina	20.49
Peroxide of iron	9.23
Magnesia	4.22
Lime	2.04
Alkalies	9 60
	99.35

The clay, which is said to improve with the depth, is worked by undermining. It is then loaded on carts and hauled about 200 feet to a platform, underneath which cars are run to receive the clay and sand. These cars in trains of three or four are drawn to the yard by four horses, the grade being slightly descending. Tempering is done in large rectangular soak pits, and open yards are used for drying the brick, or it is done on pallets. A small quantity of hematite is added to molding sand. The bricks are burnt in scove kilns with wood. Most of the product goes to Connecticut and Rhode Island.

West Deer Park, Suffolk co. About a quarter of a mile north of the station are the works of the Wyandance Brick and Terra Cotta Co. In appearance their clay bank is unique, for there is hardly another in this State which exhibits such a variety of colors. Two openings have been made for getting the clay. The main one shows a face about 12 feet high chiefly of black clay, the lower portion of this latter having thin layers of a grayish sand. Over the black is several feet of red and yellow clay. The other opening lies to the south of the first one, the clay being mottled, and shows various shades of red and yellow. Scattered through it are lenticular streaks of red and yellow sand. This second pit has a face about 20 feet high. In some places the stripping is 20 feet of sand and gravel, while in others it is not over three feet. A track is laid from clay shed to face of bank, the clay is loaded on cars and drawn by horses to the foot of an incline, up which it is drawn by cable into the clay shed and dumped.

A loam obtained near the yard is added to the clay to temper it and also to help in producing a brick of good red color. Hematite is also added to the clay while it is being pugged. The clay and loam are fed between a pair of rolls to crush any stones that may be present, and from these it passes to an inclined pug mill, where the water and hematite are added. The wet mixture goes through a second pair of rolls of smaller opening than the first, and is then carried by endless belt to the molding machine. A soft mud machine is used for molding the common brick, and for the front brick and hollow brick an auger machine is used. The molding sand is dried on brick floors 60 feet long, under which there is a series of flues, the heat being obtained from a coal fire at one end. Steam heated tunnels are used to dry the bricks. This takes about 36 hours. Exhaust fans are used to draw off the air. The burning, which takes seven to eight days, is done in Wingard and similar types of kilns, hard and soft coal being the fuel used Hollow brick are placed round the sides of the kiln, and front brick in a rectangular mass in the center. The black clay alone burns to a white brick. The product is shipped to points on the Long Island Railroad.

The light color of the brick made from the black clay is due to the absence of iron, and the black color of the clay is caused by the organic matter. The following is an analysis of it:

Silica	59.83
Alumina	24.45
Oxide of iron	trace.
Lime	0.23
Magnesia	0.59
Alkalies	8.75
Organic matter	4.28
	98.13

Farmingdale, Suffolk Co.— There is only one yard in operation at this town, that of M. Meyers. The inactive one belongs to Stewart. Meyers' yard lies about one mile north of the village, along the southern edge of the moraine, on a branch track of the railroad. The clay pit is some 300 feet from the yard, and several feet lower in level. The clay is chiefly a reddish yellow and very plastic, but tough in places. The lower portions are quite free from sand. Mr. Meyers claims a thickness of at least 25 feet of clay in addition to the 10 feet exposed. At the entrance to the pit the clay is seen to be underlain by a bluish white micaceous sand, which is cross bedded and dips under the clay at a very steep angle. Hauling the clay is done in carts, and tempering in ring pits with the addition of sand and coal dust. Soft mud machines are used, and the drying is done on palettes. The pallet racks have sectional roofs which are hinged and can be lifted by a lever for the purpose of admitting more sunlight. The bricks are burnt with wood in clamps, and the product is shipped to various points on Long Island.

Below is given an analysis of the lower clay:

Silica	62.39
Alumina	23.60
Oxide of iron	3.39
Lime	0.70
Magnesia	0.10
Alkalies	5.89
	96.07

The low percentage of lime and magnesia would make this clay available for a higher grade of clay product, such as terra-cotta or pottery, but the high percentage of alkalies is somewhat objectionable.

Staten Island has two yards where common brick are manufactured. One of them belongs to McCabe Bros. at Green Ridge. Their deposit is a stony glacial clay of a red color, and lies to the northwest of the yard. Small boulders are scattered sparingly through it, and the upper portion is somewhat loamy. Borings have penetrated the clay to a depth of 25 feet and stratification appears with the depth. No sand or coal are added to the clay in tempering. It is first passed through rolls two feet in diameter, the one making 60 the other 600 revolutions a minute, and having an opening of half an inch. This partially breaks up the stones. The crushed material falls on a belt and is carried up to a pug mill where the water is added before it passes to the machine. Drying the bricks is done either in the sun or in tunnels. In the latter the bricks shrink more. The tunnels are heated by coal fires. Wood is used for burning, and the kiln settles about four inches. The products go to New York city and the vicinity.

Wood & Keenan's yard is situated on the shore of Arthur's Kill, opposite Carteret. It is an open yard of greater capacity than its output. The clay is of the same character as McCabe's. It is tough and has to be worked with picks, and the pit is about 10 feet deep. Ring pits are used for tempering and the bricks are burnt with wood. New York city and Newark are the chief markets.

The New York Anderson Pressed Brick Co. has its works at Kreischerville adjoining Kreischer's fire brick factory. Various styles of ornamental and pressed brick are made. The company declined to give any information concerning its works. Their clay is obtained from a pit near Green Ridge. It is of a black and gray color. The pit is worked in benches, the clay being hoisted in buckets and loaded on cars which are run down to the works.

Drain-tile

A clay that is capable of making good building brick will usually make a good drain-tile. That is to say, a plastic clay and one that will burn to a tough product. Contrary to bricks tile may be somewhat porous in their character. It is of importance that the clay should be thoroughly tempered before molding. This latter is in most instances done with some form of stiff mud machine, the clay being forced out through a die of desired pattern, and the cylinder of clay as it issues from the machine is cut up into desired lengths. Drying is sometimes done on pallets such as are used for common brick, or it may be performed under enclosed sheds. The drain-tile should be thoroughly dry before being set in the kiln. Burning is done in ordinary scove kilns, clamps or down draft kilns. The smaller tile are set in the lower portions of the kiln and around the sides, while the larger ones are set in the center. Very often when several sizes are burned at the same time they are nested, the smaller ones being set within the larger.

The styles of drain-tile made are as follows:

Horseshoe-tile, having cross section shape of a horseshoe.

Sole-tile, cylindrical with a flat base.

Pipe tile, plain cylinder.

Flange tile, like preceding but with flange at one end.

It is considered by many that the best form of tile is the sole-tile with an egg shaped section having the smallest diameter across the bottom thereby keeping the water collected in the smallest possible space and securing a good current to carry off the sediment. The horseshoe-tile is objected to as it is liable to break from the lateral pressure of the soil. In Westchester county glazed sewer pipe are generally used for draining the soil, but it is doubtful if there is any special advantage in their use to warrant the use of this more expensive material. In sizes the tiles range from two to 12 inches in diameter and one to two feet in length. They are laid at varying distances below the surface according to depth the ground is to be drained. A drain is said to draw water from the soil on either side for a distance of from 30 to 100 feet, according to depth of drain and character of soil.

The following firms in this State are making drain tile:

Albany, Albany Co. The New York State Drain-tile Works are large producers. The drain-tile are made in numerous sizes. Hudson river clay is used. Front brick are manufactured.

Chittenango, Madison Co. Central N. Y. Drain Tile and Brick Co. Only tile manufactured at present. The plant is located about one mile from the N. Y. C. R. R. and three-quarters of a mile from the W. S. R. R., and a few rods south of the Erie canal. The clay bed lies at the foot of the hill. There is no stripping, and sand underlies the clay. The tiles are made with horse power machinery, dried under sheds and burned in down draft kilns.

Allen's Hill, Ontario Co. B. G. Abbey's are the only works here. Few brick have been manufactured for several years, as drain-tile are the chief production. After stripping a few inches of soil the clay is mixed from top to bottom of the bank for use. The bank is 20 to 25 feet in height, and the clay is blue in color, becoming reddish gray near the surface. A small amount of coal dust is added to the clay. The tiles are made in various sizes.

East Bethany, Genesee Co. B. F. Peck manufactures brick and drain-tile. The clay deposit worked is a portion of a strip one to two miles in width and extending east and west across Genesee Co., a few miles north of its southern boundary. The clay is usually covered with a thin layer of clayey loam. Mr. Peck has about 50 acres of clay of sufficient quality for making bricks and tile. It averages about four feet in thickness. The upper portion when dry is nearly white, but becomes blue with the depth, and below four feet is very much so. It is also tough, coming up in hard flakes of a stony nature. Below this it passes into the shale, hard enough to resist the pick but crumbling on exposure This last mentioned rock is said to contain calcareous layers, varying in thickness from one to six inches. About 250,000 feet of drain-tile are annually made for local use. The clay burns to a nice red in the drain-tile, deepening to brown when burned harder. The machinery is run by steam power.

Owasco, Cayuga Co. A. Lester's clay bank and brick yard are located in the north end of Owasco village on the bank of Owasco Creek. The clay deposit has an area of about nine acres and is from 10 to 15 feet in thickness. Gravel overlies the clay in places. Soak pits are used for tempering, and a Penfield plunger machine for molding. The tiles are dried in an open shed and burnt in scove kilns. Drain-tile is the chief production but a few bricks are made. The color of the product is white.

Other manufacturers of drain-tile and whose works have been already mentioned in the detailed account of brick yards, are:

M. H. Bender, Albany
William Davenport, Fonda
C. Stephens, South Bay
Rochester Brick and Tile Manufacturing Co., Rochester
A. Mosell, Lockport
Adams Brick and Terra Cotta Co , Buffalo
James Sigler, Clarkson
J. E. Mecusker & Son, Jamestown
B. G. Abbey, Allen's Hill
J. B. Lowe, Big Flats
P. Hayne, Goshen

Fire Brick.

A fireclay to be refractory should not contain over four per cent. of impurities Fireclays may or may not be plastic. The latter are represented by the flint clays, but these do not occur in New York. Fireclays vary in color, being black, gray, red, green, blue or white. Many are soft and can be dug with pick and shovel while others are shale like in their nature and have to be blasted. Fireware must be able to withstand great and sudden changes of temperature. It should resist intense heat without shrinkage or fusion, and it should also resist corrosion of substances in a state of fusion. Coarsegrained ware resists temperature while finegrained ware can best withstand corrosion. If the fireclay is to be used for saggers it must make a product which will not crack when subjected to repeated alternations of heat and cold. The porosity of a fire brick is often caused by

Molding-room of Gas-retort Works.

coarse sand and may be remedied by the addition while preparing of ground burnt clay, or "cement clay" as it is called. Ground quartz may be added if the material contains an excess of alumina. Weathering the clay is of the utmost importance and is often carried on for several months. It breaks up the clay and tends to lessen shrinkage in burning. The clay is next tempered as a further step toward the production of a homogeneous brick. It is first passed between rollers to break it up and is further cut up in a ring pit together with sand. The material is next soaked in a pit with water. Several grades of clay are usually mixed in certain proportions in this pit, the amounts added being the secret of the manufacturer. After soaking for a few hours the material is transferred to a pug mill for further tempering. The clay is now ready for molding. This is done by hand in wooden molds.

The chief object is to bring the mass of tempered clay into a convenient and approximately rectangular form before repressing it. Very little pressure is exerted in this handmolding. The bricks thus molded are spread out on a drying floor of brick, heated by flues passing underneath it. These brick are next repressed and further dried in tunnels before setting them in the kiln. The kilns are circular, having a height of 15 feet, and a diameter of 20 to 30 feet. Burning takes five to six days. The kiln has two openings, and while the burned brick are being taken out of one door the green brick are being carried in through the other one and set up for burning. The gas retorts are made by hand in sectional molds and burnt in the same kiln with the brick.

Although there are several fire brick factories in the state all of them with one exception obtain their clay from New Jersey. The New Jersey fire clays which are of Cretaceous age extend in a belt across New Jersey and over onto Staten Island, and it is at this latter locality that the refractory clays of New York state occur. The fire brick factory of William Kreischer's Sons is located on the southwestern shore of Staten Island at Kreischerville. They manufacture fire brick, cupola brick and gas retorts. Most of the clay used is obtained from Staten Island, and the rest from New Jersey. Four openings have been made in the vicinity of Kreischerville. The deepest one is opposite Kilmeyer's Hotel. The clay in this pit is used for fire brick. It is tough, of a whitish color and mottled with yellow. Its thickness is not very great and there is 15 or 20 feet of stripping. Southwest of this opening is another pit, but in this the clay is of a more sandy nature and is overlain by about four feet of sand. The clay is bluish in color and is chiefly used for mortar. A third opening has been made near the shore and is known as the "Wier Bank." The material obtained from it is a stoneware clay. In this pit the clay as at present exposed is about 10 feet thick, and is overlain by horizontally stratified fine sand.

Sewer Pipes

Sewer pipes are made from a clay that will vitrify. There are several works in this state which import their clay from New Jersey. The two works described below use native clay.

Angola. John Lyth & Sons. The works are situated along the Lake Shore R. R. some few hundred feet southwest of the station. The material used is a Hamilton shale, of a gray color and containing streaks of bituminous matter. It is mined about 200 feet east of the factory, and a small blast serves to loosen a large quantity of it. Cars drawn by horses convey the shale to

Press for sewer pipe, tile and hollow brick

the dry pans where it is ground to a fine powder and is then further ground with the addition of water in a wet pan. The tempered material is then carried in a bucket ladder to the upper floor of the building where it is fed into the sewer pipe press. This consists of two vertical cylinders separated by iron frames. The upper cylinder contains the steam piston and is about 30 inches in diameter. The lower one is the clay cylinder. The area of the steam cylinder is usually several times greater than the area of the clay cylinder. The clay piston is a continuation of the steam one, and within the clay cylinder at its lower end is the bell which regulates the internal size of the pipe. Sockets are made by means of a core attached to the end of the die, the bending of the pipe being caused by the core forcing the clay out through the die faster on one side than the other. Underneath the end of the cylinder is a counterpoised table which receives the pipe as it issues. When a sufficient length of pipe has issued the press is stopped and the pipe cut off at the mouth of the die. It is then removed from the table, which, relieved from the weight, ascends to receive another length of pipe. Y joints are made by hand, a hole being cut in the side of one piece of pipe and the end of another trimmed to fit over it, the joint being closed by means of wet clay.

After the pipes are molded they are set on the drying floors until thoroughly dry. Burning is done in circular down draft kilns, such as those described in the manufacture of brick. It takes five to eight days. The glaze to sewer pipe is made by adding salt to the fires toward the end of the burning and when the fires are hottest. The salt is thrown into the fireplace and by the heat is broken up into hydrochloric acid and oxide of sodium, and this latter fluxes with the silica in the pipe forming a vitreous coating known as the "salt-glaze." When sewer pipes are made of pipe clay, they are often coated with "Albany Slip," a calcareous clay obtained in the Hudson River Valley. The material composing this fuses at a lower temperature than the fire clay and gives the desired glaze. The composition of this material published in Vol. VII of Ohio Geol. Surv. 1893 is:

Silica	60.59
Alumina	12.46
Oxide of iron	5.79
Lime	6.84
Magnesia	3.28
Alkalies	4.39
Water	5.82
	99.17

Another analysis given in the Clay-worker of December, 1894:

Silica	58.47
Alumina	16.90
Lime	6.19
Magnesia	Tr.

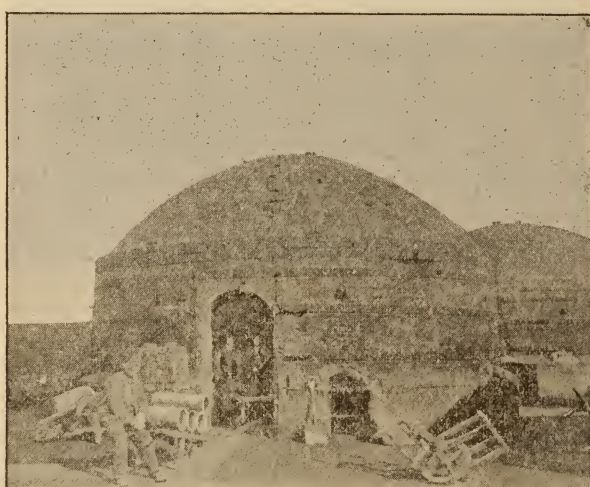
Oxide of iron	3.72
Alkalies	8.85
Water	7.49
	101.62

We give here an analysis of the shale at Lyth's yards:

Silica	65.15
Alumina	15.29
Oxide of iron	6.16
Lime	3.50
Magnesia	1.57
Alkalies	5.71
	97.38

J. Lyth & Son also manufacture hollow brick and terra cotta lumber.

Rochester. Otis & Gorsline use a mixture of New Jersey fire clay and a quarternary clay obtained from Chili near Roches-



Circular down-draft kiln for tiles, etc.

ter. The method of manufacture followed by them is very similar to that at Angola. Rectangular kilns are however used for burning, which takes about one week.

Sewer pipe are also manufactured at Albany and Troy but from New Jersey clays.

Flower Pots

There is a deposit of mottled blue clay on Long Island between Southold and Greenport, which is used for manufacturing flower pots at the latter place. The clay at Oakland Valley on the land of O. B. Wheeler has also been used for this purpose. (*See* detailed account of brick yards.)

Hollow Brick and Terra Cotta Lumber

A clay that will make a good building brick or drain-tile can generally be used for the manufacture of hollow brick. The same sort of machine is used in their manufacture as is used for drain-tile, a different shape of die being of course needed. The brick are made in various sizes and of rectangular cross section. They are manufactured by the following firms:

Wyandance Brick and Terra Cotta Co., Wyandance, Long Island,

J. E. Mecusker & Son, Jamestown,

Adams Brick and Terra Cotta Co., Buffalo,

Onondaga Vitrified Brick Co., Warners,

John Lyth & Sons, Angola.

Terra cotta lumber differs from the above in having about fifty per cent. sawdust added to the clay. This is burned out in the kiln giving a porous product. It is used for partitions and nails can be driven into it. Only two firms in New York are making it, viz. The Onondaga Vitrified Co. and John Lyth & Sons.

Stoneware — Clay

Deposits of clay suitable for the manufacture of stoneware are found on Staten Island and Long Island. Those of S. I. are located at Kreischerville. The L. I. ones are found at Elm Point on Great Neck, Glen Cove and Little Neck near Northport. They are shipped to Poughkeepsie, Rochester, Utica and Ellenville in N. Y.; also at New Haven, Stamford, Norwalk and Hartford, Conn; Newark, N. J.; and Pittston, Pa.

The Long Island clay is usually mixed with the Jersey clay in proportion of one to three. These latter clays, if used alone for the manufacture of stoneware, are apt to crack in burning, due to the unequal shrinkage and warping, while the Long Island clays, being of a more sandy nature, prevent this. The clays of Long Island when used alone for the manufacture of stoneware give a creamy colored product, if burnt medium hard, but if burnt hard they produce a ware of a light blue or drab color. The sandy nature of the Long Island clays makes it difficult to turn them on the potter's wheel.

Elm Point. About one and a half miles northwest of Great Neck on Elm Point is a deposit of dark gray clay, worked by G. W. Mahan. The clay is overlain by about 20 feet of yellow gravel and drift. Lignite occurs abundantly in the clay, and nodules of pyrite are occasionally found. Several pits have been sunk in the clay, one of them 30 feet deep and 10 feet in diameter. Much of the clay is used by the New York Architectural Terra Cotta Co., at Ravenswood, Long Island, and some is also shipped to Boston where it is used for the manufacture of clay pipes.

Glen Cove. Carpenter Bros. have a bed of stoneware clay, fire sand and kaolin on the east side of Hempstead Harbor. The clay is of a white and pink color, the layers being four inches to one foot thick and interstratified with layers of quartz pebbles. Nearer the shore this dips under a bed of the clay free from pebbles. Associated with the clay is a deposit of kaolin and fire sand The clay burns a cream color. The quartz pebbles which contain small cracks crumble easily and seem to have been subjected to the action of some alkaline solution.* When ground they can be used for the finest grades of pottery and stoneware. The fire sand and kaolin are screened and sold according to grade.

This clay is used chiefly for the manufacture of stoneware, it being shipped to various cities in Connecticut and New York states. It is also used by Perkins and Pit of Stamford, Conn., for the manufacture of stove linings. In this latter case about 15 per cent. of it is mixed with New Jersey clay. Under ordinary fire this clay burns to a light color, but with a hard fire it is said to blacken. The fire sand found associated with this clay bears a most excellent reputation as regards its refractory qualities.

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* F. J. H. Merrill. Geology of Long Island, Ann. N. Y. Acad. Sci., 1884.

Northport. The Northport Clay and Fire-sand Co. has an extensive series of pits on Little Neck near Northport. Both fire sand and clay are obtained. The clay bank has a height of about 40 feet and the clay is of a bluish black and yellowish white color. The darker clay is the lower, and contains much carbonaceous matter. The deposit is stratified, the layers of clay being separated by thin sheets of a rather coarse sand. It is shipped chiefly to New England.

The following are analyses of New York stoneware clays and Kaolin:

	Elm Point.	Glen Cove.	Little Neck.	Kreischerville.	Kaolin Kreischerville.
Silica	62.06	70.45	62.66	64.26	82.51
Alumina	18.09	21.74	18.09	24.76	11.57
Oxide of iron	5.40	1.72	0.97	0.83	0.63
Lime	1.05	0.24	0.79	0.73	0.29
Magnesia	Trace.	0.30	......	Trace.	0.78
Alkalies	6.11	5.00	2.23	2.35	2.66
	92.71	99.45	84.74	92.93	98.44

The following are analyses of Long Island stoneware clays made by C. H. Joüet (School of Mines Quart. Jan. 1895).

	White clay from Northport	Black clay from Northport	White clay from Sea Cliff.
Silica	68.34	58.84	62.35
Alumina	19.89	23.40	23.14
Ferrous oxide	.90	1.18	1.12
Lime	.35	......	....
Magnesia	tr.	......	....
Carbonic acid	......	.....	....
Sulphuric acid	......	1.03	1.09
Potash	3.55	5.04	3.17
Soda	.84	.34	1.76
Combined water	6.03	9.20	6.77
	99.90	99.03	99.40

Stoneware

The following description of the manufacture of stoneware and earthenware is quoted from vol. V of the Geological survey of Ohio.

"Stoneware is the product of an unmixed, natural clay, burnt at high enough heat to oblige the impurities to combine with the dry silica and thus cause an incipient vitrification or fretting without loss of shape. It should be impermeable to water without any glazing on it, but it frequently fails in this point. The color is bluish gray due to combined iron."

"Earthenware is a product of very similar clays burnt a little to vitrify the body or combine the iron. It is of a yellow or red color from the free iron and is porous unless glazed."

The successive steps in the manufacture of stoneware are

1. Wetting the clay.
2. Grinding.
3. Wedging.
4. Turning.
5. Drying.
6. Slipping.
7. Burning.
8. Sorting the product.

The wetting or soaking of the clay is usually done at small works where the grinding machines are operated by horse power. Several kinds of grinders are used for the clay, the simplest one being the pug mill. A machine often used at many potteries consists "of a square frame pivoted on an upright beam which runs through the point of crossing of the diagonals. On the projecting ends of this frame are fastened cart wheels which work in a circular trough beneath. The whole frame revolves by the motion of a large cog wheel above, which receives its power from the horse or engine. The machine is slowed up by weighting the corners of the frame. The wheels in their revolutions manage to cut the clay to pieces quite effectually." This machine has a capacity for grinding from 1,200 to 1,500 pounds at a charge, taking two hours for the operation. Such a charge makes from 180 to 190 gallons of ware. The ground clay is rolled into masses and "wet blanketed" to keep until used. At some factories steam tracer mills are used for doing the grinding. They can grind about 1,200 pounds in 60 to 100 minutes, but eliminate blebs or substances in the clay and particles of foreign matter. The balls of clay are successively divided by a wire into two parts, these halves being each time struck together in such a manner that the two pieces unite different faces. The clay is next turned to the required shape. Crocks and fruit jars are the simplest kinds of product made and after that come jugs, milk-pans and churns. At small works the ware is often laid on flat boards in the sun to dry. At the larger works drying is usually done in closets or rooms heated by a series of steam pipes.

The dry ware now has to be slipped, that is to say, it is covered with a wash consisting of a very fine ground clay suspended in water. By this means the ware becomes covered with a film of clay. These slip clays vitrify easily to a black glaze which covers the ware. The slip commonly used is obtained from the Hudson river clays at Albany and a partial analysis of it is as follows:

Sesquioxide of iron	1.43
Potash	3.17
Soda	.74
	5.34

There are also present large percentages of carbonates of lime and magnesia, which add to the fusibility of the clay. For other analyses see sewerpipe.

A difficulty experienced in the use of slip glazes is the tendency to blister. By many potters this is considered to be due to hasty burning, and it is thought by them that it may be overcome by heating the ware at a low red heat for several hours before raising the temperature. After this a rapid raising of the heat is harmless. The kilns in which the ware is burned vary considerably in shape and size. At small works they are often small square structures. "The fireholes are left above ground and communicate through the various arches and masonry which separate the floor of the chamber above. This floor is full of holes, through which the fire passes and the gases escape through vents in the roof which is arched." Such a chamber is usually about eight feet in diameter and seven feet high. Firing is commenced at night and proceeds slowly at first. By morning the ware is fairly dry and the heat is then continued from 20 to 30 hours, according to conditions. The slip is usually applied only on the inside of stonewares, the outside being glazed with salt.

"The salt is thrown in the fire when heat is highest, the vapors are seized by the clay and the soda silicate forms over the surface of the ware. The heat required to do this is the culminating of the point of burning." Either coal or wood fuel is used. Many of the larger works use down-draft rectangular kilns for burning their wares. At Akron, Ohio, these are 32 by 16 feet and 12 feet high. The fireplaces are at each end and are six in number. The ware is set through lateral doors. Burning requires about 70 hours. It is considered that the cooling of a kiln should occupy as much time as the burning.

A common trouble, in addition to blistering of the slip, is the pitting of the ware in spots, due to iron. "It is a peculiarity of stoneware clay that while it needs iron to give it color by far the largest part of the iron present is collected in grains and has no favorable effect on the color. These grains, if the heat is high enough to vitrify them, pimple on the surface or break out in rough spots, which are black and ill-looking from the silicate of iron formed. If the heat is too low to vitrify the clay, the slow change in its volume by heat causes a scale to separate from the ware, causing a light colored cavity with the piece of the oxide of iron at the bottom."

"Failure of the ware to glaze is also considered due to irregular burning, but another cause is thought to act at times."

In many of the clays there is sulphate of lime present in the form of fine crystals of a whitish color. When exposed to the vapors of salt at a high heat these change to a chloride of lime, leaving the soda as a sulphate, which will either not displace the silica through combination or will not do it at a temperature which the ware will stand without losing shape, and therefore no glaze is produced.

"Stoneware should exhibit on fracture a blue uniform tint of a somewhat vitrified appearance. This varies very often, however, with the clay."

Terra Cotta

There are four companies in New York who are engaged in the manufacture of this product, viz.: the Celadon Terra Cotta Co., the Corning Brick Co., the New York Anderson Brick Co., the Glens Falls Terra Cotta Co., and the New York Architectural Terra Cotta Co. The first-mentioned company is gradually giving up the manufacture of terra cotta and turning its entire attention to roofing-tile.

The Corning Brick Co. makes its terra cotta from a Hamilton shale. The New York Anderson Brick Co. makes its ware from the Cretaceous stoneware clays of Staten Island; among the largest Terra Cotta works in the state are those of the Glens Falls Terra Cotta Co.; the clay used by them is a portion of the Hudson estuary deposit, it being of a bluish gray color with the upper portions weathered to red. We give herewith a partial analysis of their two clays.

Bluish-gray.		Red.
48.35	Silica	57.46
11.33	Alumina	21.15
4.02	Oxide of Iron	5.52
15.38	Lime	3.65
3.17	Magnesia	1.50
1.18	Organic Matter	.....
6.05	Alkalies	4.72
89.48		94.00

The high percentage of lime in the bluish-gray clay enables them, by the use of it alone, to produce a light-colored ware, while a mixture of the two clays gives a speckled product, and the red clay alone, a red product.

New York Architectural Terra Cotta Company. The works of this company are situated at Ravenswood, Long Island city. They use clays from both Long Island and New Jersey for the manufacture of terra cotta. The Long Island clay is obtained from Great Neck, L. I. It produces a ware of light yellow color. Coal was formerly used for burning the ware, but oil is now used instead. It is found that 160 gallons of oil is equal to one ton of coal. The advantage of oil is a saving of labor and time, and it is also more convenient and cleaner to use.

The Manufacture of Terra Cotta

In order to produce a good quality of terra cotta, a clay should not whitewash; it should not shrink over one inch per ft. in burning, and should do so evenly; the shrinkage can be regulated by the addition of "grog," (pulverized brick, or sand). Clays which are too sandy can be washed; this is done by dumping them into a circular trough filled with water, in which there revolve paddles fastened to a vertical axis in the center of the trough; from the trough, launders run to settling vats.

The motion of the paddles drives the water with the suspended particles of clay into the launder, down which it flows to the vats, while the coarse sand remains behind in the trough; after the clay has settled in the vats. the water is drawn off; this is the method followed at Glens Falls. Before molding the clay, it should be thoroughly pugged, or, in other words, mixed, and after this the mass should be piled up and allowed to "cure," that is to say, it settles by its own weight, becoming denser while the excess of water evaporates.

The clay is next molded either by machine or by hand; the former method is used for plain forms, while the latter is used for ornamental styles of terra cotta.

Hand molding is of course slower, more difficult, and requires more care; plaster molds are used, and the clay is forced into all the corners with the hand or fingers.

The form is then allowed to remain in the mold until it has dried and shrunk sufficiently to drop out of it, or to permit the mold being lifted off entire or in sections. The surface of the molded piece is then trimmed and smoothed, and it is put in the drying room until sufficiently dry to burn. Burning is done in down-draft kilns, and takes seven to nine days. The kiln has to be fired very cautiously at first to prevent the ware from cracking; and the heat within it is regulated by means of dampers on the roof and sides.

Large lumps of clay are placed just inside the doors of the kiln to serve as testers. When the burning is nearly done, one of these is withdrawn from time to time and allowed to cool, and from its appearance is determined whether the contents of the kiln are burnt enough; the kiln must be cooled very slowly in order to prevent the ware from cracking; when cool, the terra cotta is taken out and is ready for market.

The following are analyses of New York clays used for making terra cotta:

	Alfred Center.	Glens Falls blue.	Glens Falls red.	Elm Point.
Silica	53.20	48.35	57.46	62.06
Alumina	23.25	11.38	21.15	18.09
Iron peroxide	10.90	4.02	5.52	5.40
Lime	1.01	15.38	3.65	1.05
Magnesia	.62	3.17	1.50	Trace.
Alkalies	2.69	6.05	4.72	6.11
Sulphuric acid	.41	......	......	....
Titanic acid	.91	......	......	....
Water (comb)	6.39	......	......	....
Manganese oxide	.52	......	......	....
Total	99.90	88.30	94.00	92.71

Roofing-tile

Alfred Centre is the only locality in New York at which roofing-tile are being manufactured. The Celadon Terra-Cotta Co. has been in operation for several years, and another factory has recently commenced operations. The material used is a mixture of local bluish gray clay and a Devonian shale. These two are thoroughly ground in dry pans, from which they are carried to hoppers on the floor above. They are then fed to a pug mill which mixes the clay and shale, and the pugged material is fed directly to a stiff-mud machine. As the bar of plastic mixture issues from the machine it is cut up into slabs which go to the molding room. The Celadon Terra-Cotta Co. has six hand-power machines with a daily capacity of 1,500 each. As the slab of clay comes up from the stiff-mud machine it is taken by the workman who with a wooden tool pound a broad shallow groove in one surface, and then passes it to a second workman who puts it in the machine where it is pressed into shape between two steel dies, which are heated by steam. The repressed tile is taken from the machine by a lifter having two flat steel prongs and laid on a plaster frame held in readiness by a third workman. The latter hands it to another who trims the edges of the green tile with a knife. The tile and plaster frame are set on the racks in the drying room until placed in seggars for burning. Burning requires seven days, and is done in cupola kilns. The company also has a steam power tile pressing machine which has a daily capacity of 15,000. Tests of these tile were made at Columbia college and they showed a crushing resistance of 40,000 lbs. per square inch. The tiles are made of many patterns, and each style required a plaster frame to fit its shape, while drying.

Appendix

Since the foregoing report was written in the latter part of 1892, there have been a few changes in the clay industry of New York that deserve mention.

In the manufacture of common brick, which constitutes the chief branch of the industry in this State, there has been little change; some of the manufacturers are substituting coal for wood as a fuel for kilns, and a few have given up open air drying and are using artificial means, in addition to those already doing so.

There were published in the Engineering News for Dec. 13, 1894, an exhaustive series tests of building and paving brick, many of the samples tested being from New York State.

The use of shale is steadily increasing. A paving brick plant with a daily capacity of 180,000 has recently been erected at Catskill, N. Y. The shale used is brought from Cairo, ten miles distant.

Experiments have also been made with the Niagara shale from Medina, N. Y. Sample lots were made into brick and then tested in the crushing machine, and gave very good results.

In the manufacture of fire brick the method of hand-molding and repressing are no longer used, but the bricks are molded in a soft mud machine. The time of manufacture is considerably lessened thereby as is also the selling price.

These are the principal changes which have occurred. There has been a favorable advance in all branches of the industry in this State.

TABLE OF SECTIONS OF CLAY DEPOSITS

LOCALITY	Owner	Thickness of clay, ft.	Color	Underlying material	Overlying material
Albany	T. McCarthy	15	Blue	Sand	Soil.
	A. Hunter	40	Blue and yellow		Soil.
	M. Roberts	25	Blue		Loose soil.
Greenbush	Mrs. T. Rigney	90	Blue and yellow		Loam.
Troy	A. Ferguson	40	Blue and yellow	Slate	Loam.
	J. B. Roberts	20	Yellow	Gravel	1 foot loam.
Cohoes	J. E. Murray	50	Blue	Slate	Loam.
	J. Baeby	40	Yellow and blue	Gravel	Soil.
Lansingburg	T. F. Morrissey	75	Red ⅓, blue ⅔	30 ft. sand	
Crescent	Newton Bros	30	Gray and blue		2–4 ft. sand.
Mechanicsville	Mechanicsville Brick Co.	50	Yellow 10 ft., blue 40 ft.	Sand	3 feet soil.
Saratoga	C. L. Williams	6	Blue	Sand	1 foot soil.
Middle Granville	J. H. Pepper	45	Blue	20 ft. gray soil, slate	
Hoosick Falls	J. Dolin	40			
Plattsburg	J. Ouimet	20	Yellowish brown		1 foot soil.
Gouverneur	G. R. Thompson	14	Gray 8 ft., blue 6 ft		Sand, 4 feet.
Carthage	Wrape & Peck	5	Gray		
Watertown	Watertown Brick Co	20	Red	Trenton limestone	Soil.
Ogdensburg	Paige Bros	60	Blue	Limestone	Soil.
Madrid	R. Watson	20	Blue		Sand 3 feet.
Raymondville	Coats Bros	25	Blue		Fire sand 12 feet.
Breesport	Empire State Brick Co.	50	Blue		Soil.
Spencer	W. H. Bostwick	6	Red	Sand and gravel	Soil.
Newfield	T. C. Campbell	40	Blue		Sand 4 feet.
Homer	H. Hall	5	Blue	Quicksand	Soil.
Binghamton	Wells & Brigham	6	Blue	Sand and gravel	Soil.
Goshen	P. Hayne	55		Black gravel	Soil.
Florida	W. H. Vernon	10	Red and blue	Sand and hardpan	
Oakland Valley	O. B. Wheeler	46	Blue		
New Paltz	New Paltz Brick Co	40	Red and blue		Sand few feet.
Chittenango	Central N. Y. Drain-Tile Co	....	Red	Sand	Soil.
Allen's Hill	B. G. Abbey		Blue		Soil.
Owasco	A. Lester	10–15			Gravel.
South Trenton	H. L. Garrett	4	Yellow, red, blue	Slate	
Amsterdam	H. C. Grimes	6+	Yellow and blue		Soil 1–3 feet.
Gloversville	H. McDuffie	2½	Dark brown	Hardpan	Soil.
	W. A. Stoutner	3	Red brown	Hardpan	Soil.
Ilion	S. E. Coe	8–15	Black, gray and blue		Few feet soil.
Rome	W. Armstrong	7–10	Dark gray		
	W. W. Parry	6–9		Gravel	Loam.

South Bay	C. Stephens	25		Cemented blue gravel	
Syracuse	Preston Bros	10	Red and blue	Sand and gravel	Soil.
Warners	Onondaga Vitrified Brick Co	15	Red	Shale	Soil.
Oswego Falls	W. D. Edgerton	5	Yellow	Gravel	Soil.
Baldwinsville	Seneca River Brick Co.		Red and blue	Gravel	Soil.
Seneca Falls	F. Siegfried	12		Gravel	Soil.
Lyons	F. Borck	8	Yellow and blue	Quicksand	
Canandaigua	Burke & Mead	20	Red and blue	Sand	1 foot peat.
Rochester	Rochester Brk. Mfg. Co.	5	Red	Hardpan	
Tonawanda	M. Riesterer	5	Red and blue		Soil.
Buffalo	Brush Bros	6–20	Red		Soil.
Evans	W. Bolton	10	Blue	Sand and gravel	Soil.
Dunkirk	W. Hilton	20	Yellow and blue	Rock	
Jamestown	J. E. McCusker & Son	75	Yellow 5, blue 70	Hardpan	Yellow sand 4 feet.
Big Flats	J. R. Lowe	75	Gray and blue		

DIRECTORY OF BRICK

O. Y. = Open Yard;
T. D. = Tunnel Dryer
D. K. = Down Draft kiln;
W. C. = Wire-cut machine;
F. = Front brick;

P. Y. = Pallet Yard;
S. K. = Scove Kiln;
S. M. = Soft mud machine;
H. P. = Horse power;

SUFFOLK

Post-office	MANUFACTURER	Product	Market
Fisher's Island	Fisher's Island Brick Co.	C	N. Eng.
Greenport	L. I. Brick Co.	"	Conn. & S. I
Southold	C. L. Sanford	"	"
Fresh Pond	G. Longbottom	"	"
	R. Sammis	"	"
Wyandance	Wyandance Brick and Terra Cotta Co.	" & rep brk.	L. I.
Farmingdale	M. Myers	C	"

QUEENS

Post-office	MANUFACTURER	Product	Market
Cold Spring Harbor	Dr. Oliver Jones	C	N. Y. C. & S. I
Oyster Bay	Dunn, Dolan & Co.	"	"
Cold Spring	W. Hammond	"	"
East Williston	W. & J. Post	"	L. I. & N. Y. C

WESTCHESTER

Post-office	MANUFACTURER	Product	Market
Croton Landing	Anchor Brick Co.	C	N. Y. C.
	Croton Brick Co	C & F.	"
	W. A. Underhill Brick Co.	"	"
Crugers	W. H. Fisher	C	"
	C. Carman	"	"
Montrose	Lynch & King	"	"
	O. & C. Frost	"	"
	Montrose Brick Co.	"	"
	C. Hyatt	"	"
	J. Morton	"	"
Verplank	King & Lynch	"	"
	A. Fisher	"	"
	T. N. Avery	"	"
	B. J. McGuire	"	"
	J. Morton	C & F.	"
	S. Travers	C	"
	McConnell & O'Brien	"	"
Peekskill	Cole & Bonner	"	"
	Oldfield Bros.	"	"
	Bonner Brick Co.	"	"

ROCKLAND

Post-office	MANUFACTURER	Product	Market
Haverstraw	H. Cristie	C	N. Y. C., few to N. J.
	J. Felter	"	N. Y. C.
	P. Lynch	"	"
	Shankey, Kelly & Renn	"	"
	Denton, Fowler & Son	"	"
	Excelsior Brick Co.	"	"
	F. Frederick	"	"
	A. Donnelly & Son	"	"
	F. McGuire & Sons	"	"
	Murray & Morrissey	"	"
	G. I. Sherwood	"	"
	G. Archer	"	"
	Snedeker Bros	"	"
	C. D. & G. Archer	"	N.Y C., N. J. & N. Eng.
	B. J. Allison & Co	"	N. Y. C.
	Allison, Wood, Keenan & Co.	"	"
	Wood & Keenan	"	"
	Bennett, Rowan & Scott	"	"
	Fowler & Washburn	"	"
	Diamond Brick Co	F. & C.	"
	Kelly & Byrnes	C	"
	T. C. McGuire	"	"
	M. F. & L. F. Washburn	"	"
	Carr & Smith	"	"

MANUFACTURERS.

D. T. = Drain tile;
C. = Common brick;
C. Y. = Covered yard;
S. P. = Sewer pipe;
Cl. = Clamp;
T. = Terra-cotta;
D. M. = Dry Clay machine;
R. T. = Roofing tile.

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	P.	"	"	
"	O. Y.	"	"	
"	"	"	"	
S. M. & W. C.	Steam	Wingard K.	Coal	
"	P. Y.			

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M. & W. C.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	
"	O. & P. Y.	"	"	

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M. & W. C.	C. Y.	Cl.	Coal	
"	P. & O. Y.	S. K.	Wood	
"	C. Y.	Cl.	Coal & wood	
S. M.	O. Y.	S. K	Wood	
"	"	"	"	
"	"	"	"	
"	C. Y.	"	"	
"	P. Y.	"	"	
"	O. Y.	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	C. Y.	"	"	
"	O. Y.	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	C. Y.	"	"	
"	"	"	"	
"	O. Y.	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	C Y.	"	"	
"	P. Y.	"	"	
"	O. Y.	"	"	
"	Hot air tun.	"	"	
"	O. Y.	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	

Post-office	MANUFACTURER	Product	Market
			ROCKLAND
Haverstraw	Morrissey & Co.	C	N. Y. C
	P. Brophy	"	"
	Dolan, Dunn & Butler	"	"
	T. & C. Peck	"	"
	T. Malley	"	"
	P. Goldrick	"	"
	T. & G. Peck & Co.	"	N. Y. C. & N. J
	Buckley & Carroll	"	N. Y. C.
	T. Clark	"	"
	J. Brennan	"	"
	P. Ohler	"	"
	D. Fowler Jr. & Washburn	"	"
	J. Shankey & Son	"	"
Stony Point	C. A. Marks	"	"
	Riley & Clark	"	N. Y. C. 2/3
	Riley & Rose	"	"
	Allison, Wood & Allison	"	N. Y. C.
Thiells	Felter & Mather	"	Patterson & Passaic
			ORANGE
Cornwall	C. A. & A. P. Hedges	C	N.Y.C. & N.Y.,O.& W.
New Windsor	J. A. Whitbeck	"	Newburgh
	E. Lang	"	N. Y. C.
	J. T. Moore	"	"
	Q. Davidson's Sons	"	"
	Moore & Lahey	"	"
	D. Carson	"	"
Goshen	P. Hayne	C. D. T.	Vicinity
Florida	W. H. Vernon	C	"
Roseton	Rose & Co.	"	N. Y. C.
	J. J. Jova	"	"
			DUTCHESS
Storm King	Mosher Bros.	C	N. Y. C.
Dutchess Junct	T. Timoney	"	"
	L. Van Buren	"	"
	Covert Bros	"	"
	Aldridge Bros. & Co	"	"
	Barnacue & Dow	"	"
	Carman & Denton	"	"
	W. D. Budd	"	N. Y. C & Ct.
Fishkill	Denning Pt. Brick Co	"	N. Y. C.
	Harris & Ginley	"	"
	W. H. Aldridge	"	"
	J. P. Sherman	"	"
	O'Brien, McConnell & Vahey.	"	"
	Brockway Brick Co	"	"
	Lahey Bros	"	"
	Dinan & Butler	"	"
Low Point	J. V. Meade	"	"
	C. E. Griggs & Co.	"	"
Arlington	Flagler & Allen	"	Local
Amenia	Amenia Brick Co.	"	Harlem R. R.
			COLUMBIA
Hudson	J. Fitzgerald's Sons	C	N. Y. C.
	Arkison Bros.	"	"
	W. E. Bartlett	"	"
			RENSSELAER
Stockport	Walsh Bros.	C	N. Y. C.
Stuyvesant	E. Brousseau	"	"
Greenbush	Mrs. T. Rigney	"	Albany & N. Y. C.
Troy	A. Ferguson	"	Vicinity
Lansingburg	T. Morissey	"	
Hoosick Falls	J. Dolin	"	
			ULSTER
Port Ewen	S. D. Coykendall	C	N. Y. C.
	J. Kline	"	"
East Kingston	W. Hutton	"	N. Y. C. & local
	Terry Bros	"	"

COUNTY — (*Continued*)

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	
"	P. Y.	"	"	
"	O. Y.	Cl	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	C. Y.	S. K.	"	
"	O. Y.	"	"	
"	"	"	"	

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	C. Y.	"	"	
"	O. Y.	"	"	
"	C. Y.	"	"	
S. M. & W. C.	O. Y.	"	"	2½
"	"	"	"	1
S. M.	"	"	"	
"	"	"	"	

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	1500 ft.
"	"	"	"	40 A. land
"	"	"	"	450 ft. front
"	"	"	"	250 " "
"	"	"	"	800 " "
"	"	"	"	700 " "
"	"	"	"	
"	"	"	"	26 A. land
"	"	"	"	18 A.
"	"	"	"	300 ft. front
"	"	"	"	" "
"	"	"	"	500 " "
"	P. Y.	"	"	1200 " "
"	O. Y.	"	"	650 " "
"	P. Y.	"	"	475 " "
"	O. Y.	"	"	
"	"	"	"	100 A.
"	"	"	"	Horsepower
"	"	"	"	4

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	12 A.
"	"	"	"	
"	"	"	"	

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	2½ A.
"	"	"	"	H. P. 1½ A.
"	"	"	"	6 A.

COUNTY

Machine used	System of drying	Kind of kilns	Fuel	Remarks
S. M.	O. Y.	S. K.	Oil	
"	"	"	Coal	
"	"	"	Wood	
"	"	"	"	

Post-office	MANUFACTURER	Product	Market
			ULSTER
East Kingston	R. Maine & Co	C	N. Y. C
	A. S. Staples	"	"
	C. A. Schultz	"	"
	Brigham Bros	"	"
	D. S. Manchester	"	"
	Streeter & Hendrix	"	"
	D. C. Overbaugh	"	"
	A. Rose & Co	"	"
	C. H. Littlefield	"	"
Glasco	U. F. & J. T. Washburn	"	"
	T. Porter	"	"
	F. N. Van Dusen	"	"
	Washburn Bros	"	N. Y. & J. C.
Malden	Cooney & Farrell	"	N. Y. C
Smith's Dock	T. Brousseau	"	"
			GREENE
Catskill	A. McClean	C	N. Y. C
	Ferier & Golden	"	"
	Derbyshire Brick Co.	"	"
Athens	W. Ryder	"	"
	J. R. Porter	"	"
Coxsackie	F. W. Noble	"	"
			ALBANY
Coeyman's Landing	Corwin & Cullough	C	N. Y. C
	M. J. Sutton & Co	"	"
	J. A. Brower	"	"
	H. Slingerland	"	"
	S. K. Brower	"	"
	Sutton & Suderly	"	"
Albany	T. McCarthy	"	Albany
	M. H. Bender	C., F., D. T.	"
	J. Babcock	C	"
	E. Smith	"	"
	D. H. Stanwix	"	"
	J. C. Moore	C. & F.	"
Cohoes	J. Baeby	C	V
			SCHENECTADY
Crescent	Newton Bros	C	
Niskayuna	J. E. Winne	"	Schenectady
			SARATOGA
Mechanicsville	Mechanicsville Brick Co.	C	Neighboring towns
Saratoga	C. L. Williams	"	"
			WARREN
Glens Falls	Glens F. Br. & Terra Cotta Co.	C., F., T.	N. Y. State
			WASHINGTON
Mid. Granville	J. H. Pepper	C	
			CLINTON
Plattsburg	J. Ouimet	C	Local
	C. Vaughn	"	"
	Gilliland & Day	"	"
			FULTON
Gloversville	Wm. Stoutner	C	Local
			MONTGOMERY
St Johnsville	J. Smith, J. McDuffie	C	Local
Fonda			
Amsterdam			
			HERKIMER
Herkimer	J. J. Mabbett		
Ilion	S. E. Coe	C	Local

COUNTY — (*Continued*)

Machine used	System of drying	Type of kiln	Fuel	Remarks
S. M.	O. Y.	S. K.	Wood	5 A. land
"	"	"	"	A few go to N. J.
"	"	"	"	
"	"	"	"	
"	"	"	Coal	
"	P. Y.	"	Wood	
"	"	"	"	12 A. land
"	O. Y.	"	"	Staated in '91
"	"	"	"	60 A. land
"	"	"	"	Staated in '91
"	"	"	Coal	
"	O. Y. & P. Y.	"	Wood	150 A. land
"	O. Y.	"	"	Staated in '91
"	"	"	"	
COUNTY				
S. M.	O. Y.	S. K.	Wood	12½ A. land
"	"	"	"	
"	O. Y. & C. Y.	"	"	
"	O. Y.	"	"	
"	"	"	"	
"	"	"	"	
COUNTY				
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	Coal	
"	"	"	"	
"	"	"	"	
"	"	"	"	
S. M.	"	"	Wood	4 A. land
S. M. & W. C.	"	S. K., D. K.	Wood & coal	2 A. land
S. M.	"	S. K.	Wood	1½ A. land
"	"	"	"	2 A. land
"	"	"	"	1½ A. land
"	"	"	"	4 A. land
"	"	"	"	
COUNTY				
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
COUNTY				
S. M.	P. Y.	S. K.	Wood	
"	"	"	"	
COUNTY				
S. M., D. P.	T. D.	Cl., C. K.	Coal	
COUNTY				
COUNTY				
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	
COUNTY				
S. M.	O. Y.	S. K.	Wood	
COUNTY				
"	"	"	"	
COUNTY				

Post-office	MANUFACTURER	Product	Market
			ONEIDA
Sangerfield		C	
South Trenton	H. L. Garrett	"	
Utica	F. Borck	"	
Rome	W. W. Parry	C., F.	
			MADISON
Chittenango	Central N. Y. Drain Tile Co.	D. T	
South Bay	C. Stephens	C	
			ONONDAGA
Syracuse	Onon. Vit. Brick Co.	C., P.	N. Y.
	N. Y. Paving Brick Co.	P	"
	F. H. Kennedy	C	Syracuse
	Preston Bros.	"	"
	T. Nolan	"	"
	C. L. Merrick	"	"
	J. Brophy	"	"
Baldwinsville	Seneca River Brick Co.	F	"
Camillus			
			CAYUGA
Auburn	J. Harvey	C	
Owasco	A. Lester	"	
			MONROE
Rochester	Roch. Brick & Tile Mfr. Co.	C	Local
	German Brick & Tile Mfr. Co	"	"
	Rochester Sewer Pipe Works,		
Maplewood	Robert Gay	"	"
Clarkson	J. Siegler	C., D. T	
			NIAGARA
Lockport	A. Mosell	C	Local
Niagara Falls	R. P. Slater	"	"
La Salle	Tompkins & Smith	"	"
			ERIE
Tonawanda	M. Riestrer	C	Vicinity
Buffalo	Chas. Berrick & Sons	"	"
	Brush Bros.	"	"
	H. Dietschler & Son	"	"
	F. Haake	"	"
	L. Kirkover	"	"
	Schusler & Co.	"	"
	C. W. Schmidt	"	"
	Adams Brk. & Ter. Cot. Co.	C, F., D. T.	"
Black Rock	Black Rock Sewer Pipe Co.	Sewer pipe	
Lancaster	Lancaster Brick Co	C	Buffalo & vicinity
	Buffalo Star Brick Co	"	"
Angola	John Lyth & Sons	S. P., H. B., D. T.	N. Y. State
Evans	Wm. Bolton	C	Local
Jewettville	Brush & Smith	F. & C	
			CHAUTAUQUA
Dunkirk	Wm. Hilton	F. & C	Local
Jamestown	J. E. McCusker & Son	F, C, D. T, H. B.	"
	C. A. Morley	C	"
			CATTARAUGUS
Randolph	J. Turner	C	Local
			GENESEE
East Bethany	B. F. Peck	D. T.	Local

Machine used	System of drying	Type of kiln	Fuel	Remarks
COUNTY				
S. M., W. C		S. K		
COUNTY				
COUNTY				
W. C	T. D	D. K	Coal	
S. M	"	"	"	
"	O. Y	S. K	Wood	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
D. M,		D. K	Coal	
COUNTY				
COUNTY				
S. M	O. Y	S. K		
"	"	"		
"	"	"		
COUNTY				
S. M	O. Y	S. K		
"	"	"		
"	"	"		
COUNTY				
S. M	O. Y	C	Coal	
"	P. Y	S. K	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
"	"	"	"	
S. M., D. M., W. C.	1 P. Y	O. K. & S. K	"	
S. M	P. Y	S. K	Wood	
"	"	"	"	
	Drying rooms	Cupola Kilns	Coal	
"	O. Y	S. K	Wood	
D. M	T. D	S. K, D. K	Coal	
COUNTY				
S. M	B. Y	S. K	Coal	
S. M., W. C	P. Y	S. K, D. K	Coal & wood	
S. M	"	S. K	Wood	
COUNTY				
COUNTY				
W. C				

Post-office	MANUFACTURER	Product	Market
ALLEGANY			
Alfred	Rock Cut Clay Co	F	
Alfred Centre	Celadon Terra Cotta Co	T. & R. T.	All over
STEUBEN			
Hornellsville	Hornellsville Brick Co	P. & C	N. Y. State
	W. H. Signor	C	Local
Corning	Corning Brick Co	C. & T. C.	"
ONTARIO			
Canandaigua	Burke & Meade	F	Local
Allen's Hill	B. G. Abbey	C	
Geneva	Torry Park Land Co	"	
CHEMUNG			
Horseheads	R. G. Eisenhardt	C	
Breesport	Empire State Brick Co	"	Local
	P. M. C. Townsend	"	"
	Locy Bros	"	"
TOMPKINS			
Newfield	T. B. Campbell	F	Local
TIOGA			
Spencer	W. H. Bostwick	C	Local
CORTLAND			
Homer	Horace Hall	C	
BROOME			
Binghamton	Ogden Brick Co	C	Local
	Wells & Brigham	"	"
OTSEGO			
Oneonta	Crandall & Marble	C	Local
	J. Denton & Son	"	
OSWEGO			
Oswego Falls	W. D. Edgarton	C. & F.	Local
JEFFERSON			
Carthage	Wrape & Peck		
Watertown	Watertown Brick Co	C	Local
ST. LAWRENCE			
Ogdensburg	Paige Bros	C	Local
Madrid	Robert Watson	"	"
Raymondville	Coats Bros	"	"

Machine used	System of drying	Kind of kiln	Fuel	Remarks
COUNTY				
D. M.		D. K.	Coal	
Tile machine	Hot rooms	D. K.	"	
COUNTY				
W. C.	Tunnel D.	D. K.	Coal	
W. C. & S. M.	O. Y.	S. K.	Wood	
S. M.	T. D.	S. K.	"	
COUNTY				
D. M.		S. K. & D. K.	Oil	
COUNTY				
		S. K.	Wood	
S. M.	T. D.	"	"	
"	O. Y.	"	"	
"	T. D.	"	"	
COUNTY				
W. C.	T. D.	Cl. & S. K.	Coal	
COUNTY				
S. M.	P. Y.	Cl	Coal	
COUNTY				
COUNTY				
S. M.	T. D.	S. K.	Wood	
"	P. Y.	"	"	
COUNTY				
COUNTY				
S. M.	O. Y.	S. K.	Wood	
COUNTY				
S. M.	P. Y.	S. K.	Wood	
COUNTY				
S. M.	O. Y.	S. K.	Wood	
"	"	"	"	
"	"	"	"	

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STATE OF NEW YORK
SHOWING THE
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AND
MANUFACTORIES
BY
HEINRICH RIES
1893
Scale of Miles
Clay deposits only
Clay deposits and manufactories
Refractory clays
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
ATLANTIC OCEAN

University of the State of New York

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THE SAN JOSE SCALE, *Aspidiotus perniciosus*

AND

SOME OTHER DESTRUCTIVE SCALE-INSECTS OF THE STATE OF NEW YORK

BY

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ALBANY

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WHAT SCALE INSECTS ARE

There is a large class of small insects — some, indeed most, of which require a magnifying glass for their observation, which are particularly detrimental to fruit-culture, yet from their inconspicuous appearance usually escape notice until discovered when search is made for the cause of the languishing condition or death of the tree or shrub infested by them. Even then it is rather difficult to believe that the true cause has been found in what often seems to be merely an unnatural roughening of the bark or a moderate incrustation formed upon the surface.

The species more commonly met with (the Diaspinæ) have received the name of *bark-lice*, from the appearance of the young as they travel over the bark for a few days after they are hatched; and of *scale-insects*, from the scale-like covering secreted by the insect and beneath which it is hidden after it has fastened itself to the bark. Scientifically, they, together with the "mealy-bugs," are known as Coccidæ. In classification they have place in that division of the Hemiptera (a large order of suctorial insects) known as Homoptera, the wings being of a uniform thickness throughout, and thereby distinguishing them from the other division (Heteroptera) in which the front wings are thickened in their basal half to a degree, often, approaching the elytra or wing-covers of beetles. It is to this last-named Division that the popular name of "bugs" has become attached. All of the Hemiptera are suctorial, and take their food through a beak or proboscis instead of by biting jaws. They differ greatly in their structure, and in modes of development; the latter, in some of the families, as in that of the Aphididæ or plant-lice, is of intense interest.

The development of the Coccidæ is quite peculiar. The females do not become perfected into winged creatures, but with age assume the form of scales or galls, or of grubs covered with wax or powder; or become degraded beneath their sheltering scale into barely more than egg-sacs, retaining only such simple organs as are essential to their life during the reproduction of their young. The male, however, undergoes a complete transformation and becomes winged, but with only a single pair of wings of very simple structure (see in Figures 3, 2 and 3 in Plates I, II and VII). It lives but a day or two, dying speedily after the fulfilment of the purpose of its being. It takes no food, for in this stage it possesses no mouth or digestive organs.

A few species of the Coccidæ are of service to us, such as the *Coccus cacti* from which the valuable dye, cochineal, is obtained; the *Carteria lacca* which excretes the material known to us as shell-lac; from another species we have the commercial article known as china wax; and still another species occurring in Arabia produces a solidified honey-dew called "manna," which "is thought by some to have been the heaven-sent manna that nourished the Hebrews in their wanderings."

About 125 species of North American Coccidæ have been described, and others are being brought to notice each year, either from having been previously overlooked, or recently introduced from abroad. All of them are destructive in proportion to their rapidity of multiplication and the greater or less economic importance of the plants that they infest.

SOME DESTRUCTIVE SCALE-INSECTS OF THE STATE OF NEW YORK

Before proceeding to the consideration of the San José scale,—the subject of this bulletin, it may be of service to refer briefly to a few other species which, although common in the State of New York, and quite harmful to the trees that they infest, are still almost wholly unknown to the fruit-grower and to others who are suffering from their presence. From the figures given of them, they may at once be distinguished from the San José scale.

The Apple-tree Bark-louse

The most common of these is the apple-tree bark-louse, shown in Fig. 1 of Plate I, in its natural size as it occurs on the bark of trunks and limbs, often more abundantly than is represented in the cut, completely covering the bark and overlaying one another, and lending an increased diameter to the infested twig. The color of the scale is brown or ash-gray, nearly approaching that of the bark. The female scale measures about one-twelfth of an inch in length, of a long, usually more or less curved form, pointed at one end on which a magnifier may show the yellowish cast-off skin of the insect, and rounded at the other end. From its peculiar shape it has been frequently written of under the name of the oyster-shell bark-louse. It bears the scientific name of *Mytilaspis pomorum* Bouché. The male scale is of a considerably smaller size, the sides nearly straight, less rounded at the larger end, and of a brighter color. It will seldom be found associated with the females on the bark, as its natural place is on the leaves on either side, especially along the midrib (Riley). If a recent uninjured female scale be carefully lifted after oviposition — at any time during the winter — from fifty to a hundred small, oval, white eggs may be found underneath it, which would ordinarily give out the young insect about the first of June in the latitude of New York.

This destructive scale is far from being confined to the apple, but may also be found on the plum, pear, raspberry, wild gooseberry, wild cherry, red currant, sugar and swamp maples, white and black ash, birch, poplar, willows, linden, horse chestnut, elm, &c. It will be seen from the above, that it has a large number of host-plants.

The Scurfy Bark-louse

This scale-insect, known to science, as *Chionaspis furfurus* (Fitch), is quite common in the State of New York, where, it is believed to be more numerous and more injurious than in any other of the United States. I have recently seen an orchard of the Kieffer pear, in Columbia Co., N. Y., in which the trunks, of from three to four inches in diameter, were so thickly coated with the scales that at a little distance they appeared as if they had been whitewashed.

The scale, as it appears when scattered over the bark, and the male and female scales magnified, are shown in Fig. 2 of Plate I. The young larva, the mature female, the male pupa, and the male, are represented in Figure 3 of the same Plate, which has been prepared under the supervision of Mr. L. O. Howard, of the Entomological Division at Washington, to illustrate the insect in his article on the "Scale Insects of the Orchard" shortly to appear, and kindly furnished for use in this Bulletin by consent of the Department of Agriculture in advance of its own publication.

Dr. Fitch has described so faithfully the appearance of a badly infested tree and of the scale, that his account is transcribed herewith: "The bark of the limb [pear tree] was covered with an exceedingly thin film, appearing as if it had been coated over with varnish, which had dried and cracked and was peeling off in small irregular flakes, forming a kind of scurf or dandruff on the bark. In places this pellicle was more thick and firm, and elevated into little blister-like spots of a white and waxy appearance, of a circular or broad oval form, less than the tenth of an inch in diameter, abruptly drawn out into a little point at one end, which point was stained of a pale yellowish color and commonly turned more or less to one side." This refers to the female scale, shown in enlargement at *c* of Figure 2, Plate I. The male scales, which usually congregate by themselves (enlarged at *d* in same figure), are only from one-fourth to one-third as large, narrow, usually straight, three-ribbed, and of a snowy-white color. The eggs found beneath the scales are of a purplish-red color. They hatch about the first of June.

This scale attacks the apple, pear, black cherry, choke cherry, and mountain ash. I have recently found it abundantly on the Japan quince, *Pyrus japonica*, in Washington Park, Albany, — large plots of which were being killed by it.

The Pine-leaf Scale-insect

This is another white scale which is quite conspicuous on the leaves of the pine and the spruce on which it occurs. It attacks mainly transplanted trees, and had not been seen by Dr. Fitch, when described by him, on those growing spontaneously in the Forests. The foliage of a large number of Austrian pines (*Pinus Austriaca*) growing in Washington Park, in Albany, a few years ago, was so thickly covered with the scales that it was literally whitened with their myriads. Hundreds could be counted on a single leaf. Nearly all of the infested trees were taken up and burned. Large numbers of the scales were eaten into and destroyed by a little lady-bug, — "the twice-stabbed lady-bird," — and to the abundant presence of this scale-eating insect, may be owing the fact that in late years the scale has been far less destructive (see *Fifth Report Insects of New York*, 1889, page 266).

The scale is represented in Fig. 1 of Plate II, in natural size upon the leaves, and much enlarged, beneath. They are of an elongate oval form, of a pure white color with a waxy lustre, and with the conspicuous yellow cast skins resting on the smaller end. Dr. Fitch, in his Second Report, 1856, has devoted a half-dozen pages to the insect and its lady-bug destroyer.

The White Scale

A troublesome scale frequently infests conservatories and house plants, which may be recognized from the representation of infested leaves and the magnified scales shown in Fig. 2 of Plate II.

The scales are white and are sometimes so abundant as to give a whitewashed appearance to the trunks of the trees that they infest. It is known, in science, as *Aspidiotus nerii* Bouché. Its specific name of *nerii* is drawn from the botanical name of the oleander, *Nerium*, which is one of its favorite food-plants. Ivy, when grown within doors, is quite subject to its attack, and is liable to be killed by it unless care is taken to prevent the multiplication of the scale. Professor Comstock reports having studied the species on the following named plants: Acacia, magnolia, oleander, maple, Yucca, plum, cherry, currant, English ivy, and lemons from the Mediterranean.

The scale of the female is nearly circular, flat, whitish or light gray, with the dull orange exuviæ (cast skins) central or nearly so. The ventral scale (as distinguished from the exuviæ) is a mere film applied to the bark. Diameter when full-grown, one-twelfth of an inch. The male scale is snowy-white, slightly elongated with the light yellow larval skin nearly central — diameter one-half that of the male. It is distributed over all the United States, and over much of Europe.

The Maple-tree Scale-insect

This is one of our largest scale-insects, and, at the time of hatching of the eggs in late June and early July, is more conspicuous than any other found in this part of the United States. It is observed more frequently upon the soft maple, *Acer dasycarpum*, than elsewhere, but it is often found infesting grapevines where it is known as the grapevine bark-louse. It was described forty years ago as *Coccus innumerabilis* — (now included in the genus *Pulvinaria*) — the specific name applicable both to the myriads in which it appears in some localities and to the immense number of eggs produced by the female: often a thousand or more can be counted from underneath a single scale. Fig. 1 of Plate III illustrates the scale as it appears when attention is usually drawn to it. It is then seen as a white, cottony mass of from three- to nearly four-tenths of an inch long, about one-half so broad, of a sub-oval form, bearing upon the narrower end a brown scale darker at the margin, somewhat flattened down or bent upward near its middle to nearly a right angle, oval, broader behind, where it is notched and apparently cleft for a short distance on its middle: on the front is a medial ridge for about one-fourth or one-third its length: it usually shows five transverse wrinkles or folds and about the same number of raised lines running outwardly on each side to the hinder margin. A common appearance of the adult scale is shown at *b* of Fig. 3 of Plate III, and at *a*, *b* and *c*, immature forms in Fig. 4.

The white cotton-like mass, which is a characteristic of the genus *Pulvinaria*, is a secretion thrown out by the insect for the protection of its eggs, and also of the young insects for a short time after their hatching.

In Fig. 2 of Plate III (after Walsh and Riley) the scales and egg-masses are shown on osage-orange as *Lecanium Maclurœ*, and on maple as *L. acericola*, but both now referred to *P. innumerabilis*.

This scale had become very abundant upon the maples in the streets of Brooklyn in 1890, and was reported as having killed a large number of the infested trees.* In 1884, it was excessively abundant and quite destructive over the larger part of the State of Illinois. Further particulars of it, and available remedies, may be found in the *Sixth Report on the Insects of New York*, 1890, pp. 141–147.

The Plum-tree Scale-Insect

In Plate IV, the plum scale is shown, — an apparently new and destructive plum pest, which has during the past year made its appearance in different localities in the State of New York, particularly in its western portion. Examples of it were received by me on May 14th and 15th from Dr. Collier of the Geneva Agricultural Experiment Station, and from C. M. Hooker and W. C. Barry, of Rochester. No record could be found of its previous occurrence as infesting the plum. Upon submitting it to Prof. T. D. A. Cockerell, of Las Cruces, New Mexico, who has made special study of scale insects, it was determined by him, with a possible doubt, as *Lecanium juglandis* Bouché. This determination has not been accepted by some entomologists, while as an explanation of difference of opinion in regard to it, it has been suggested that two closely resembling species are associated on the infested trees.

The species of *Lecanium* are large, conspicuous scales, as may be seen covering the branch in the figure, approaching a half globe in form, and in the season of reproduction, containing within their capacious bodies a very large number of eggs — a thousand, or it may be two thousand or more. From their rapidity of multiplication they may prove very injurious to the trees that they infest, but fortunately their size, and their tenderness during a portion of their existence, exposes them to parasitic attack, and to destruction from certain weather conditions. They are amenable to treatment with kerosene emulsion, and to the methods which will be recommended for the destruction of the San José scale.

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* *Eighth Report on the Insects of New York*, 1893, page 177.

Prof. M. V. Slingerland, of the Cornell University Experiment Station has made a study of this insect in the plum orchards of Western New York, the results of which are published in Bulletin 83 of the Station — describing it, narrating its destructiveness, naming the few plants upon which it is believed to have passed from the plum, its life-history, its natural enemies, and approved methods for combatting it.

This scale has been found abundantly in some localities in Eastern New York: in Orange Co., it has been mistaken by some fruit-growers for the San José scale, but from their great dissimilarity in appearance, there is hardly an excuse for confounding them.

The figure representing an infested plum branch is from a photograph taken by the Geneva Experiment Station, and employed in illustrating a brief notice of the insect by Prof. S. A. Beach, in *Garden and Forest* for July 18, 1894, from which paper it has been obtained.

In the preceding brief notices of some of our more common scale insects, particular mention of the insecticides available for their destruction and methods of application, have been omitted, as those which will be indicated for use against the San José scale, will be found equally serviceable against each one of them.

THE SAN JOSÉ SCALE

The San José Scale — from the many different fruit trees that it infests, the rapidity of its multiplication through its successive broods during the year, and the short time in which it kills the trees that it attacks — is justly regarded as one of our most pernicious scale-insects. Its character is indicated in the specific name of *perniciosus* given to it by Professor Comstock when first described by him in 1880, in the *Report of the Commissioner of Agriculture* for that year. He has written of it: "It is said to infest all the deciduous fruits grown in California, excepting peach, apricot, and the black Tartarean cherry.* It attacks the bark of the trunk and limbs as well as the leaves and fruit. I have seen many plum and apple trees upon which all the fruit was so badly infested that it was unmarketable. In other instances I have seen the bark of all of the small limbs completely covered by the scales. I think that it is the most pernicious scale-insect known in this country."

The Los Angeles (Cal.) Horticultural Commission, in their report for 1893, say of it: "This pest, if not speedily destroyed, will utterly ruin the deciduous fruit interests of this coast. It not only checks the growth of the tree, but it covers the tree literally entirely, and the fruit nearly as much so, and, if left unchecked, the tree is killed in three years' time."

Introduction and Spread

As with the larger number of our more injurious pests, the San José scale is not native to North America. Where it originally occurred is not known. It is frequently found upon plants imported from Japan (Coquillett), and also occurs in Chile and in Australia. It is believed to have been brought into California in or about the year 1870. It first attracted the attention of fruit-growers at San José, in Southern California, in 1873. In 1882 it had extended into all the fruit-growing districts of California, and had entered Oregon and Washington. It is also found in Nevada, but when first observed there is not known. It is reported in one locality in Idaho in 1894 (Aldrich), and as well established at Las Cruces, New Mexico (Cockerell).

* It has since been found on the peach, and apricot.

Occurrence in Eastern United States

It was quite a surprise when not long ago the discovery was made that this destructive insect had crossed the continent and had made its appearance in the Atlantic States. Its first recognition was by Mr. L. O. Howard, of the Division of Entomology at Washington, in August, 1893. A supposed fungus disease on pear sent from Charlottesville, Va., to the Department of Agriculture and shown to Mr. Howard, was "at the first glance recognized as that scourge of western orchards, the San José scale (*Aspidiotus perniciosus* Comst.)."

Investigations, etc., by the U. S. Department of Agriculture

During the autumn, two of the assistants of the Entomological Division, Messrs. Schwarz and Coquillett, were sent to Charlottesville, to examine and report upon the infestation. It appeared from their examinations that it was limited in extent, being almost wholly confined to a pear orchard of about a square acre in area, but that it affected pear, peach, plum, apple, currant, rose, quince, gooseberry, and raspberry, and that it had already been present there for several years. It was subsequently learned that, in all probability, it had been introduced on nursery stock purchased from a New Jersey firm. Mr. Hedges, the owner of the orchard, was of the opinion that it had been brought on currant plants purchased in New Jersey eight years previously. Mr. Schwarz reported on the situation of the infested orchard, the plants attacked, other infested places adjoining, habits of the scale, and its observed enemies. Mr. Coquillett reported upon the infested locality, and the conjectural sources of the scale. (*Insect Life*, vi, 1894, pp. 247–254.)

Early in the spring of 1894, through the coöperation of the U. S. Department of Agriculture and the Virginia State Board of Agriculture, Mr. Coquillett, who had conducted very successfully most of the experiments in California for the destruction of scale insects by inclosing the infested trees with tents and fumigating them with hydrocyanic acid gas, was entrusted with the operations for destroying the scale in Charlottesville by the same method — always effective when properly conducted. It appears in his report submitted (*loc. cit.*, pp. 324–326), that 326 trees and shrubs were subjected to the gas treatment. Examination made a few months thereafter disclosed no living scales.

In Maryland.— In March, 1894, the scale was sent to the Division of Entomology on peach twigs from a large peach orchard in Riverside, Charles Co., Md. It was learned that the scale had been introduced in 1887 and 1888, on peach trees purchased of a New Jersey nursery. Many of them had died, and nearly all of those that remained were found to be thoroughly encrusted with the scale, so that at the time of examination they were being taken up and destroyed. (Other trees to which the scale had spread, had been treated by their owner during the preceding winter, apparently with good results, with the three principal winter washes, viz., strong kerosene emulsion; lime, salt, and sulphur; and resin wash.) A trunk-washing in April with strong kerosene emulsion was successful to the extent of killing 90 per cent of the scales. Several sprayings were made during the summer with different mixtures,— some of them under direction of Mr. Coquillett,— by which most of the scales were killed. At the time of Mr. Howard's report (from which most of these items relating to the eastern presence of the scale have been drawn) in August, it was thought safe to say that the insects would be completely stamped out in this locality by the close of the year.

In Florida.—At the same time of the discovery of the Maryland locality, the scale was also received from De Funiak Springs, Florida. At the request of the fruit-growers of that section of the State, the Department of Agriculture sent Mr. H. G. Hubbard to make examination and report. The insect was practically confined to the peach and plum, but occurred also, in small numbers on Kieffer pears, and on pecan and persimmon. Many thousands of trees were infested, and nearly every orchard within a radius of five or six miles was more or less attacked. Arrangement was made for the Experiment Station of Florida to undertake the work of destroying the scale, by going over all the infested trees in the district with five or six applications of the resin wash. If the weather should prove favorable for the use of the wash, there was reason to believe "that the nuisance will have been abated by the close of the season in Florida, although extermination [from the peculiar conditions of the infested locality] may not be found possible."

Discovered in other States.— In consideration of the discovery that some at least of the above-noticed infestations of this pernicious California scale, were traceable to New Jersey nurseries which were, in all probability, still serving as distributing centers for the distribution of the pest over nearly all the country, a Circular was prepared by Mr. Howard, Chief of the Division of Entomology, U. S. Dept. Agricul., describing and figuring the scale and warning fruit-growers of its exceeding dangerous character, which was distributed in the first week of April (1894) to all Eastern agricultural newspapers and to nearly 12,000 Eastern fruit-growers whose addresses were obtained from the pomologist of the department. This circular,— with its excellent illustrations*, description of its appearance, explanation of its manner of spreading, and the best remedies for it — as might naturally be expected, excited much interest and alarm. Scale insects of many kinds as well as insects belonging to other groups, were sent to the Department, with the inquiry if they were the San José scale.

As the result of the distribution of this Circular, the following additional localities were ascertained:

Neavitt and Chestertown in Maryland; Bartle, Indiana; many points in New Jersey; Atglen and Lewisburg, in S. Eastern and Central Pennsylvania. It was also received from Middletown, Idaho; and from British Columbia.

Referring to the above attacks, Mr. Howard gives encouraging reports: The orchard of 7,000 trees in Atglen, Pa., under direction of Dr. J. B. Smith, Entomologist at Rutgers College, New Jersey, had been treated three times at intervals of ten days, with kerosene emulsion, with absolute success.

At the Lewisburg locality, the few infested pear trees that had been bought from the New Jersey nurseries in 1890, had all been killed but one. Other trees to which the scale had spread were being treated by the owner with every prospect of extermination.

At Bartle, Indiana, two young apple trees from New Jersey were infested. Those were taken up and burned, and no more of the insects were discoverable by careful search. (A second infestation has since been discovered at North Madison — See *Rural New Yorker*, liv, p. 87.)

* I am indebted to the Department for the privilege of introducing them in this paper: see Plates VI and VII.

At Neavitt, Md., a 10-acre orchard of peach trees was badly infested — nearly every tree was languishing from the attack. Many had been taken up and destroyed. Full directions were given for spraying, and the success of the operations will be watched. The source of this infestation could not be definitely ascertained, but it was thought by the owner that the first affected trees had come from a Missouri nurseryman — not from New Jersey.

Chestertown, Md., showed but few infested trees. They had been treated by the owner with thick whale-oil soap of the consistency of molasses, with every prospect of extermination of the scale. The infested trees had been received from New Jersey in 1890. As a summary of the above, Mr. Howard states that the scale had been exterminated (in 1894) in Indiana and Virginia, and the probabilities were strong of a like result before the close of the year, at the other localities named, except in Florida and New Jersey.

It has since come to the knowledge of the Division of Entomology, that the scale has been found abundantly in three new localities in Maryland. It has also been discovered in a locality in Southern Georgia; in an orchard in Southern Ohio; in Newcastle Co., Md.; in Jefferson Co., Indiana; at City Point, Va.; and at Bristol, Pa. In some of these localities the infestation was quite limited, and it is believed to have been exterminated. (L. O. Howard: Further Notes on the San José Scale, in *Insect Life*, vii, 1895, pp. 285, 286.)

The San José Scale in New York

During the meeting of the American Association for the Advancement of Science, at Brooklyn, N. Y., in August last — in a paper read by Dr. Smith before the Association of Economic Entomologists on "The San José Scale in New Jersey," it was incidentally stated that an orchard in Columbia County, New York, was known to be badly infested with the scale. The particular orchard was not named, but later, at my request, the information was obtained from Dr. Smith, that Mr. L. L. Morrell of Kinderhook, had not long ago purchased a number of young apple trees (Ben Davis variety) from one of the New Jersey nurseries. Two years later (in 1894), on examination of these trees by one of the owners of the nursery (a relative of Mr. Morrell), they were found to be badly infested, and advice was given that they should be at once taken up and destroyed. A week or two later it was learned from Mr. Morrell that this had been done, and it was thought that with the destruction of the entire purchase, the scale had been exterminated.

Thinking it important to know whether the measure had been entirely successful, I visited Mr. Morrell early in November, and was met with the unpleasant intelligence that he was fearful that he still had the insect with him, for he had found upon a single pear what he believed to be the scale. It proved to be such,— perhaps a half-dozen of individuals being scattered over its surface.

On examining his orchards, the scale was found abundantly in one of them — a young pear orchard in which a few trees had borne fruit, for the first, the present year. Some of the trees were moderately infested — perhaps a half-dozen scales or less being found upon them; on others the scale was so numerous as to fairly encrust the branches and most of the trunk. It was apparent that the latter were those upon which the insect had been introduced, and from which they had been scattered throughout the orchard by the agency of birds or otherwise to individual trees in various portions of it.

Most, if not all, of the stock of this orchard, had been purchased of the New Jersey nursery two years preceding the planting of that which had been taken up and destroyed — the condition of this having been overlooked at the time. A large portion of the orchard was critically gone over by me, and the trees marked which called for special care in the application of the winter wash recommended, and those which should be at once taken up and burned. The examination of the remainder of the orchard was subsequently made, and a number of infested trees discovered. So determined was Mr. Morrell to rid himself of this pest, that rather than wait for a winter treatment, all of the infested trees, as he has informed me, were taken up and burned: he believed that he did not have a scale remaining in his orchard. If it should prove that in this he has been over-confident, there is every reason to believe that within another year, the scale will be exterminated in this locality.

As the scale occurs also on the leaves — usually in rows along the midrib on the upper side, it was recommended to Mr. Morrell that the leaves from the worst infested trees which at the time of my visit were lying on the ground beneath or near them, should be raked together and burned, in order to prevent the chance of the scales being carried by the winds over the entire orchard.*

The infested trees were entirely of the d'Anjou variety. In two other orchards of Mr. Morrell of the Kieffer pear, not a scale was found, nor on the apple, cherry, and plum trees that were examined. The infestation was apparently confined to the two purchases made at the New Jersey nursery and had not extended beyond them.

The Scale on Long Island

In September of last year the scale was discovered in abundance in some of the nurseries on Long Island by Messrs. Sirrine & Lowe, who had been commissioned by the State Agricultural Experiment Station at Geneva for conducting some entomological investigations especially desired on Western Long Island, under an appropriation of $8,000 made by the Legislature of 1894 to the Station named, "for the purpose of agricultural experiment, investigations, instruction and information, in the Second Judicial department" of the State.

Among the earlier results of their investigations was the discovery of the San José scale in great abundance in some of the nurseries on the Island. The following notice of its first observation was communicated to *Garden and Forest*, of November 7, 1894:

The San José scale was observed first in the market at Jamaica on some Bartlett pears said to have been grown on the Island. The scale was also conspicuous on some fancy varieties of pears exhibited at the Queens County Fair; and by tracing the fruit to its source some of the infested nurseries were located. We have found the scale on Pear, Apple, Peach, and Quince stock in several nurseries.

The nurserymen were unable to give any definite information regarding the length of time that they had had the scale, but it was thought by some of them that it had been with them for the past twenty years. This, under the circumstances, is impossible: They had doubtless mistaken some other scale for it. Nor can anything definite be learned of the source of the infestation. If known to

*Dr. Smith does not believe that the fixed scale can be carried on fallen leaves. He states (*Bulletin* 106 *New Jersey Agricul. Coll. Exp. Station*, 1895, page 15): "Only such as are affixed to the tree itself have any chance of reproducing their kind. Those that fix to the leaves fall with them, and as these dry or decay the insect dies for want of food before attaining maturity."

them they have been unwilling to communicate the fact. It is stated that the stock that was infested was not grown by them, but was received from other nurseries. It would be of material service in the efforts that are being made for the extermination of the scale in the East if the localities of these "other nurseries" could be learned, but for some unknown reason it is being withheld. This unfortunate reticence is reflecting on all the other nurseries of the State of New York, for it seems to be implied that from some one or more of them the Long Island infested stock was originally received. It is conceded that its source was not the New Jersey nurseries.* The Geneva nurseries have been inspected by Mr. Lowe, with the result, it is inferred, that the scale was not found therein. The Rochester nurseries have been strongly suspected. Mr. W. C. Barry, when consulted, believed them to be entirely free from its presence, and this belief was subsequently carried to approximate certainty by examinations made by Mr. Sirrine, from which it resulted that the reported San José scale at Rochester, when examined at Washington, was found to be *Aspidiotus ancylus* — a closely resembling, but comparatively harmless species.

Condition of the Long Island Nurseries

It would be of interest if the exact condition of the Long Island infestation could be given in this Bulletin. I can state, however, from information received from Mr. Sirrine, under date of March 22d, that he had visited the following nurseries on Long Island: — of Fred Boulon, Sea Cliff; Keene & Foulk, Flushing; Parsons & Sons, Flushing; Isaac Hicks & Sons, Westbury Station; R. P. Jeffery & Sons, Smithville South; P. H. Foster, Babylon; W. C. Wilson, Astoria; Gabriel Marc & Co., Woodside; and the Long Island Nursery Company, Brentwood.

The last six of the nine above-named nurseries were found to be free from the scale. In the worse infested of the three,— as soon as the attention of the proprietors was called to the destructive enemy that they were harboring, a large number of trees were taken up and burned. The remainder were sprayed, according to

*It has since been learned that one of the Long Island nurseries has been receiving stock nearly every year since 1888 from one or the other of the New Jersey nurseries.

directions given by Mr. Sirrine, and would be followed by other sprayings in the event of the first not proving to be entirely effectual.

In the other two nurseries, the few trees that had been found to be infested had been destroyed, and it was thought that such further work would be done before the time for shipment, that no infested stock would be sent out from them.

It was probably one of these two, that had been reported as intractable last summer. As represented at the time, the owners were indifferent to the evil pointed out to them that would result from the multiplication of the pest, and indisposed to take any measures against it. When again seen by Mr. Sirrine in March, they would give no assurance of adopting the measures deemed necessary for preventing the distribution of their infested stock. The only promise that could be obtained from them was, that "they would treat with gas the stock they sold, providing that they had the time." A promise so broadly qualified could carry no weight with it. Unless a satisfactory understanding can be had with the firm, its name, if furnished to me, will be given in a foot-note, as a protection to purchasers of Long Island stock.*

There is scarcely a doubt but that infested stock has been sent from these nurseries to many places in the State of New York. If the attempt that is being made for the extermination of the scale in the State during the present year is to prove successful, it is of the utmost importance that each locality where possibly infested trees have been delivered within the past five years (dating back to the

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*The name of this nursery has since been given me as the Parsons & Sons Company, at Flushing, Long Island. In a letter addressed them on April 8th, the following questions were asked, and the reasons stated why replies were needed: 1. Have you taken steps to learn by application to Mr. Sirrine or by other proper means, of the extent of the infestation in your nurseries? 2. Have you taken up and burned the stock that was found to be the worst infested? 3. To what extent and with what results have you sprayed with proper insecticides such other infested stock as it was not thought necessary to wholly destroy? 4. Have you arranged for treating the nursery stock sent out this season with hydrocyanic acid gas, according to the approved directions published and accessible to you? 5. Have you sent out any nursery stock this year which may have been infested without having been subjected to the gas treatment?

In the answer returned by the Parsons & Sons Company to the above-mentioned letter, the only reply to the questions proposed is that found in the following—

probable establishment of the scale on Long Island) should be ascertained, and carefully inspected as soon as possible. Request was accordingly made of the proprietors of these infested nurseries, that they would furnish the State Entomologist with a list of their New York sales from and including the year 1890 to the present. One of the firms promptly complied with the request, so far as it could be done without involving excessive labor, and sent to this office extended lists, at the same time offering to open their books for further examination and transcription by any one who might be commissioned for the purpose.

It is due to this firm — Keene & Foulk, Bloodgood Nursery, Flushing, L. I., that they be specially mentioned, and commended for the earnest manner in which they are working for the extermination of the scale in their nursery. They have asked for suggestions and directions and have promptly and faithfully carried them out — not only in burning and spraying, but also in arranging, under the best approved method, for the fumigation by the hydrocyanic acid gas treatment of all the stock that they send out this season; the latter should ensure the destruction of any scattered individual scales that may have been overlooked. They will also, upon request, replace at half-price, all such infested stock that has been received from their nursery in former years before its condition was known.

In consideration of what they have done and are doing for the protection of their customers (and at the same time, of their own interests), it is believed that orders may be more safely sent to them

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prefaced by, "We only knew last fall of the San José scale:" "He [Mr. Sirrine] has informed us now of the plants infected, and we shall take them up and burn them as soon as possible. It is our intention to destroy rather than to spray. In the plants now sending out we have not noticed any infected: it would be impossible in any event to subject to the gas treatment while in the rush of sending off trees."

Is it possible — as may be inferred from the above, that up to the middle of April, absolutely *nothing* has been done by this company toward freeing their nurseries from this dangerous insect?

In the absence of present legislation authorizing entrance upon private grounds for the destruction of the San José scale, it only remains for purchasers of trees, shrubs, etc., subject to its attack, to protect themselves so far as they may, by withholding orders from localities known to be infested and where no efficient measures have been and are being taken for its extermination.

than to other nurseries where the scale may be reasonably looked for — where no thorough inspection has been made — where it may exist without having been detected, and where no gas fumigation, as a safeguard against such a contingency, is practised.

From the two other known infested nurseries on Long Island, no notice has been taken of the request for lists of New York sales of possibly infested stock, sent them under date of Feb. 15, 1894.*

The San José Scale in New Jersey

Nearly all of the infestation in the Atlantic and adjoining States having been clearly traceable to the sale — without knowledge or suspicion of their dangerous condition — of infested trees by two

*The following letter was addressed to each of three nursery firms above referred to:

Gentlemen: — Will you be kind enough to favor me with a list of the addresses of all the persons in the State of New York to whom you have made sales during the last five years (1890–1894) of nursery stock which might possibly have been infested with the San José scale which you have in your nurseries.

We are expecting to get a bill through our present Legislature by means of which we shall be able to have each locality into which infested stock may have been introduced, examined by an expert, and such measures taken as give promise of exterminating the scale in our State during the present year.

If you will furnish me with the list requested, it will aid much in this undertaking.

You will also see that in consideration of the serious character of this pest and the danger of its introduction into new localities, that not until we are able to report as free from infestation, all the nurseries of the State, especially those on Long Island which have been widely published (without names), will there be a willingness on the part of fruit-growers to order stock from nurseries actually having or suspected of having, the dreaded San José scale.

One of the largest nurseries in New Jersey which had made wide distribution of the scale, has sent me a list such as I ask of you, and is doing everything in its power to prevent distribution of any infested stock.

I had asked Mr. Sirrine to procure such a list for me, but I have thought it better to make a personal request.

We must, if possible, in the interests of both fruit-grower and nurseries, as soon as it can be done, exterminate the scale from our State.

I am very desirous of being able to say in the Bulletin which is nearly ready for publication, that I have reliable assurance that no further distribution of the scale will be made from New York nurseries. The name of your nursery will not appear in it.

Very truly yours,

nurserymen in New Jersey, there will naturally be a deep anxiety to learn what has been done in New Jersey toward the prevention of further distribution of the dangerous pest, through purchases that may have been made in 1894 or to be made hereafter.

From a Bulletin entitled "The San José Scale in New Jersey" (*Bulletin* 106 *of the New Jersey Agricultural College Experiment Station*), prepared by Dr. J. B. Smith, Entomologist of the Station, and issued in January, 1895, we learn that the introduction of the scale in New Jersey occurred either in 1886 or 1887, upon a "Kelsey" plum ordered by the two nurseries under the representation of its being curculio proof, from the San José district, California. It is also known that some Idaho pear stock brought from nurseries on the Pacific Coast were also infested.

As soon as Dr. Smith became aware (in April 1894) of the existence of the scale in the State, he at once, with his accustomed energy, entered upon the task of finding the nurseries from which the infested stock had been sent, and so far as possible, the other infested localities within the limits of the State. Two large and well-known nurseries, widely separated, were soon located, and these, so far as could be ascertained, were the only distributing centers. The owners, upon being informed of the dangerous character of the pest that they were harboring, and the effect that it might have upon their business in the future, immediately took active steps for stamping out the insect upon their bearing trees, upon which it mainly occurred, and promised to prevent, through fumigation or otherwise, further shipment of infested stock. In one of the nurseries several blocks of young stock were at once torn up and burned.

The scale had been distributed from these nurseries to a number of orchards throughout the State (nearly one hundred were known to Dr. Smith), but nowhere in sufficient numbers to have spread from the orchard in which it was at first introduced. In all of these, it is believed that measures will be taken by their owners for the prevention of further spread, and toward extermination.

The work will be carefully watched, and, with our knowledge of the zeal, persistence, and ability shown by Dr. Smith in all of his operations against the noxious insects that are so unfortunate as to intrude within his jurisdiction, we have every assurance that, if extermination is possible, it will be speedily effected.

The Two Infested New Jersey Nurseries

The interest felt among the fruit-growers of New York in the New Jersey nurseries, from which large purchases have been made each year, has been already mentioned, and will warrant a more particular reference to their present condition. Quite a satisfactory account of one, and an encouraging account of the other, can be given, based on letters from Dr. Smith, from correspondence with the proprietors of the nurseries at the suggestion of Dr. Smith, and from statements made in a recent number of the Rural New Yorker (of March 9th). The article in the R. N. Y., written by a gentleman connected with that journal, after a visit to Little Silver, N. J., to examine into charges that had been "publicly made that the Lovett Company have done practically nothing to exterminate the scale," publishes the names of "the two nurseries as those of Wm. Parry and The Lovett Company." There can, therefore, be no impropriety in the mention of their names in this Bulletin.

The Wm. Parry Nurseries.— The nurseries of Wm. Parry, are gladly mentioned, for the same reason given for making public the name of the nursery of Keene & Foulk, of Long Island. Unqualified praise is due Mr. Parry for his strenuous efforts for the extermination of the scale in the widely-known and far-famed "Pomona Nurseries," at Parry, and the aid so freely extended, in the endeavors being made, for its extermination wherever his extended sales may have borne it.* Promptly upon receiving a request for a list of New York sales which may have distributed the scale throughout the State, the desired list, embracing several hundreds of names, scattered through nearly every county, was sent to me, without any suggestion of compensation for the labor which it necessitated.

The expression of the confidence with which it is believed, orders could be sent at the present time to the Bloodgood Nursery, would apply in, at least, equal force to the Pomona Nurseries, where operations against the scale have been conducted largely under the direction and supervision of the New Jersey State Entomologist, Dr. J. B. Smith.

The Lovett Company Nurseries.— Of the condition at the Lovett Company Nurseries, the following is reported in the Rural

* We are indebted to Mr. Parry for the detection of the scale at Kinderhook, N. Y., in the summer of 1894, as noticed on page 279.

New Yorker, *loc. cit.* Some bearing trees upon which the scale had been located last autumn by Prof. Smith, had meantime been cut down and destroyed. Satisfactory apparatus for treating the infested nursery stock was found. Upon the scale being pointed out by Prof. Smith on a considerable number of young pear and apple trees that were heeled in, and in patches here and there in rows, they were cut down as fast as found, and, finally, Mr. Lovett agreed to chop out and burn the entire block. The larger part of the nursery stock had been heeled in, after having been treated with gas. The scales upon them, according to Prof. Smith, had been "practically killed," and, if treated again before being sent out, he would consider them safe. Mr. Lovett would "guarantee to destroy every tree where Prof. Smith had found the scale, and, also, to give all these trees a second treatment with gas." The Rural New Yorker concludes its account thus: "If this is done, there will be little danger of importing the scale from this nursery. This statement refers simply to the trees now in the nursery. What has already been sent out we do not know."

Much may be inferred, and seems to be implied, in the short sentence last quoted. It is here that the Lovett Company has chosen to place itself in a position exposing it to just and severe criticism. It virtually declines to do anything toward undoing the evil which it has perpetrated — for the most part unwittingly, we believe — in the distribution of infested stock in the State of New York.

Request was made of them from this office in November, 1894, for a list of sales such as Mr. Parry had sent me — stating fully its character. After several months' delay, reply was made (Feb. 4th), declining the request upon the ground of the immense labor that it would involve, but offering to place their order books at the disposal of any persons who might be sent for their examination. As this plan did not seem feasible to Dr. Smith — after further correspondence with him, he was asked to procure, if possible, the desired list from the Company for me, for which the expenses incurred would be paid. Dr. Smith wrote them, urging compliance with my request. The letter received from the Company in answer contained the following proposition: "If he [Prof. Lintner] will send us, or you either, a remittance of $250, we will attempt to make the examination desired. * * * But we want a clear understanding before we begin as to the settlement of cost of sending the list he requires." No comment on this modest proposal is needed!

The course taken by this firm has been so unaccountably strange in other respects as to expose them to suspicions which possibly may do them injustice. On the authority of Dr. Smith, the statement is made, that during last autumn [in September] in a visit of observation made them, he found that practically all of the trees in their nursery blocks were infested by the San José scale. He notified them of this fact at the time, and showed to both the President and Secretary of the company who were with him, the infested trees and the scales.

Under date of December 28th following, the Lovett Company, writing to the Director of the Ohio Agricultural Experiment Station in relation to some infested apple trees that had been sent by them to Clermont county, Ohio in 1890 — disavow all knowledge of the scale. They say: — "We would like very much indeed to have some branches from the trees referred to for examination ourselves. We have made a critical examination of our trees here in the nursery and also fruiting trees, and can find no trace whatever upon any of them of the San José scale or other scale. Having read reports upon the San José scale, we are confident that we could detect this insect if it existed upon our trees." (*Bulletin* 56, Dec. 1894, *Ohio Agr. Exper. St.*, p. 83.)

It is fortunate that since this letter was written, such pressure has been brought to bear upon the firm that it has taken the effective measures for its destruction reported in the Rural New Yorker cited, and in letters received from Dr. Smith.

As no aid is to be obtained from the company toward the examination of stock that it may have sent into the State of New York, request is herewith made of each person who within the last five years has received from the nurseries of the Lovett Company, Little Silver, N. J., fruit trees and ornamental shrubs, or other plants on which the scale is known to feed, that he will send his name to the State Entomologist, at Albany, with mention of the fact. If the arrangement proposed can be carried into effect, examinations will be made by competent persons of all such stock for the detection of the scale if present.

The San José Scale in Ohio

It is learned from Prof. F. M. Webster, that an infested locality in Clermont County, Ohio had come to his notice in December of 1894. The scale had probably been introduced in 1891 on apple trees purchased of the Lovett Company, of Little Silver, N. J. Prof. Webster reports: "The orchard comprised about 600 trees, probably one-third of which were more or less infested — twenty-five at least so badly as to preclude all possibility of saving them, and at least double that number that could only be utilized by cutting off the trunks at a short distance above the ground and grafting them, first disinfecting the stumps. The pest had been noticed the previous year. * * * A smaller orchard set at the same time and with trees from the same nursery, was found infested to a much less extent, though the scales were badly scattered through the orchard. * * * The owners of these two orchards will take this scale in hand and stamp out the pest before it gets a stronger foothold or becomes more widely spread." (*Bull.* 56 *Ohio Agr. Exper. St.*, December, 1894.)

Description of the Scale

The female scale, greatly enlarged is shown at Fig. 4 of Plate V and at *b* in Fig. 2 of Plate VI. It is flat, almost circular in outline, dark mottled with gray in color, with a small elevated spot at or near its center which is black or yellowish; it measures about one-sixteenth of an inch in diameter, but under some favoring conditions may attain a size of one-eighth of an inch; in its original description it is given as 0.08 of an inch.

Professor Comstock described the male scale as "black, somewhat elongated when fully formed. The larval skin is covered with secretion; its position is marked by a single nipple-like prominence which is between the center and the anterior margin of the scale. The scale of the male is more abundant than that of the female." It is often oval in shape, and of a smaller size than the female. It is represented at 5 in Plate V.

When occurring upon the bark of the twigs or leaves and in large numbers, the scales lie close to each other, frequently overlapping, and are at such times difficult to distinguish without a magnifying glass: see Fig. 1 of Plate VI. The general appearance that they present is of a grayish, very slightly roughened scurfy deposit. The natural rich reddish color of the limbs of the peach and apple is quite obscured when these trees are thickly infested, and they then have every appearance of being coated with lime or ashes. When the scales are crushed by scraping, a yellowish oily liquid will appear, resulting from the crushing of the soft, yellow insects beneath, and this will at once indicate to one who is not familiar with their appearance, the existence of healthy living scales on the trees. (*Circular No.* 3, 2*d series, U. S. Dept. Agriculture*, Washington, 1893.)

As before stated, the scale is also found upon the fruit. When present, in large numbers to the extent of covering the entire surface, it interferes seriously with the proper development of the fruit, causes it to crack, often to fall from the tree, or when it remains thereon, renders it unmarketable. It is a conspicuous object from the little depression which it causes (at least late in the season) and usually a well-defined purplish ring with which each scale is surrounded of a diameter considerably larger than that of the scale (see Figure 3 on Plate V and Figure 2 on Plate VI).

The Insect

The male.— As previously stated, the male only, becomes winged. It is shown greatly enlarged in Fig. 3 of Plate VII — its natural size being indicated by the crossed lines within the circle beside it. Examined under a high magnifying power its wings are seen to be transparent, each with two delicate veins only. It has a well-defined thorax and a rather large head with two large eyes. Its body is of a light amber color with dark brownish markings, and terminates in a slender "stylet" nearly as long as the body, which is the external organ of reproduction. The antennæ are long and conspicuous, ten-jointed, eight of which are hairy.

The above description of the male will be of no particular interest to others than the entomological student, as but few fruit-growers will ever see it in nature, as it is difficult to obtain and needs a good microscope for its inspection.

The female.— Soon after the leafing of the tree in the spring, when the young have crawled out from beneath the scales, close examination of an infested twig will show them as yellowish objects, scarcely more than points to the unaided eye moving over the bark (Matthew Cooke has given their size as one-seventyfifth of an inch). They are of an oval form, with the normal number of legs pertaining to insects — three pairs — and a pair of antennæ. In Fig. 1 of Plate VII, giving an enlarged view of the insect from the under side, its curious long hair-like beak or proboscis which serves it fór feeding and for fastening itself to the bark or leaf or fruit, is shown as curled up between the legs.

The mature female can only be seen by taking her from beneath the scale at the proper time. She then appears in a very different form from that when moving over the bark. In a subsequent molting she had lost her legs and antennæ, retaining only for her need her long and delicate proboscis consisting of four hair-like bristles within a two-jointed sheath. Fig. 2 of same Plate represents this stage of the insect, enlarged from the hair-line at the right-hand side. It is shown from the underside as seen with its transparency in nature, with a number of its young within,— this species, unlike most of the scale-insects, which produce eggs — bringing forth its young alive. Of the several segments into which the body is divided, as indicated in the figure, the last one bears groups of spinnerets, anal and vaginal openings, and upon its border, lobes, incisions, and spines (some of which are shown in enlargement at *d*): from the location, number, and form of these, important and reliable characters are drawn for the separation of the species, which may not be found in the study of the external scale alone, where they closely resemble one another.

Its Life-History

Most of the Coccidæ are oviparous — that is, they deposit eggs underneath the scale, from which the young are soon thereafter hatched. A few are known to be viviparous, i. e., bringing forth living young, as *Aspidiotus tenebricosus* occurring on maple, and a few species of the genus *Lecanium*.* It would seem that the San José scale, *Aspidiotus perniciosus* is both oviparous and viviparous, for while generally regarded as giving out its young alive (the young shown within the body of the parent in Fig. 2 of

* As *Lecanium hesperidum*, *L. platycerii*, *L. tulipiferæ*, and two unnamed species on the red bay and on Acacia.— Riley, in *Proc. Ent. Soc. Wash.*, III, 1894, pp. 67, 69.

Plate VII), it is also recorded as producing eggs. Dr. Riley has stated of it (*loc. cit.*) — "specimens examined in December, 1879, showed that the mature females were hibernating, and that with some of them were found a few eggs and recently hatched larvæ:" on the authority of Professor Comstock (*Rept. Commis. Agricul.* for 1880, p. 305), "the eggs are white:" Matthew Cooke has written (*Inj. Ins. Orchard, Vineyard*, etc., 1883, p. 62) — "each female produces from thirty-five to fifty eggs:" W. G. Klee, State Inspector of Fruit Pests in California, states (*Bien. Rept. St. Bd. Horticul. Cal.* for 1885 and 1886, page 373) — "eggs, thirty to fifty produced by each female; color yellow; form ovate:" Mr. C. H. T. Townsend, formerly of the New Mexico Agricultural Experiment Station, states of the eggs — "According to Comstock, the eggs are white; but according to my own observation, they turn to an orange-yellow color in the spring. They hatch here about the first or second week in May." (*Bulletin No. 7 New Mexico Agr. Exper. St.*, June, 1892, p. 7). Other writers have also mentioned the eggs. As opposed to this, however,— in colonies of the scale carried over on potted pear trees in the Insectary of the Entomological Division at Washington during the winter of 1893–4, although watched with care and subjected to daily observation,— in no instance were eggs seen (*Insect Life*, vii, p. 287).

Early in June, ordinarily, in New York and New Jersey, the young escape from underneath the scale, and for a short time may be seen traveling actively over the branches, when they fasten themselves to the bark and commence to secrete a scale. They are not all given out at the same time, even the members of the same family. How long the hibernating female continues to reproduce, is not known. It is thought by Dr. Smith that it may extend over the greater part of the summer, and until "their grand-daughters are already full-grown with nearly full-grown progeny: there may be, therefore, upon a plant at one time, young born of as many as three or even four distinct generations." Certain it is that examination of an infested orchard will show the presence of the young traveling insects at any one time from early June until nearly the last of autumn. On some pieces of twigs cut in Mr. Morrell's orchard on November 1st, the little yellow young were seen in motion two days thereafter in my office. It is probable that the young will not survive on a twig cut from the tree, for more than four or five days.

Observations made on isolated individuals at Washington showed that "the newly-hatched larvæ after crawling about for a few hours, settle down and commence at once to form a scale, which is white and fibrous. In two days the insect becomes invisible, being covered with a pale, grayish-yellow shield with a projecting white nipple at the center. * * * * * Twelve days after hatching, the first skin is cast. * * * * * In twenty to twenty-one days after hatching, the females cast their second skin. At 24 days the males begin to issue. * * * * * At 30 days the females are about full grown, and embryonic young can be seen within their bodies; and at from 33 to 40 days the larvæ begin to make their appearance." For additional observations on the development of other broods, see Howard, *Insect Life*, vii, pp. 288, 289.

From the first brood hatching early in June, a second is undoubtedly disclosed in July. How many follow, has not been ascertained. Matthew Cooke has placed the number during the season, at three,— the first in June, the second in July, and the third in October; but it would seem that the high temperature of summer could hardly fail of developing at least one additional brood intermediate to those of July and October. Four broods were developed at Washington from over-wintered females, and it was thought that there were ordinarily five. They soon became so inextricably mixed that the only importance that could attach to a determination of their number, would be as indicating the rapidity of increase of the insect in different localities and under different seasonal conditions.

The females continue to feed until prevented by the dormancy of the tree in the late autumn. It is thought that most of them pass the winter in about a half-grown stage, and resume their feeding in early spring, as soon as practicable for their entrance upon active life, in June as above stated.

Its Food-plants

In addition to the food-plants of the San José scale that have been mentioned in the preceding pages, several others have recently been reported to me by Mr. Sirrine, as observed by him on Long Island.

The following is the list as it now stands. It will doubtless be largely extended by future observations:

Tiliaceæ

Linden (*Tilia*).

Celastraceæ

Euonymus.

Leguminosæ

Acacia.

Rosaceæ

Almond.
Peach.
Apricot.
Plum.
Cherry.
Spiræa.
Raspberry.
Rose.
Hawthorn (*Cratægus*).
Cotoneaster.
Pear.
Apple.
Quince.
Flowering Quince.

Saxifragaceæ

Gooseberry.
Currant.
Flowering Currant.

Ebenaceæ

Persimmon (*Diospyros*).

Urticaceæ

Elm.
Osage Orange

Juglandaceæ

English Walnut.
Pecan Nut.

Betulaceæ

Alder ? (*Alnus*).

Salicaceæ

Weeping Willow.
Laurel-leaved Willow (from Asia).

It will be seen from the above that the scale is recorded as occurring on plants in ten of the Orders, although one-half of the food-plants named belong to the Order of *Rosaceæ*.

Spread of the Insect

The natural spread of this scale is not a rapid one. As the female is unprovided with wings, and is unable to change its position after having become fixed and throughout its entire period of reproduction, the insect can only pass from one tree to another during the few hours that it continues in its active larval stage. Although a rather rapid traveler its range of locomotion would hardly ever carry it to neighboring trees in an orchard, unless the branches should interlock, in which case every facility is afforded it for spreading the infestation,— almost equal to that existing in nurseries where the young trees are grown so closely together as to form compact masses.

Carried by birds, etc.— It has been found that the young insect may be distributed through the agency of other insects and of birds. When abounding on a tree to the extent that much of the bark is already occupied by the scales, they apparently show a disposition to leave the tree and fasten upon any visiting insect or to the legs of birds. If this is instinctive or in accordance with a purpose, they will leave their hosts as soon as transported to a favorable place for the establishment of a new colony. It is stated that several of the young have been seen upon the wing-covers of a single lady-bird,— that they are often found on ants, and that they show a preference for insects of dark color.

Distribution in Nursery Stock.— The ease with which many of our most serious insect pests may be widely distributed through sales of nursery stock, has been brought to notice so frequently in recent years by studies made of the means by which injurious insects have suddenly made their appearance in new localities, that our economic entomologists have deemed it their duty from time to time to warn fruit-growers of the danger to which they are exposed, and to press upon them the great importance of a thorough inspection of all the nursery stock purchased by them. Each of the recent occurrences of the San José scale in the Eastern States, has been traced directly, or with a strong probability, to nursery infestation as its source. Of course, the danger of such introduction is the greater when the insect is so inconspicuous as is this scale, or when it is entirely hidden within its burrows in the branches or trunk, as in the case of the flat-headed pear tree borer, *Agrilus sinuatus* Oliv., lately discovered in New Jersey orchards by Dr. Smith, and by him traced to a New Jersey nursery which it was supposed had imported it from Europe about ten years ago.

Protection from Infested Stock

In view of this danger, the following suggestion made by Dr. Smith (*Entomological News*, v, p. 311) is both timely and important: "No farmer should set out a tree until he has examined it closely and made certain that no scale-insects infest any portion of it. He should also wash at least the trunk and larger branches with a kerosene emulsion, diluted by no more than five parts of water; and he should, finally, trim back to the smallest possible amount of wood, burning or otherwise destroying all the cuttings," thereby facilitating the growth of the tree, and disposing of the eggs of the Aphides or plant-lice and of mites occurring on the smaller twigs.

Dr. Smith also offers the following: — "Purchasers of nursery stock could insist on a written guarantee with each lot of stock purchased, that they are clean and free from insect pests, and had not been, in the nursery, affected by any plant disease, nor grown in the vicinity of diseased trees".

It is not probable that the New Jersey or Long Island nurserymen would give such a guarantee, nor does it seem that they could safely do so. Were they, one and all, skilled entomologists they might, even then, with reason, decline to commit themselves so broadly,— covering insects of all kinds, both exposed to view and hidden from the eye. But for the present, at least, while the scale infestation of these localities is so generally known, some assurance of protection will be demanded by all to whom the knowledge has come, before further orders are sent to the nurseries involved.

The following form of certificate is offered to the consideration of purchasers and nurserymen, in the belief that it would prove equally beneficial to each party. Without it, or something to the same effect, there is reason to believe, from action about to be taken in another State, that some of the unfortunate nurseries may suffer for a time from a "boycott". Let it be understood — there is no disposition on the part of any entomologist to magnify the danger to important interests from this newly introduced pest, but simply to accept it at its full magnitude: —

I do hereby certify that the stock sent out herewith has been examined by a competent entomologist, and has been pronounced by him, to the best of his knowledge and belief, to be free from living San José scales (*Aspidiotus perniciosus*); and in the event of its being shown that the stock now sent has carried with it the living insects, I do hereby agree to replace it free of cost with uninfested stock.

Proposed Legislation

No legislation has been had in the State of New York against insect pests. Laws of this character, more or less broad and stringent, have been passed in ten of the States, viz., California, Colorado, Idaho, Kansas, Massachusetts, Minnesota, Missouri, Nebraska, Oregon, and Washington. A compilation of these Laws, which will be found convenient for examination and as aids to future legislation, has recently been made in a pamphlet of 46 pages by Mr. L. O. Howard, and issued as *Bulletin No. 33 of the U. S. Department of Agriculture — Division of Entomology.* California, it appears, has taken the lead in resorting to legislation, moved thereto by the urgency of preventing the introduction of species known to be destructive to fruit culture in other parts of the country and from the Old World.

Although the State of New York is subjected each year to losses from insect injuries which would aggregate in amount to several millions of dollars — a large proportion of which is preventable,— no effort has hitherto been made toward the removal of so onerous a burden through a resort to legislative aid. An investigation of the insect pests of the State which was commenced forty years ago and continued, with a short interval, up to the present, has given to the people of the State details of the life-histories and habits of all of our more noxious insects, accompanied with methods for their control. These studies are accessible in State reports to all who may desire to consult them. Their recommendations are conceded to be of great value, and if the information they contain be utilized to the extent that it should be, the occasion will seldom arise when aid from legislation is needed.

There may be, however, insect infestation in some other State or country of such a pronounced dangerous character, that its introduction should be guarded against by quarantine laws. Or, an insect may have multiplied to such an extent that its control is entirely beyond individual effort, as in the case of the gypsy moth in Massachusetts. Again, a newly introduced insect pest, known only in a single locality but threatening an almost unlimited range, may call for its extermination while the task is simple and inexpensive.* Still another instance, is that of the presence of the San José scale in the State of New York. There is reason to fear that it has been sent in every county of the State. In how many orchards it has found place can not be known, with-

*Such an opportunity was lost when the pear-midge was confined to a few orchards in the town of Meriden, Conn.

out special examination of suspected localities by a person competent to identify it. Its dangerous character demands its extermination if it can be accomplished. Although it has had a foothold in the State for, probably, five years or more, it is believed that its extermination is practicable if the proper effort can be made at once, under the provisions of a bill which has been drawn up and introduced in the present Legislature — reading as follows:

An Act to provide for the Extermination of the San José Scale in the State of New York.

The People of the State of New York, represented in Senate and Assembly, do enact as follows:

Section 1. Whenever the state entomologist may have knowledge of the existence of the San José scale, or has reason to believe in the probability of its existence in any locality within the State of New York on any trees, plants, vines, or fruit, he shall notify the commissioner of agriculture, who shall thereupon appoint one or more experts who shall be sufficiently familiar with the scale to be able to recognize it, for the prompt inspection of the infested or suspected locality.

§ 2. Such agent shall make thorough inspection of the locality named, and if the existence of the scale is found therein, he shall notify the owner or owners of the orchard, nursery, or grounds in which the insect is found, of its existence therein, and serve a notice containing a statement of all the facts found to exist, upon the owner or owners, with an order that within ten days they shall take such measures as have been proven to be effectual in the destruction of the scale and for prevention of its further distribution, and to continue them until its extermination has been effected.

§ 3. If the owner or owners shall refuse to comply with the order of the agent, as above stated, the agent shall be charged with its execution, and for this purpose, shall employ all necessary assistance; and such agent or his employes may enter upon any or all premises within the town or city for the purpose of the speedy extermination of the scale. Such agent shall be entitled to compensation for his services under this act at the rate of five dollars for each full day spent by him in the discharge of his duties, and the necessary disbursements paid or incurred by him therein.

§ 4. The sum of five thousand dollars, or so much thereof as may be necessary, is hereby appropriated out of the state treasury to carry out the provisions of this act.

§ 5. This act shall take effect immediately.

Remedies

There is no difficulty in killing this insect at any time and in any form of its existence, if the proper remedies are used and properly applied: but if entire success is demanded — that is, if all of the insects infesting an orchard are to be destroyed, which means extermination,— so far as our present knowledge extends, it can only be accomplished in the winter season. During the many years of its existence in California the experiments there conducted, showed that several of the insecticidal applications tested, were entirely effective — particularly some of the "winter washes" of which the formulas have been frequently published. When it became necessary to contend with the insect in its eastern invasion, it was naturally supposed that the Californian remedies would be equally effective here, but experiments with them proved that they only sufficed to destroy a certain percentage of the hibernating form; and even when used in double strength, a large proportion of the scales was not destroyed. These unexpected results may probably be accounted for by a more perfect dormancy of the insects in the East than in California.

Winter washes.— The experiments that have been conducted under the direction of L. O. Howard, Chief of the Entomological Bureau at Washington, during the past year (1894), have been so varied and apparently so thorough that it would seem that the results attained might be accepted, without further experimentation, for future guidance in our operations against this scale. During the latter part of the year, twenty-nine different washes were tested by experienced entomologists from the Bureau, upon badly infested trees in Charles county, Maryland. In summing up these results, Mr. Howard has stated: "The only perfect results which have been reached have come from the application of two pounds or more of commercial whale-oil soap to a gallon of water, and from the application of a resin wash of six times the normal summer strength. The effects following the application of these washes leave nothing to be desired. In all cases the most careful search over the sprayed trees has failed to show a single living scale."

Unfortunately, both of the above-named washes are somewhat expensive, as the lowest price at which the whale-oil soap can be purchased is four cents the pound by the barrel, making the wash to cost eight cents per gallon. The resin wash is still more expensive. When large orchards are to be treated, the cost is quite an item, but the intelligent fruit-grower will not hesitate when convinced that the choice lies between the expense of the wash and the loss of the trees.

The above are known as "winter washes," since they may only be used without serious injury to the tree during its winter dormancy. Later, it would not be safe to apply them unless in a considerably diluted form, when they would only suffice to destroy a portion of the scales.

Home-made whale-oil soap.— For those who would prefer making the soap for themselves, at a less cost than if purchased by the small quantity in market, Mr. Howard has given the following formula:— Potash lye, one pound; fish oil, three pints; soft water, two gallons; dissolve the lye in water and add the oil on bringing the mixture to a boil; boil for about two hours and then add sufficient water to make up for the evaporation. This will make about twenty pounds of soft soap — equivalent to about five pounds of the hard.

The winter resin wash.— The composition and proportions given for this, are as follows:— Resin, 120 pounds; caustic soda, 30 pounds; fish oil, 15 pints; water sufficient to make 100 gallons. The resin and soda are broken up and, together with the fish oil are placed in a large kettle, sufficient water being added to cover them. The whole is then boiled for several hours, or "until the compound will mix properly in water without breaking up into yellowish flakes." (*Insect Life*, vii, p. 293).

Potash wash.— Dr. Smith, in his experiments with the scale in New Jersey, has tested to his entire satisfaction the efficacy of a saturated solution of crude or commercial potash, i. e., potash in a sufficient quantity of water to dissolve it, to be used upon trees during their dormancy in the winter season, only. It may be applied either by means of a cloth or stiff brush, or by thorough spraying. The potash eats into or corrodes the scales and kills a large proportion of the insects beneath them. A month later, by which time the scales will have become riddled or loosened, it should be followed with kerosene emulsion made after the usual formula and diluted to a strength of one part to five parts of water. If these applications are thoroughly made,— according to Dr. Smith, "not a single insect need escape."

Before using any of the above washes, it is recommended to cut back as freely as may be properly done, the infested trees, and burn the cuttings, as a large part of the scales are to be found on the terminal twigs.

Summer washes.— Experiments thus far made with applications that may be safely used during the summer, have failed to give a wash that will destroy all the scales — a small percentage will escape. The two that have given the best results are the summer resin wash and an ordinary diluted kerosene emulsion. With either of these, "by three applications at intervals through the summer, the insects may be kept from increasing to any serious extent." The unattached insects and those in which the scale is in its incipiency will readily be killed, and if it were possible to reach all of them the entire destruction of the insect would be effected. But this is impracticable. The young are hatching continually during nearly five months of the year, and are to be found at any time during this period in their active stage upon the tree. The number of sprayings that would be required to reach the young before they are protected by their scale, would render this method altogether too laborious and costly to depend upon it for extermination.

Gas treatment.— The treatment of infested trees with hydrocyanic acid gas, generated within a canvas tent made air-tight through the application of boiled linseed oil, and fastened closely down over the tree to be treated, has been extensively used in California and with entire success against some of the scale-insects of the Western Coast. The cost of the tents and the labor involved in their management, render it altogether too expensive for general use; and further,— although it has been hitherto claimed that the gas applied in this manner was absolutely fatal to all animal life, yet, late experiments appear to show that it may not be entirely depended upon for the complete destruction of the San José scale when infesting orchards. According to Mr. Howard, an orchard in Charlottesville, Va., which had been treated with the gas in March last, under the skilled supervision of Mr. Coquillett,— although "the operation was as thorough as it could be made, a few of the insects survived the treatment, as was shown by the receipt of living specimens late in the fall from Dr. Hedges." (*Insect Life*, vii, p. 286.)*

* Mr. Howard has since made personal examination of this orchard, and has found the gas treatment inefficacious. The trees are again badly infested, while one result of the fumigating has been to seriously injure the trees by causing the blackening and cracking of the bark.

Treatment of Nursery Stock.—It is believed that the hydrocyanic acid gas treatment is reliable for disinfesting nursery stock of infested nurseries previous to its distribution. Of course, all such stock found to have the scale in abundance, should be promptly taken up and burned, but where the scale is sparsely present or even where there is barely a suspicion of its presence, it should, before shipment be subjected to the gas fumigation. This is now being done in New Jersey and Long Island nurseries — in some of them at least, and should be made a condition upon which any further orders may be given or stock received from either of the infested districts or others that may hereafter be discovered.

The manner of treatment is the following: An air-tight box is made of suitable size for the reception of as much stock as may be conveniently treated at one time. The stock is placed therein and subjected for an hour to the gas generated in it by the combination of three ounces of water, a little more than one fluid ounce of commercial sulphuric acid, and one ounce of 60 per cent cyanide of potassium, to be placed in a glazed earthenware vessel of the capacity of at least a gallon, in the order above named: these amounts are for 150 cubic feet of space. It should be remembered that this gas should not be breathed as it is exceedingly poisonous.

Bibliography

The following references to publications upon *Aspidiotus perniciosus* are given as an aid to those who may wish to learn more minutely of the life-history and habits of the insect, or for information upon topics which have been omitted from this Bulletin in order not to extend it to an undue length, as for example: the parasites of the insect (see *Insect Life*, vii, pp. 289–292); the possibility of the limitation of its multiplication in its northeastern range to certain portions of the State of New York and the Eastern States (*id.*, p. 292); its possible introduction through infested Californian fruit (see *Bull.* 106 *New Jersey Agr. Coll. Exper. St.*, p. 17, *and Insect Life*, vii, p. 167); the varieties of plums and pears more liable to its attack (*Bull.* 106—*ante*, p. 16); and its natural enemies (*id.*, p. 16).

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Townsend: in Bull. 7 New Mex. Agr. Exp. St., June, 1892, pp. 6, 7 (in Las Cruces).

Riley: in Rept. Sect. Agr. for 1891, 1892, p. 244 (washes used in California); in id. for 1893, 1894, pp. 215–221, pl. 1, f. 1 (general account); in Proc. Amer. Assoc. Adv. Sci., xlii, 1893, p. 229 (discovered in Virginia).

Howard: Circular No. 3, 2d Ser. U. S. Dept. Agr.—Div. Ent., April, 1893, 10 pp, 5 figs. (its Eastern appearance and remedies); in Insect Life, vii, 1894, pp. 153–163 (Eastern occurrence); in Canad. Entomol., xxvi, 1894, p. 355 (its distribution); in Insect Life, vii, 1895, pp. 283–295 (life-history, spread, parasites, remedies).

Cockerell: in Canad. Entomol., xxvi, Feb. 1894, p. 32 (No. 73 in list of Nearctic Coccidæ).

Smith: in Entomolog. News, v, 1894, pp. 182–184 (Eastern occurrence), p. 312 (discovered on Long Island); in Insect Life, vii, 1894, pp. 163–167 (in New Jersey); in Gard.-Forest, vii, 1894, p. 344 (danger from infested California fruit); Bull. No. 106 N. J. Agr. Coll. Exp. St., Nov. 22, 1894, 1895. 24 pp. 5 figs. (in New Jersey, and general account); in Entomolog. News, vi, 1895, pp. 153–157 (operations against, in New Jersey nurseries).

Koebele: in Insect Life, vi, 1894, p. 27 (Orcus parasites).

Schwarz: in Insect Life, vi, 1894, pp. 247–252 (in Charlottesville, Va.).

Lintner: in Rur. New Yorker, liii, 1894, p. 791 (neglected on Long Island); in Albany Eve. Journ., Nov. 7, 1894 (observed at Kinderhook, N. Y.).

Sirrine: in Gard.-Forest, vii, 1894, p. 449 (on Long Island).

Fletcher: in Evidence bef. Commit. Agr., 1894, p. 19 (in British Columbia); in 24th Ann. Rept. Ent. Soc. Ont., 1895, pp. 73–76, f. 48 (in Br. Columbia, habits, remedies).

Slingerland: in Rur. New Yorker, liv, 1895, p. 5 (Eastern localities and prospects).

Webster: Bull. 56 Ohio Agr. Exp. St. for December, 1894, 1895, 18 pp. 5 figs. (in Ohio, and N. J. Bull. 106 quoted).

H. W. C[ollingwood]: in Rur. New Yorker, liv, 1895, p. 167 (observations at Lovett Company nurseries), p. 317 (the Parsons Company nursery on Long Island).

Explanation of Plate I.

Fig. 1.— The apple-tree bark-louse, *Mytilaspis pomorum* (Bouché), on apple bark. (After Comstock.)

Fig. 2.— The scurfy bark-louse, *Chionaspis furfurus* (Fitch): *a*, the female scales, and *b*, the male scales, in natural size on twigs; *c*, the female scale, enlarged; *d*, the male scale, enlarged. (From the Division of Entomology, U. S. Dept. Agr. at Washington.)

Fig. 3.— The scurfy bark-louse: [*a*], the male; *c*, the young larva; *f*, the male pupa; *g*, the female, from beneath — all enlarged; *b*, *d*, *e*, *h*, structural details of legs and antenna, in greater enlargement. (From the Division of Entomology, Washington, D. C.)

PLATE I.

Fig. 1

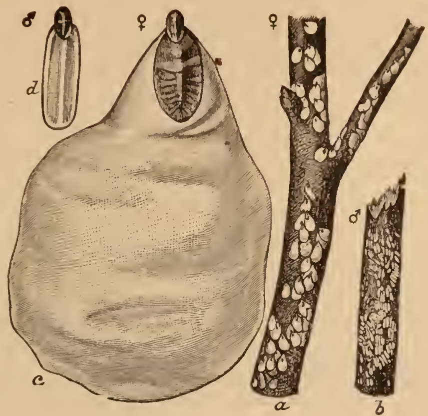
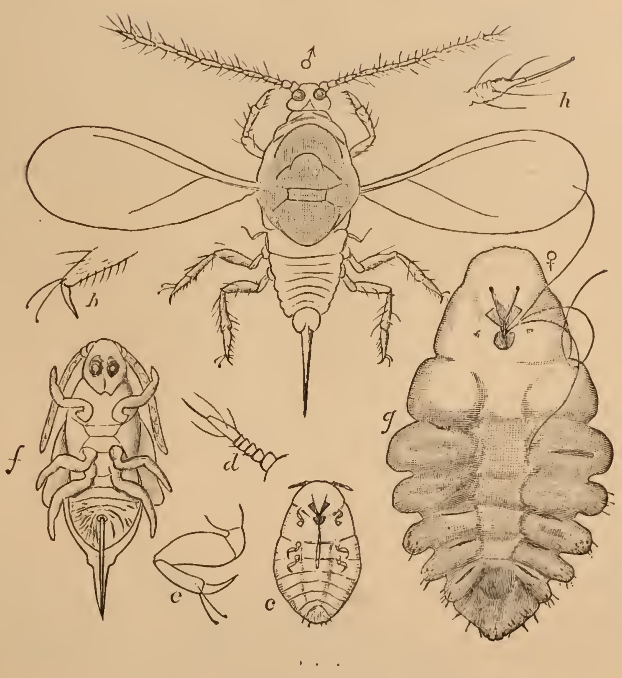


Fig. 2



Explanation of Plate II.

Fig. 1.— The pine-leaf scale-insect, *Chionaspis pinifolii* (Fitch): *1*, the scales on the leaves in natural size: *a*, leaves not stunted by the presence of the scales; *b*, scale of female of usual form, enlarged; *c*, wide form of the same, enlarged; *d*, a male scale enlarged. (After Comstock.)

Fig. 2.— The white scale, *Aspidiotus nerii* Bouché, on an Acacia twig, in natural size: *a*, the male insect, enlarged; *b* and *c*, the male and female scales, enlarged. (After Comstock.)

PLATE II.

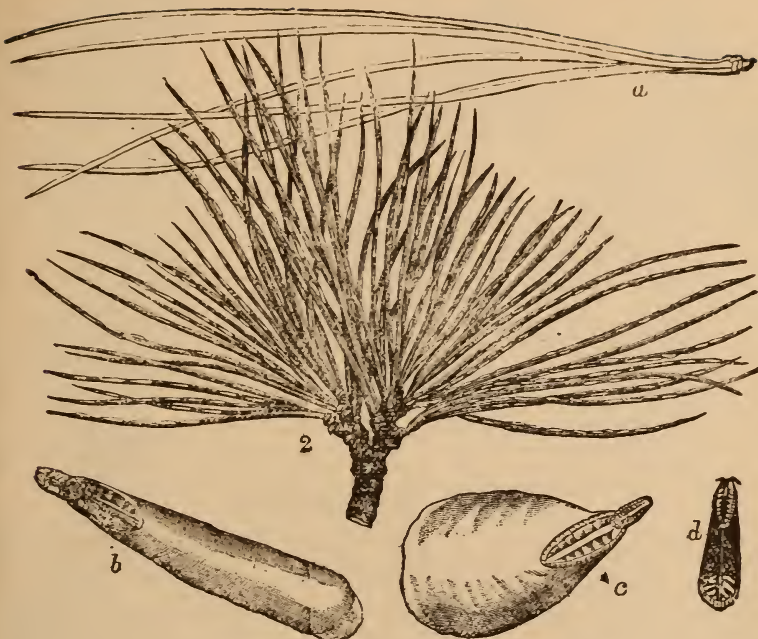


FIG. 1

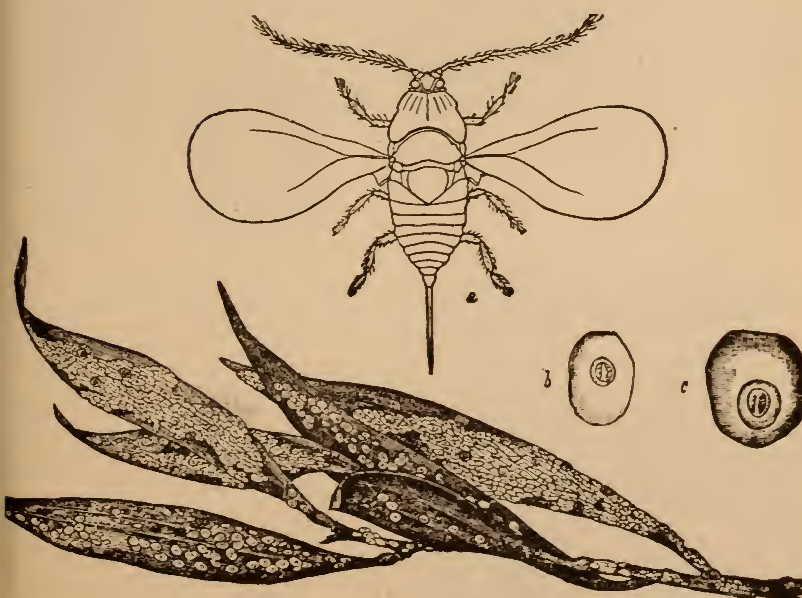


FIG 2.

Explanation of Plate III.

Fig. 1.— The maple-tree scale-insect, *Pulvinaria innumerabilis* (Rathvon), with extruded egg-masses, on grape, natural size. (After Comstock.)

Fig. 2.— The same, on osage orange and on maple. (After Walsh and Riley.)

Fig. 3.— The same: *a*, a twig with mature female scales and egg-masses, natural size; *b*, mature female scale from above, enlarged; *c*, female scale from below, more enlarged; *d*, the thread-like setæ of the proboscis. (From the Seventh Report on the Insects of Illinois.)

Fig. 4.— The same: *a*, a twig with half-grown female scales, in natural size; *b*, autumnal female scale from above, enlarged; *c*, the same from beneath; *d*, the male insect enlarged. (From the Seventh and Thirteenth Illinois Reports.)

PLATE III.

FIG 1.

FIG 2

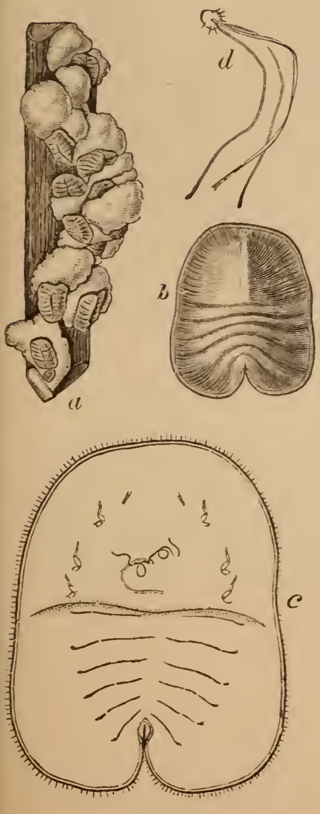


FIG. 3.

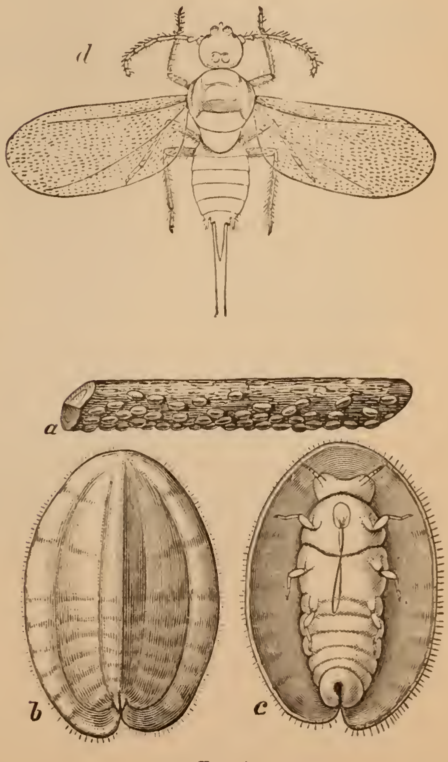
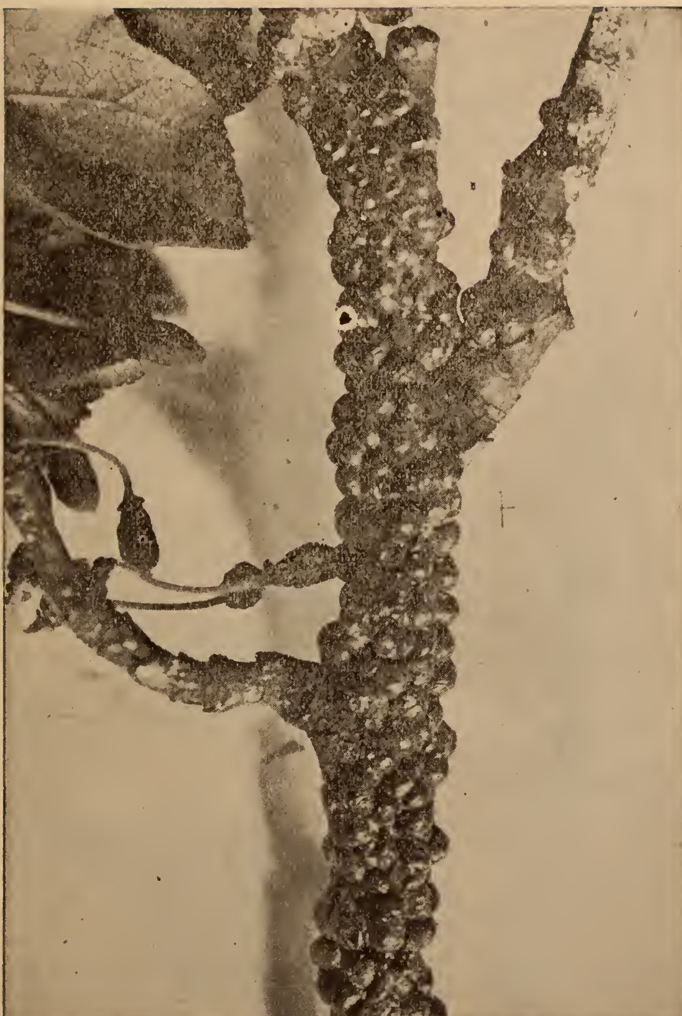


FIG. 4.

Explanation of Plate IV.

The plum-tree scale-insect, *Lecanium ?juglandis* Bouché in natural size, on plum. (From Garden and Forest.)

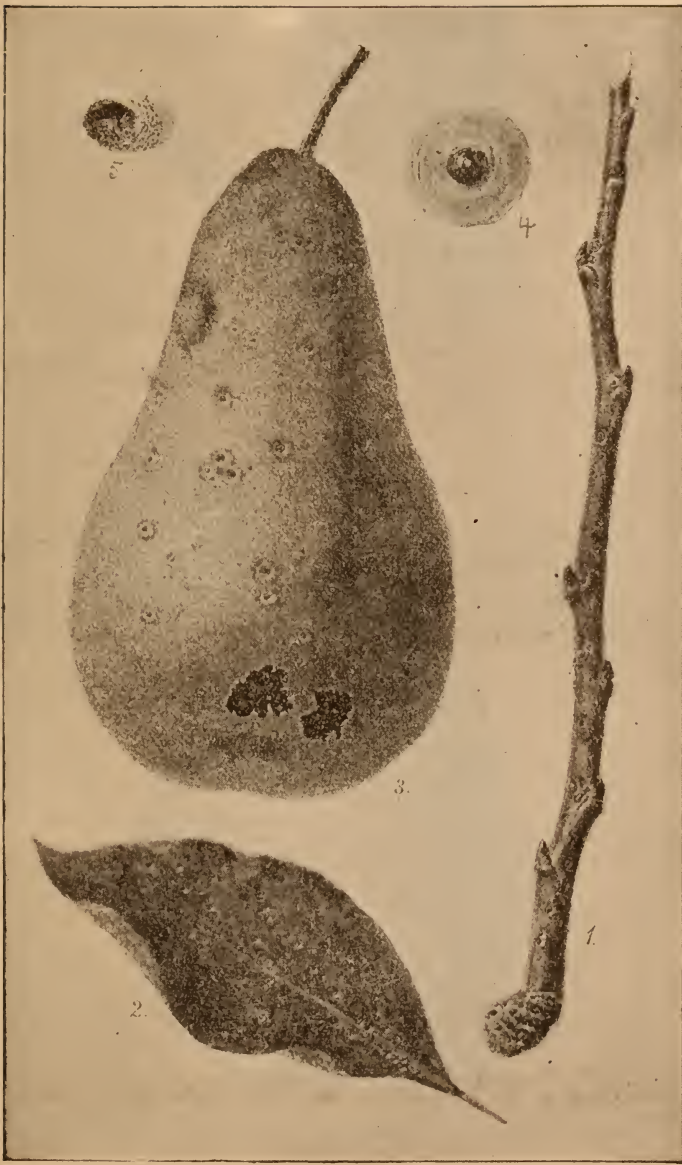
PLATE IV.



EXPLANATION OF PLATE V.

Fig. *1*, the San José scale, *Aspidiotus perniciosus* Comstock, infesting a pear twig; *2*, the scales on a leaf; *3*, scattered scales on a pear; *4*, a female scale. enlarged; *5*, a male scale, enlarged. (From the Cornell University Agr. Exper. Station, and by permission of the California State Board of Horticulture.)

PLATE V.



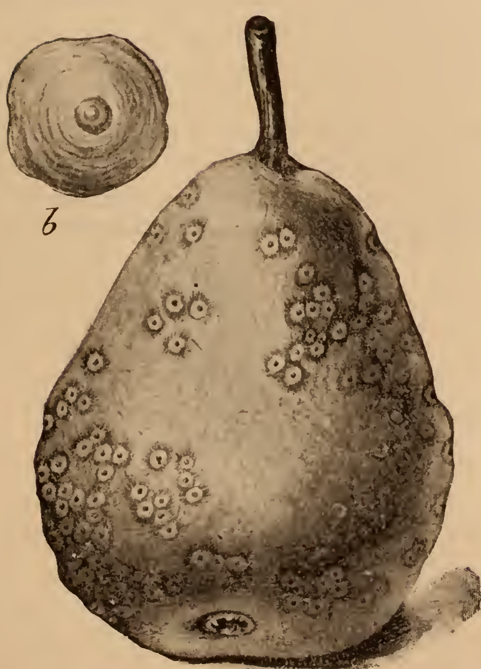
Explanation of Plate VI.

Fig. 1.—The San José scales, in natural size on an apple branch; scales somewhat enlarged on apple bark at above at the left.

Fig. 2.—San José scales on a pear showing the surrounding ring; *b*, a female scale, enlarged.

PLATE VI.

FIG.



a

FIG. 2

Explanation of Plate VII.

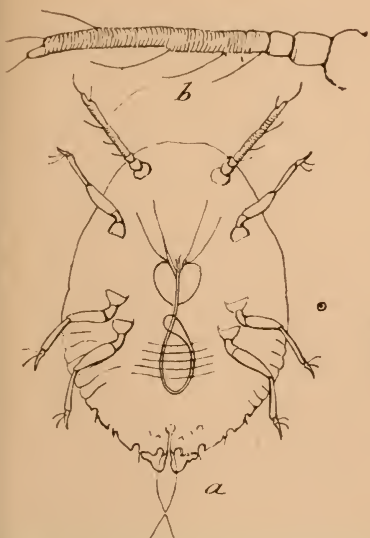
Fig. 1.—Enlarged view of the young larva of the San José scale-insect, seen from beneath, with a greater enlargement of an antenna at *b*.

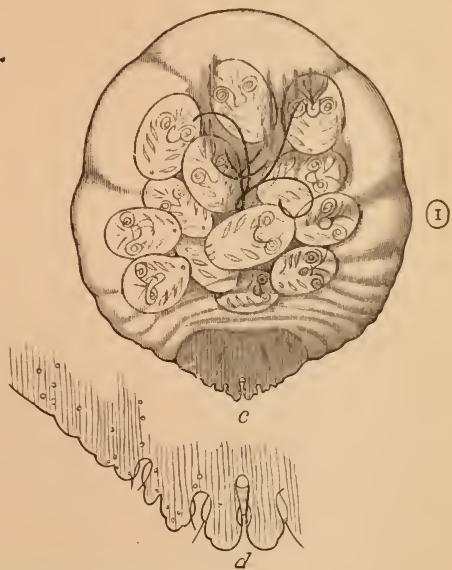
Fig. 2.—An enlarged view of an adult female of the San José scale-insect, containing young; at *d*, a still greater enlargement of a portion of its anal fringe.

Fig. 3.—A greatly enlarged view of the adult male of the San José scale-insect; its natural size shown in the inclosed crossed-lines at right-hand side.

(The figures of this Plate and the preceding one are from the U. S. Dept. Agriculture—Division of Entomology.)

PLATE VII.





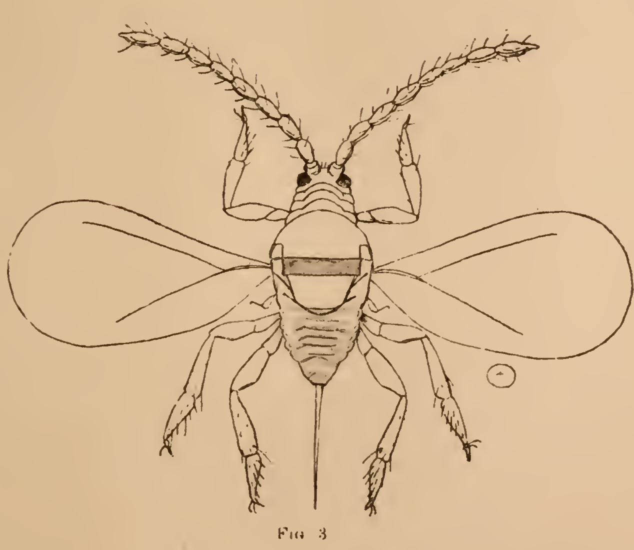
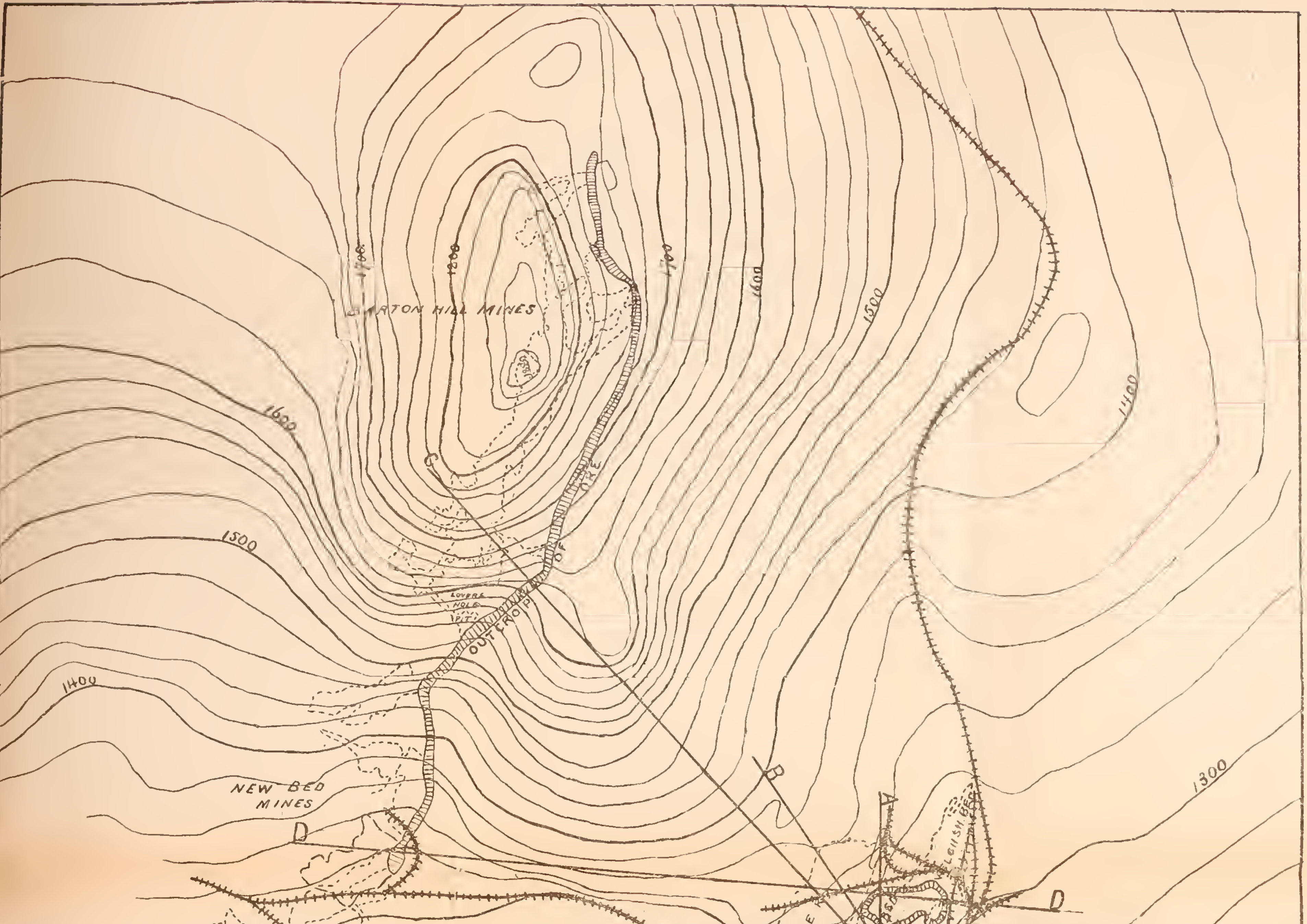


FIG 3



II. Map of the Mineville District, Essex Co., New York

Based on a Map by S. B. McKee, Engineer of Witherbee, Sherman & Co., and the Port Henry Iron Ore Co.

University of the State of New York

BULLETIN

OF THE

New York State Museum

VOL. 3 No. 14

SEPTEMBER 1895

THE GEOLOGY OF MORIAH AND WESTPORT TOWNSHIPS, ESSEX COUNTY, N. Y.

WITH A GEOLOGICAL MAP

PREPARED UNDER THE DIRECTION OF

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BY

JAMES FURMAN KEMP, E. M.

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1895

INTRODUCTION

The geology of the eastern Adirondacks presents many problems of interest. The townships along Lake Champlain contain within their borders the contacts of the labradorite rocks — (gabbros, norites and anorthosites) with the quartzose gneisses and crystalline limestones; and the later-formed unconformabilities of all these with the Potsdam sandstone of the Upper Cambrian. The crystalline rocks of the Archæan invite study of both igneous and metamorphosed forms, while along the old shore line are the Cambro-Silurian sediments, unchanged, not much disturbed and often rich in fossils. Remarkably little, detailed, field work upon the crystalline rocks has been done in the region since the early survey of Emmons and Hall, 1835–1840. What has been written is incomplete and the stratigraphical conclusions are drawn from too little recorded data. A general review of these papers has been given by the writer, in the Transactions of the New York Academy of Science, v. 12, p. 19, Nov. 1892. Emmons in his Final Report, 1842, devoted almost no attention to the relative stratigraphy of the crystalline rocks and not until 1876, is the question alluded to and then by James Hall only as regards the age of the serpentinous limestones (Amer. Jour. Sci. Oct. 1876) which are spoken of as being later than the Laurentian and earlier than the Potsdam. Dr A. R. Leeds' paper entitled "Notes on the Lithology of the Adirondacks" (Chemical News, Mar. 1877, 36th Annual Report, N. Y. State Cabinet 1877, p. 79) relates to the chemistry and petrography of the anorthosites and trap dikes only.

In 1879 C. E. Hall published a short condensation of what was apparently expected to be a longer contribution. It is entitled Laurentian Magnetite Iron Ore Deposits in Northern New York." (32nd Annual Report of the N. Y. State Cabinet — 1879, p. 133–140.) A brief outline is given of the township geology in the Eastern Adirondacks, and a colored map on a small scale (3 miles to the inch) accompanies the report. Mr Hall divides the Archean into the 1, Lower Laurentian Magnetic Ore Series. 2, Laurentian Sulphur Ore Series. 3, Crystalline Limestones. 4, Labrador Series or Upper Laurentian with Titaniferous Ores. The relations of 2 and 3 are said to be uncertain, but later, in a note, the limestone of 3 is stated to be later than 4. It is to be regretted that Mr Hall did not complete his paper, for too much attention could not have been given to proofs of these stratigraphical relations, and in the following pages, it will be shown that the conclusions reached in this paper favor his first arrangement. T. S. Hunt in the short description of the geology of Port Henry, (Canadian Naturalist, 2nd series, v. 10, p. 420,) regards the limestones near the town as a great, metamorphosed vein of calcite. C. R. Van Hise, in company with C. D. Walcott and R. Pumpelly, made an excursion in 1890 from Whitehall north along the Delaware and Hudson R. R. to Westport and thence into the mountains near Mt Marcy. They saw much that suggested the deposition of the limestones along an encroaching shoreline of gneiss, and remark also the extensive gabbro area of Westport. In December, 1893, J. F. Kemp read before the Geological Society of America, a paper on the Gabbros on the Western shore of Lake Champlain, (Bulletin V. 213–224) in which the petrography of these rocks is discussed. In December, 1894, the same writer read a subsequent paper on the Crystalline Limestones, Ophicalcites and Associated Schists of the Eastern Adirondacks, (Bulletin VI. 241–262) which treats both of petrography and stratigraphy.

All the other papers that have been written on the region, have small reference to these questions, but as bearing on petrographic points, some are important. Recently an account of the geology of Gouverneur township, on the western side, has appeared from the pen of Prof. C. H. Smyth, jr,* and many facts are adduced. The field work was undertaken in close association with the writer's work on the eastern side and with the general plan of keeping our investigations in harmony. Although no anorthosites are known there, basal gneiss was found practically like that near Lake Champlain and with it is associated igneous granite. Next in succession is crystalline limestone, with some black schists at its base, but serpentinous limestone is practically absent. Above all these is Potsdam sandstone. There is further, a great area of serpentine with red hematite, whose stratigraphic relations remain to be worked out.

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*A Geological Reconnoissance in the Vicinity of Gouverneur, N. Y. Trans. N. Y. Acd. Sci. XII. 97, Feb. 23, 1893. A still more important paper by Dr Smyth on the Gabbro contacts in certain townships in St. Lawrence Co. appears in the Bulletin of the Geological Society of America VI. 263.

We hope year by year to add the geology of new townships to those already mapped, until the whole region has been carefully covered. The problems are not easy ones and the many questions require very thorough exploration.

The present contribution is only concerned with Moriah and Westport townships. The field work was done in the summer of 1892, but the writer has been making excursions into the mountains for five years past, and a general introduction is given, based on the data thus gathered.

In the field work efficient assistance was rendered by Mr W. D. Matthew, late Fellow in Geology, Columbia college, and acknowledgments for indispensable aid are here gladly given.

GENERAL TOPOGRAPHY AND GEOLOGY

The country along the western shores of Lake Champlain, is diversified in its contours. While the larger share of the water-front is formed of the later sedimentary strata, and while these do not reach in the townships here described, a height of much over 400 feet above the lake (this is not far from 500 feet above tide) they are either soon succeeded in the region south of Plattsburg, by the gneisses, serpentinous limestones, gabbros and anorthosites* as one goes inland, or else are cut by spurs of the latter which jut out in high ridges to the water itself. The heart of the Adirondacks is formed of the anorthosites and the highest peaks are dome-shaped masses of this rock. But the flanks on all sides consist largely of quartzose gneisses, and more or less of serpentinous limestones, which latter have interbedded with them black hornblendic and pyroxenic schists, and are heavily charged with bunches of silicates. The gneisses attain to less altitudes than the anorthosites, although in

*The term anorthosite has been long in use among Canadian geologists, as a special name for the rocks of the Norian series, that consist almost entirely of plagioclase. It is derived from the old French word "anorthose," which is a collective term for the triclinic feldspars. While with New York geologists, norite is generally used for the labradorite rocks, yet increasing observation shows that true norites (i. e. containing plagioclase and orthorhombic pyroxene) are not so general as at first supposed, and as gabbro is a much wider term, embracing under it collectively, the gabbros proper, (plagioclase and monoclinic pyroxene), the norites and the anorthosites, it is here employed.

the region about the outlet of Lake George, these are by no means inconsiderable. The anorthosites occur in general throughout a broad belt, which extends from Port Kent and Saranac Lake, southwesterly 60 or 70 miles. The anorthosites do not form a solid belt, as is the general impression, but are found in ridges of northeasterly trend, with gneiss and crystaline limestone almost always appearing in the valleys. Still around Mt Marcy there is a great group of peaks and no gneiss or limestone has been found in between them.

The relief of the country is not entirely due to erosion, although this has been extensive both by water and ice. One can not resist the conviction when viewing the dome-shaped peaks or knobs, that they are in a large part due to block faulting, and the steep cliffs of Adirondack Pass, of Avalanche Pass and many others, confirm the impression. The remarkable shear-zone at Avalanche Lake* is also an additional proof. In the iron mines it has been a frequent experience to find the ore body cut off by a fault where it has been followed under a gulch. What is true for the small depressions is doubtless applicable on a large scale. The mountains repeatedly have a much steeper eastern face than western, as if presenting to the east, old, eroded, fault-scarps. Erosion both by water and ice has contributed its share in modifying contours, so that now the angles are largely rounded off.

Over the whole country is spread the drift, either sorted or unsorted, and no more striking exhibition of it is to be found in the United States, than in the Adirondacks. As a general thing, aside from the mountains, the country is extremely sandy, and often in the valleys shows unmistakable evidence of having once been lake-bottoms,† on whose shores the deltas still remain.

GENERAL STRATIGRAPHY

The stratigraphical relations of the Archean crystalline rocks are obscure as decisive evidence is not easy to procure. In the writer's opinion we have the same succession as in Canada, where the Ottawa Gneiss is the lowest member; the Grenville Series of more schistose rocks and limestones lies over it; and through both these are

*J. F. Kemp. The great Shear-zone at Avalanche Lake. Amer. Jour. Sci. Aug. 1892, p. 109.

†H. Ries. A Pleistocene Lake-bed at Elizabethtown, N. Y. Trans. N. Y Acad. Sci. Nov. 1893.

intruded the gabbros and anorthosites of the Norian. Purely lithological names are here chosen to indicate these and they are subsequently described in what is believed to be their stratigraphical succession. It would not be advisable to discuss at length this problem from the restricted area covered by this report. The difficulties in accurate determination and classification rise from the intrusive nature and vast extent of the Norian. Near the contacts of the undoubted gabbros and anorthosites with the gneisses there are all manner of intermediate types of rock, and even far out from the central masses, we find what are regarded as intrusive sheets of gabbroitic gneiss, which possess the characters of both the gneisses and the gabbros. It is hoped that by the close of the summer of 1894, that the whole of Essex co. will have been gone over once and that then these questions can be more intelligently discussed.

General character of the gneisses. The gneisses give little decisive evidence of their origin, whether they have been derived from sediments or from granitic rocks. Dr Smyth has shown the latter to be true in the township of Gouverneur on the west side, and the remarkable instances later described, by which the massive gabbros have become gneissic, lends much support to this view for many other regions. So far as they have been examined in the townships specially noted here, they are aggregates of quartz, normal orthoclase, microcline, pyroxene, biotite, hornblende and great quantities of microperthitic orthoclase. The last named is rather the most abundant component. It consists of orthoclase crystals so thickly set with blades of albite that at times they almost seem like crystals of banded plagioclase. Such structures are well known in both igneous granites and metamorphic gneisses. At times, specially near the Bessemer iron ores the gneiss becomes a nearly pure mixture of quartz and feldspar.

General characters of the crystalline limestones. The limestones are variable in structure and composition. They are in instances extremely pure carbonate of lime. The quarry opened for the Port Henry furnaces, a quarter of a mile north of Port Henry and east of the Treadway ophicalcite quarry was of this character. But here as elsewhere great bunches of silicates came in and necessitated much waste. It is rare that a bed of any size is met, which is not limited on either side by a black, hornblendic schist or gneiss. The exposed cross-sections show this alteration over and over. Frequently the limestone becomes more magnesian and is full of the altered pyroxene crystals, which give it the well-known green, serpentinous mottlings. This ophicalcite or ophiolite is widely familiar under the name "Moriah marble," by which trade designation it has been placed on the market as an ornamental stone. G. P. Merrill has shown that the serpentine has resulted from the alteration of a white pyroxene.* The limestones have undoubtedly been penetrated by igneous dikes before their metamorphism, for these show in broken fragments with the limestone in between. Whether all the interbedded, black schist was of this character is doubtful.

The limestone series rests on the gneiss and is later in age.

General characters of the rocks of the gabbro family. The gabbros are unquestionably true, igneous rocks of invariable plutonic habit when not rendered more or less gneissic by mountain-making disturbances. Passages of the one into the other can be traced. But even in the purely plutonic or granitoid structures the microscope shows widespread crushings and strainings, the results of dynamic disturbances. The typical anorthosites exhibit nearly pure feldspathic aggregates, specially in the interiors of the Norian mountain ridges. The darker, basic gabbros appear on the skirts of the latter or as more remote outliers. They consist of plagioclase, green monoclinic pyroxene, hypersthene, brown hornblende, titaniferous magnetite, almost invariable garnet and alteration products from all these. Olivine has been discovered but does not appear to be as abundant as in the analogous Canadian exposures described by F. D. Adams.

General characters of the Cambro-Silurian sediments. The earliest of the sediments is the Potsdam sandstone. It rests on all the members of the Laurentian in one place and another and sets up into them as embayments. It reaches a maximum altitude of 500 feet above tide at the first Y of the Mineville railway, out from Port Henry. None other of the sediments rises as high at this. Along the lake shore, the Potsdam is succeeded by the Calciferous Limestone, which appears just north of Port Henry and in Westport. In the latter town we find also the still higher Chazy and Trenton. Less attention was given to these than to the crystalline rocks, although later on some further details and lists of fossils are appended.

* Proc. U. S. Nat'l Mus. XII, 595. 1890.

Brief description of the map. The accompanying map has been roughly reproduced from advance sheets of the U. S. Geological Survey and from the County Atlas of Essex Co. Only the 100 foot contours are given, to avoid confusion of lines. While not claiming to be more than a general picture of the topography, it does show the elevations with all the accuracy needed for a first draft and as such has been employed. In the subdivision it has been the endeavor to show the areas occupied by the gneiss, the crystalline limestones, the outlying gabbros, the main anorthosite masses, the Potsdam sandstone and the Lower Silurian limestones. Where all rocks are concealed by drift, this has its appropriate sign. Practically all the roads were traversed in Moriah and Westport and a corner of Elizabethtown. The only omitted area is a small one in the extreme northwest of Moriah.* But it is recognized that some outlying gabbro areas may have been overlooked, although all accessible hills were climbed. On many the forest growth and smaller vegetation conceal all exposures. Some gneissoid forms of anorthosites may be included in the areas drawn as gneiss, for as already remarked the intermediate varieties are extremely hard to classify, even when the prominent types are readily recognized. The geological sections will serve to indicate the stratigraphical relations in several places.

OUTLINE OF THE GEOLOGY OF MORIAH

An examination of the accompanying map will show that the gneisses with iron ores make up the greater part of Moriah. There is also a belt of crystalline limestone and black schist in Port Henry and another east of Ensign Pond. Along the Lake Champlain front the Potsdam sandstone is well developed, and the Calciferous shows in one small spot just north of Port Henry. The later sediments although present in the townships on the north and south are absent in Moriah. The anorthosites appear in the southwest and form one especially high hill, Harris Hill, and several others, hardly inferior.

Outlying masses of gabbros are frequent and often strongly gneissoid. A great sheet of gabbro has been cut by drill cores near Mt Bob, Mineville, and an enormous mass of it underlies the Cheever Mine, outcropping all along the lake. Another great sheet, at least 250 ft thick forms the middle (horizontal) third of Bald Peak. Several diabase dikes have also been met. Geological sections accompany the map.

*Since filled from observations made in 1894.

OUTLINE OF THE GEOLOGY OF WESTPORT

The southern part of Westport is mainly gneiss, but the northern is is all anorthosite and gabbro. The anorthosites have an extended development in Split Rock Mountain, and also appear in the southeast. The gabbro is especially important in the central portion. The sedimentary rocks mark the southeastern lake shore. The Potsdam, Calciferous, Chazy and Trenton are all well shown.

PETROGRAPHY

Petrography of the gneisses. There are several varieties of gneiss as shown by the thin sections. These occur, forming the larger portion of what is regarded as the basal series. Gneisses are also found as immediate associates with the undoubted anorthosites, and such are doubtful forms for stratigraphic classification. The endeavor has been made to differentiate the certain and well marked varieties in each series from the intermediate or doubtful ones.

The most characteristic gneiss in the undoubted exposures of the basal series, is formed by an aggregate of quartz and microperthitic orthoclase in largest amount, with which are orthoclase, plagioclase and brown biotite in less degree. The rock shows no features at all remarkable among gneisses. The accompanying figure (Fig. 1)

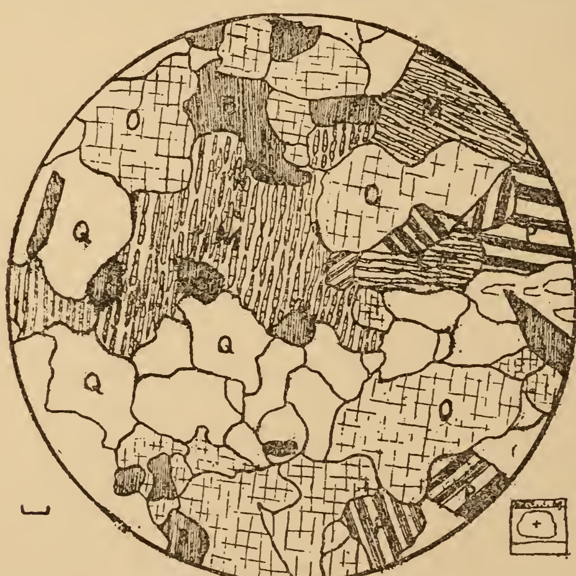

Fig. 1.—Common biotite-gneiss, Bulwagga Mountain, Moriah. O is orthoclase; M, microperthite; Q, quartz; B, biotite; P, plagioclase.

gives a fair illustration. Occasionally a little garnet is seen, but it is a very light colored or quite colorless one, in contrast with the deeper pink variety of the anorthosite derivatives. It shows also no tendency to characterize the contacts between the dark silicate and the feldspar, as is the case with the anorthosites. It contains quartz inclusions and is thus doubtless a result of metamorphism and of late formation in the history of the rock. A few minute zircons are also seen, and a few grains of magnetite. The gneisses do not show wide spread evidence of dynamic disturbances. While one or two exposures, exhibit the operations of crushing forces, the others from the main ridges are quite without such effects. These latter are far more widely shown by the anorthosites in which they seldom fail. Prof. Smyth after examination of the writer's slides of gneisses states that dynamic effects are much more widely shown by the gneisses on the western side of the mountain.

Along the lake front just above the Cheever dock, and near the great gabbro mass, are several exposures of brecciated gneiss. This seems to have been a micaceous variety originally, but the dark silicate is now altered beyond recognition. Even in the outcrop the rock is visibly crushed into small angular fragments, now recemented, and in the slides this comes out in a still more marked way. Strained fragments of quartz, microperthite and chlorite fill the field. The crush was apparently caused by the intrusion of the neighboring gabbro. A less common variety of gneiss contains, instead of biotite, dirty green hornblende, but all the other features are essentially like the micaceous ones.

In the walls of the non-bessemer ore bodies the gneisses appear to become somewhat richer in dark silicates as the ore is approached. Near the ore the slides show chiefly plagioclase, with abundant green hornblende, green augite, scattered magnetite and titanite.

The lean ore is chiefly mixed with pyroxene, black in the hand specimens, but of a beautiful, emerald green in the sections.

Much black hornblende is also met. Diamond drill cores near Mt Bob, Mineville, have shown as the wall rock of the Bessemer ores a very feldspathic gneiss, with scarcely a trace of a dark silicate. The lean ore is mixed with quartz and feldspar. There is some reason for thinking that this contrast of wall rock may often show itself. Gneisses are also met, practically like those cited as most typical and characteristic; except that they contain green monoclinic pyroxene instead of either hornblende or biotite, or else this in association with hornblende. Their acid character, possessing as they often do, much quartz, causes them to depart from the gabbro types. Especially towards the great masses of gabbro and anorthosite, gneissoid rocks appear that are difficult to classify in their stratigraphical relations. They contain abundant plagioclase, augite, hornblende and deep pink garnets and are probably gneissoid forms of gabbro. Still the relations are much confused. Towards the contacts, pegmatite masses are also met at times of great size, but they are better shown in adjoining towns.

Petrography of the limestones and associated black schists. In thin sections the pure white limestones show little of interest. They contain flakes of graphite, small scales of phlogopite, an occasional apatite crystal and little else. Such occur at the furnace quarry on the ridge just north of Port Henry; below this along the lake shore; and south of the Pilfershire Mine.

The limestone afforded is a very pure calcium carbonate at the first mentioned locality. It has yielded some unique crystals of calcite. Often closely associated with this latter is the mottled serpentinous limestone or ophicalcite. Its best exposures are in the belt along the ridge from a point north of the Cheever Mine and thence southward to the Lee Mine. Quarries have been opened at several points. It outcrops again west of Moriah Center, on the present road to North Hudson, and also on the old and now abandoned highway, nearly due north of Ensign Pond. The rock is a dolomitic marble with copious green mottlings of serpentine. At times these are evenly distributed and a quarter inch across as a maximum, and then the stone is very beautiful, when polished, but such pieces can seldom be obtained of large size or of even texture. The masses of serpentine too often form great blotches, up to several inches across, and mar the appearance of the stone. Small bunches of silicates also appear and afford white pyroxene, brown tourmaline, rose quartz, beautiful crystals of brown hornblende, titanite, etc., as later set forth. Similar serpentinous marbles have in Warren county afforded specimens thought to be Eozoon, as described by A. M. Edwards (Proc. Lyceum Nat. Hist. N. Y., 1870, p. 96). G. P. Merrill has also written of them and is able to show in many cases that the serpentine is secondary after pyroxene, but some forms of serpentine seemed to him not to be referable to this original. In my slides, the core of pyroxene is usually present and the process of alteration is graphically shown. The total effect resembles an altered olivine crystal most closely. In one instance the core proved isotropic and showed no trace of an optic axis. It would appear to be an isometric mineral of quite high index.

The limestone series is accompanied by masses of silicates of all sizes from small bunches up to large lenses. There are also beds of dark schistose rocks that are an inseparable associate, and no extended section was met devoid of them. The small bunches are especially numerous near the contacts with gabbros, and in the Delaware and Hudson railway cuts, two miles and less above Port Henry, along the lake they are very numerous. They assume very fantastic shapes, from the small foldings and stretching of the limestone, and specially resemble snakes. These are here regarded as due in part to the metamorphism of siliceous portions of the original limestone, but still more often to bunches of minerals formed by contact action along the intruded gabbro. They have been afterwards stretched in the general dynamic disturbances which have given rise to such extended foliation. The limestone everywhere gives evidence of being very plastic under these conditions and has wound itself around the inclusions and followed them in many intricate curves.

The inclusions exhibit in thin section, plagioclase and hornblende in greatest amount, and with these phlogopite, scapolite, pyroxene, quartz and probably orthoclase. In larger ones fine crystals of brown tourmaline and light brown hornblende, titanite and rather rudely bounded pyrrhotite appear. All these show characteristic forms. Very similar mixtures are met at Van Artsdalen's quarry near Philadelphia, Penn. as has been cited by the writer (Trans. N. Y. Acad. Sci. Vol. XII. p. 74, Jan. 23, 1893) where they are referred to the contact action of gabbro. They are practically duplicated in the bunches of silicates contained in the marbles on the contact with the hornblende granite of Mount Adam and Eve, Orange co. N. Y. A very complicated and interesting mass of silicates occurs in the cut on the railway from Port Henry to Mineville, just at the grade crossing of the northeastern highway in O8, of the map. Garnet, quartz, tourmaline, phlogopite, and magnetite can be readily recognized, while in the slides, scapolite is abundant and small masses of titanite are everywhere through the somewhat altered phlogopite. Pyrite and apatite also appear. It is an unusually complex bunch of silicates in the limestone series. The dark schistose rocks that penetrate the limestones in instances apparently parallel to the foliation are shown by the thin sections to consist of brown hornblende, rather scarce brown biotite, plagioclase, some pyroxene and magnetite. Either hornblende or augite may fail. The rocks are at times quite gneissic or even massive, as in the great sheet just over the limestone of the abandoned Pease Quarry in the outskirts of Port Henry. In thin sections these more massive sheets bear the strongest resemblance to the metamorposed dikes from the Hudson River shore above West Point, described by the writer in the American Naturalist for August 1888. There is much that leads one to regard them as intruded dikes and sheets, doubtless contemporary with the gabbro, and offshoots from its magma, that have afterwards become foliated by metamorphism. Such a dike from the limestone quarry near the Pilfershire Mine is shown in the accompanying reproduction of a photograph. It is clearly a broken dike, between whose separated fragments the limestone has been forced. The mineralogy and structure of this is precisely like the gneissic ones above referred to, but less certainty is felt that the more schistose ones may not be metamorphosed sediments. Very similar beds occur in the limestones of Gouverneur, St Lawrence co. where they are regarded by C. H. Smyth, jr as altered sediments, (Trans. N. Y. Acad. Sci. XII p. 102 Feb. 23, 1893) and where they are far west of any exposure of gabbro. Their noticeable parallel arrangement in the limestone makes it seem extraordinary that dikes should have been so regular unless the apparent bedding of schists and limestones is due to mountain making processes. One or two beds of light grey gneiss with graphite and sillimanite were met with in the limestone series. One occurs along the highway south of the Pilfershire mine, N8 on the general map. It may represent a silicious bed, deposited in with the limestones.

Petrography of the gabbros and anorthosites. In the high knobs of Mount Harris, in the western portion of Moriah, near Ensign Pond, and also in the northern part of Westport, the

PLATE I — View in a quarry of white crystalline limestone, near the Pilfershire Mine, Moriah Township. The limestone has been penetrated by a dark dike of gabbro which has been subsequently broken by dynamic disturbance. The limestone has been forced in between the sundered ends of the dike. The view is intended to illustrate the plasticity of limestone under pressure.

anorthosites make up the country. The most massive variety consists of large, bluish labradorite crystals, up to an inch and a half in length, with almost no traces of dark silicates. The rock is nearly pure feldspar, but it has been subjected to powerful dynamic disturbances and now exhibits a mass of larger nucleal fragments, often of considerable size, surrounded by fine breccias of the same. The specific gravity of the large pieces, free from garnets, lies between 2.65 and 2.71, proving them to be labradorite. The thin sections bring out the crushed condition still more strongly. Even small brecciated cracks penetrate the larger pieces. The comminuted feldspar is more or less altered, and often presents a fibrous or scaly mass of sericite. Other darker varieties from this western border of Moriah, contain bisilicates and tend to assume gneissoid forms, from the alignment of these, in continuous bands. The plagioclase is much smaller than in the first mentioned variety. The dark silicates are green monoclinic pyroxene, deep brown, almost opaque hornblende, and less common hypersthene, in about this order of abundance. There is also more or less titaniferous magnetite. The two pyroxenes are evidently original minerals and much of the brown hornblende is also, but there are cases, later described where it forms one of the zones in the reactionary rims, which give the impression, that some of it may be secondary. Deep pink garnets are universal and often associated in a most intimate way with the pyroxene. The same cracks pierce both minerals, and though the line of demarcation is sharp, it makes the observer suspect that the garnet has resulted from the pyroxene. The reactionary rims of garnet give some added ground for this suspicion. But garnet often appears alone with no bisilicate near it, and in such cases it is probably an original mineral, as garnet often occurs in this relation in plutonic rocks. A microscopic drawing of a typical anorthosite is given by the author in a paper in the Amer. Jour. Sci. for Aug. 1892, p. 111, Fig. 2.

Generally outlying from the main exposures of anorthosites and separated from them by intervening gneiss are the areas of rocks, marked gabbro on the map. The gabbros exhibit massive, coarsely banded and very thinly laminated forms, and in several places the unbroken transition can be followed from one into the other.

In general, the massive gabbro makes the impression of a dark rock upon the observer and this is due to the abundance of magnetite grains and dark silicates. The minerals present are plagioclase, green monoclinic augite, brown hornblende, hypersthene, garnet, titaniferous magnetite and titanite. The more important ones of these are shown in the accompanying figure (Fig. 2) which is a little

FIG. 2.—Gabbro without reaction rims—near Ensign Pond, Moriah. F is labradorite; P, augite; Hy, hypersthene; H, hornblende; Q, quartz; G, garnet; M, magnetite.

richer in hornblende than the average. The rock is blotched with light green from the altered feldspar, and has faint, pink streaks running through it, due to the garnets. These latter give it a peculiar reddish cast that is very characteristic. The feldspars are now largely altered to saussuritic matter, but when not too far gone they have a broad, lath-shaped outline, more or less idiomorphic, and are rather coarsely twinned. At times they are filled with minute dots or crystals of brightly polarizing character which are so small as not to be easily recognized, but they are probably pyroxene. Less commonly, polygonal scales of a brown color and in geometrical arrangement are to be seen. These latter are generally regarded when seen in other exposures as a micaceous variety of ilmenite. The successive zones of grains of garnet and brown hornblende between the dark silicates and the feldspar, or surrounding the magnetite are extremely interesting. They have been described and figured by the writer in the Bulletin of the Geol. Soc. of Amer.— V. 218, and are regarded as due to the reaction of the bisilicate or other basic mineral and the feldspar on each other. Olivine is found in the gabbros on the lake shore north of Port Henry, and in the walls of the Split Rock Mine — on Split Rock Mountain, Westport.

In the gneissoid varieties of gabbro, hornblende appears in notable preponderance, and in the extreme cases, of very thin lamination it is the only dark silicate present. It is quite certainly of secondary origin.

Petrography of the palaeozoic sediments. The microscope yields little in addition to the macroscopic examination. The Potsdam sandstone shows considerable calcite, in small rhombs mingled with the quartz grains. The Calciferous cherty limestone consists of fine grained calcite crystals and the chert is devoid of fossil organisms of any sort. The others were not ground in sections.

Dikes. These two townships are not as prolific in dikes as others to the north. Several have been noted recently by Kemp and Marsters* and determined with the microscope. They are all diabase or closely related types. There is a bunch of dikes on Mill brook, just west of the lake in Port Henry. One or two cut the ore beds at Mineville. A fine one is in a hill a short distance northeast of Moriah Corners, (No. 56 in O5 of map) where it has been mined out for an ore body. Several others are exposed along the lake shore a mile or two north of Westport, — and others appear in the old iron mines on the west side of the Split Rock ridge. Porphyries, tho' known in the next township north, have not been met.

GENERAL CONCLUSIONS

The two older series of rocks, the gneisses and the crystalline limestones were formed before the intrusion of the anorthosites and gabbros. These latter came up as great plutonic masses and as offsetting sheets penetrating the older rocks, and contributing to their metamorphism. Much faulting and folding ensued, by which the latest intrusions became involved in the earlier rocks in very

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*The trap dikes of the Lake Champlain Valley. Bulletin 107, U. S. Geol. Survey.

puzzling ways, and by which they received brecciated and gneissoid structures. This metamorphosing process then ceased in pre-Cambrian time and on the flanks of the old crystallines were laid down the Potsdam sandstone and the Silurian shales and limestones, all of which show comparatively unaltered forms and not greatly disturbed positions. Their dips are low, mostly to the north, and beyond comparatively slight faulting they have not been participants in heavy movements. What disturbance appears is probably to be attributed to the upheaval of the Green Mountains.

There is evidence in neighboring townships which indicates that the Cambro-Silurian sediments formerly reached well up into the valleys, at least in the case of the Potsdam, but that they have been since extensively eroded.

IRON ORES

The ores are all magnetite, but as already outlined are of two varieties. The one that is useful and merchantable to-day is practically free from titanium. Variable amounts of phosphorus and sulphur, occasionally reaching high percentages are present. These ores seem to be uniformly associated with the older gneisses. The second variety contains titanium, often in very considerable amount. The limestones are devoid of ore in these townships. In Moriah there are the following mines, all of which have been practically worked except the last named. They are all non-titaniferous. The Mineville Group; the Barton Hill Group; the Cheever Group; the Pilfershire and Pease Pits; the Lee Mine; and the Coot Hill Mine. In Westport there are the following which are all titaniferous, except perhaps the first named. The Nichols Pond Mines; the Split Rock Mines; and the Ledge Hill Mines. None of these latter have been worked in years.

The general merchantable ore in Moriah is non-bessemer, for only the mines on Barton Hill furnish bessemer ores. The following table illustrates their composition. The Lee mine is quite sulphurous. The Pilfershire and Pease pits have been long abandoned. The Coot Hill mines have no serious showing of ore and were an ill-advised enterprise; and the mine put down on the county atlas as occurring north of Crowfoot pond is purely imaginary. The outcrop of gabbro or gabbro-gneiss near Mr J. Lewis's house, Moriah,

PLATE II.

PANORAMA OF MINEVILLE, N. Y.

Looking southeast. Lake Champlain in the distance.

and near some prospects that he has opened make it seem probable that the ore will prove titaniferous, but no analyses are available. The Barton Hill mines and their prolongation, the Fisher Hill and Burt Lot openings are bessemer, and some lots have been found surprisingly low in phosphorus. They occur at a higher horizon in the gneisses than the Mineville group as will be later shown by sections.

TABLE OF ANALYSES

	Bessemer Ores—		Non-Bessemer Ores—				
Mine	Barton Hill.	Fisher Hill	Welch Shaft	Miller.	Old Bed.	"21"	Cook Shaft
Authority	Birkinbine	Tenth Census.	do	do	do	do	do
Fe	65 12	46.96	57.71	60.54	62.64	62 10	62.80
P	0.0289	0.03	1.266	0.830	0.908	1.198	0.870
TiO_2	....	present.	present.	present	present	present	present.

			Titaniferous Ore.			
Mine	Cheever.	Lee	Split Rock	do	do	Cook Shaft—Humbug Vein—
Authority	Tenth Census.	do.	....	......	......	F. S. Witherbee.
Fe	63.86	45 01	44.77	32 59	40 42	
P	0 680	0.047	....		. ....	
TiO_2	present.	Absent	13.15	14.70	16.37	Circa 20.

In the octahedral ore of the Lovers Hole Mine, T. R. Woodbridge found with iron 68.58 and phosphorus .004, titanic oxide .147. Thus where found in these ores it is in very minute amount.

The beds are often disturbed by small faults and very frequently these are occasioned by the intrusion of a trap dike. In fact hardly a mine has failed to reveal these. Profounder faults may also intervene and cut off the ore entirely as at the Cheever mine.

The ores in the richest forms are granular. They have for a gangue, pyroxene as a general thing, and in the thin sections of lean ores this is seen to be of a brilliant emerald green hue, though black in the thicker masses. Grains of apatite are at times very abundant, and are present in most of the mines. Pyrite is notable in a few. Bessemer ores are afforded by several very large openings.

GENERAL FEATURES OF THE TITANIFEROUS ORES.

The titaniferous ores are in true igneous gabbro, which has been more or less metamorphosed and to which a foliation or banding has been imparted by pressure. The ore-bodies are thus flattened parallel to the banding, but their general shape, if indeed they have any uniformity, is far less clearly understood than that of the ores in gneiss as they have not yet been much mined.

GENERAL FEATURES OF THE NON-TITANIFEROUS MAGNETITE ORE-BODIES

The common form assumed by non-titaniferous ore bodies, and the one usually associated with gneisses for wall-rock, is that of a bed or flattened lense, or pod, which lies parallel to the general foliation. They show no traces of having filled a cavity, but unless regarded as segregated veins, i. e. as having gathered along the bedding by the concentration of iron oxide from the walls, after the manner of a concretion on a grand scale, they must be considered true beds. For the smaller ore bodies in the two towns here described, these general relations and shapes hold good but for the great ore-bodies at Mineville, it is difficult to see how any folding and contortion of simple beds can explain the peculiar and irregular shapes which are later illustrated. They are decidedly abnormal. In the writer's estimation no segregative agency strictly so called could have occasioned them and some other method of origin must be invoked. The true lenses pinch, swell and feather out at the boundaries. They often fork when wedge-shaped masses of the walls come in. They are often distributed along a general horizon in the gneiss, although at times several beds, one over the other are afforded. The long axis of the ore-body does not run straight down on the dip, but diagonally, and this inclination is called the pitch in distinction to the true dip. The rule already formulated in New Jersey also holds good in the Adirondacks, that with a westerly dip the pitch is to the southwest, and with an easterly dip the pitch is northeast.

DETAILED GEOLOGY OF THE IRON ORES

The Mineville and Barton Hill Groups. The topography of this district may be seen from the accompanying map. As already stated the Barton Hill group occurs at a higher horizon in the gneisses than the Mineville group, but just what it is in feet is hard to say, for there is a fold or crumpling between. As shown by the table the ores are contrasted in composition, the lower series being much higher in phosphorus. Almost no sulphur occurs in either, and titanium is insignificant.

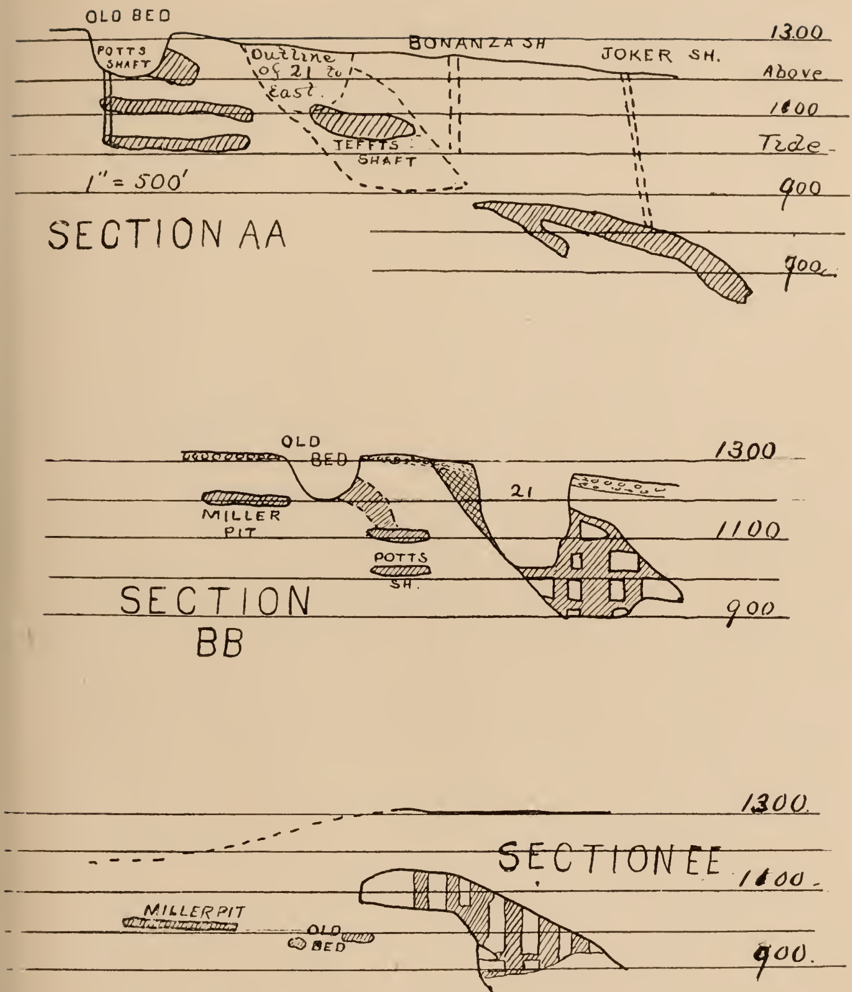

FIG. 3. SECTIONS OF THE MINEVILLE ORE-BODIES CORRESPONDING TO MAP NO. 2.

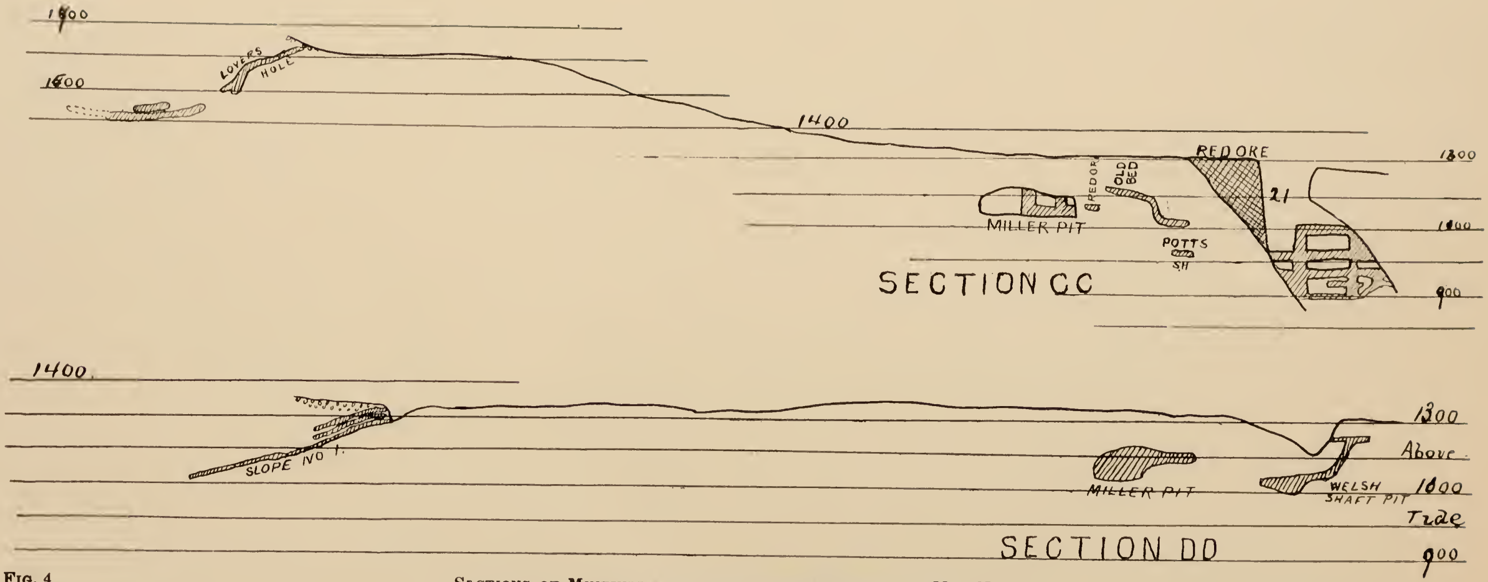

FIG. 4

SECTIONS OF MINEVILLE ORE BODIES CORRESPONDING TO MAP NO. 2.

The relations of the Mineville ore bodies have always proved confusing, but it is hoped that the accompanying sections may help to throw some light on them. Referring to the plan of the workings as shown on the map, it will be seen that the axial direction of all the ore bodies is southwest and that they lie in two or three parallel ranges. There are irregularities entering in that upset the uniformity of this somewhat, but in general it holds. There are five distinct mines. One is based on the bed, tapped by the Brinsmade and Welch shafts, and is generally called the Welch shaft bed. This dips westward at a varying angle that is nearly vertical at the north end and about 45° at the Welch shaft. In its southern part it runs in under the Old Bed (called in earlier days the Sanford) but a drift has been run through the intervening rock. The widest breast is about 50′ from wall to wall but at the northern end it pinches to an unworkable thinness. This bed appears in Section DD.

Lying over the last but also extending further south is the Old Bed. Old Bed has an axis that runs about S. 30 W. The pitch is quite flat being but 20°. The dip in the eastern workings is much more southerly than the Welch Shaft bed and on the western side it becomes more westerly. The Old Bed is quite complex in form and structure. It starts from the surface with a low dip, as already mentioned, but soon rolls over more and more steeply until it connects with a lower lying ore-body, which sets back under its upper portion, and is called the Potts Shaft bed, because opened by a shaft of that name. This same shaft tapped a still lower lying and parallel bed with which Old Bed also connects down the pitch. They are shown in Sections AA, BB, and CC. The structure can be best summed up, perhaps, as a triple forking of an original bed. The Old Bed, as do also the Miller and "21," thickens very much from a comparatively thin outcrop to a much greater section lower down. The mining has shown breasts varying from 20 to 125 feet. Mr Putnam of the Tenth Census referred this to the buckling of a sigmoid fold. He makes however no mention of the lower Potts shaft Bed and when this is included, the forking original seems more probable. The ore next the footwall in both Old Bed and 21 is specially charged with apatite. Indeed the workings in 1852 on the former were begun in order to procure phosphates for fertilizers. (W. P. Blake, Trans. Amer. Inst. Min. Eng. Balto. Meeting 1892.) Considerable quantities have 10% or more of this mineral. This variety is called "red ore" and is of course avoided. This especial richness in apatite is interesting when compared with the investigations of D. H. Browne, on the distribution of phosphorus in the Ludington mine, Menominee District, Mich. (Trans. Amer. Inst. Min. Eng. XVII 616). Between the Old Bed and the Miller, there is a long pod of this red ore, which is separated from the Miller by a trap dike for its greatest part, but which runs into the Miller at its northern end.

The Miller bed has an axis that runs about S. 30 W, but it pitches at a higher angle than the Old Bed and in the northerly portion has a quite steep westerly dip, corresponding closely with the Welch Shaft bed. The inclination of the skipway is about 40°. To the southwest along the line of the axis it lies quite flat from east to west, but it has one notably steep drop on the pitch. This is indicated by the different altitudes of the several sections of this bed. Thus from DD to EE, it has pitched 200 feet, and a large part of this is in the one roll just mentioned. The breasts varied from 10 to 100 feet.

Mine 21 is the largest of all and has a magnificent ore body, 200–300 feet perpendicularly between walls. It has the general northwest course for its axis, while the pitch is not to be easily, if at all, determined. The dip varies from being nearly south and very flat in the Tefft shaft extension to an increasing steepness around to the eastward and to an increasingly eastward dip. The skipways, which are nearly parallel to the footwall, run down at about 60°. The ore body seems to lie on the southeast side of a doming anticline.

The fifth bed or mine is the Bonanza-Joker, lying south of the others, and not outcropping. It is an extension of "21," for the workings are now approaching each other and a hole has been bored through. (Section AA.) The axis of the Bonanza runs southwest as do the others. The bed is a double one, as it splits between the Bonanza and Joker shafts into two, over and under. A great horse of rock comes in, but each portion forms a noble ore body, the upper being 100′ thick and the lower 65′ as mined.

Still another thin ore body has been lately shown by the diamond drill south of the Joker, and a hole in the footwall of the Joker has revealed a vast additional thickness lying lower. The map with

Plate III

Skipway into Mine 21, Mineville, N. Y.

Plate IV.

Burt Lot Mines North of Barton Hill.
The two beds of ore are indicated by the skipways.

the outlines of the workings which are reduced from the surveys of Mr McKee, the engineer of the two companies, gives a clearer idea of the relations in plan than any description could and also of the surface topography. The sections will further afford a picture of the relation in elevation. They have been compiled from the most recent mine surveys (1893), but aid has been obtained from the drawings of Mr. Putnam (10th Census, v. 10, plate 27, p. 108) and from personal notes on the surface and underground. The important structural features are these: The westerly dip of the north ends of Welch shaft and Miller beds; the flat and more southerly dip of the Old Bed, of its several divisions and of the Miller; the southerly and easterly dip of "21." These facts indicate an anticline with a doming development in the easterly extension of "21." The forking of the bed makes it possible to have several of them one over the other. The Bonanza-Joker bed lies not far from the axis of this anticline on its southerly pitching crest, as does also Old Bed. The general southwest and somewhat parallel arrangement of all the beds or lenses is strongly shown in the map. Before the folding took place they doubtless all formed horizontal and parallel-tending, pod-shaped masses, and were afterwards heaved into their present position with some attendant faulting. The wall rock of "21," and some distance from the pit, is a light colored gneiss, consisting of microperthitic orthoclase, green augite, a little quartz and magnetite. The same rock also forms the summit of Barton Hill. It may be mentioned that the usual gneiss of the oldest formation contains biotite and some quartz but near the ores it becomes augitic. Microperthite is present in both. The strike of the gneiss is very irregular. Between the Miller Pit and Barton Hill readings were obtained varying from N. 10 E. to N. 85 E. with in one case N 60 W. The general average is about northeast. Section CC is drawn nearly across this strike. As indicated in the section the dip toward the Miller Pit is westerly but it changes to easterly and again toward the Barton Hill to the normal westerly.

In variety of minerals the mines are not prolific. Many years ago James Hall obtained from the Old Bed (called also the Sanford Bed) an unusually fine crystal of allanite which has been figured and described by E. S. Dana, (Amer. Jour. Sci. June 1884. 479).

In the office of Witherbee, Sherman & Co., at Mineville, there are slabs with calcite, and one superb octahedron of magnetite, that is nearly symmetrical and perfect. A few quartz crystals also occur. The Barton Hill mines as later noted yield a greater variety.

The Barton Hill Group. The highest outcrop of ore at Barton Hill is as much as 400′ above the highest of the Mineville Group. Measured across the strike (Section CC) it is about 300′ between corresponding points, and there is at least 500′ of rock section in the interval. The dips show a fold to intervene, and allowing for this the distance 500′ is given. It is also possible that there is faulting and this is suggested by the steep slope of Barton Hill, resembling as it does a fault-scarp. The outcrop of the beds at Barton Hill is long, being over $\frac{3}{4}$ of a mile. It is shaded in on the map. The general southeasterly pitch for the axes of the lenses is also well shown by the map and is notably parallel to those of the Mineville group.

This belt has been exploited over nearly the whole of the outcrop but all the output is not equally good. The deepest workings are at the New Bed where the slope has followed the chute down over 2000 ft. The beds are not as thick as in the Mineville Group. They range about 8′, with 20′ as a maximum, and are quite irregular. In places three beds have been met, as at the New Bed. The Lovers Hole exposed but two but one was very thin, (See Figure in paper by Mr John Birkinbine, Crystalline Magnetite in Port Henry Mines, Trans. Amer. Inst. Min. Eng. Feb. 190. Vol. XVIII), and the other thickened to a large body of extraordinarily pure and rich ore. 40,000 tons of the run of the mine gave 68.6 Fe. As the map shows, the workings are quite irregular all along the belt and much exploration is necessary to keep them well in hand. The continuation to the north appears to be broken beyond the Little Orchard Slope, and a barren piece comes in. The ore, doubtless from the same belt, reappears in the Fisher Hill Mines and their northerly extension, the Burt Lot. In the last named there are two beds separated by about 50 ft. vertical thickness of rock, although much more across the surface from slope to slope, as the dips are flat. The dip at Fisher Hill is about 25° southwest as measured on the skipway. This flattens out in the northerly openings to 22°.

In the Burt Lot Mines the dip is about 25°. These latter are in Elizabethtown. The break between Barton Hill and Fisher Hill may be due to a fault or eroded fold, but the lack of outcrops pre-

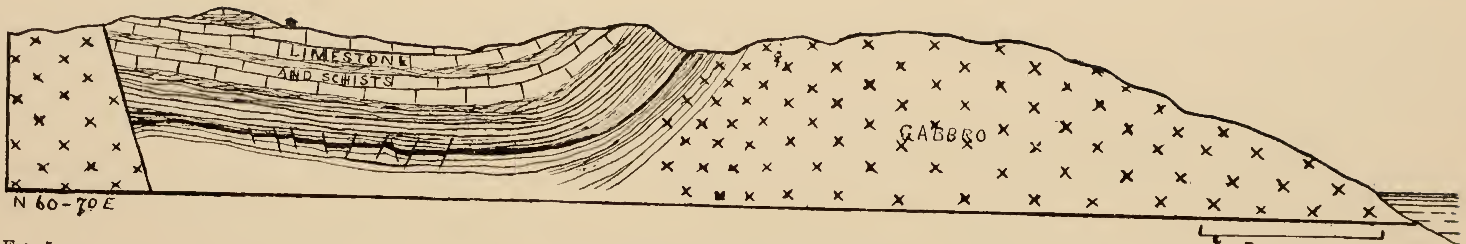

FIG. 5.

CROSS-SECTION OF THE CHEEVER MINE.

vents observation. The belt continues beyond the New Bed to the south, as recent drilling has tapped it.

In this section, the wall rock near the ore at the Lovers Hole, is seen to contain plagioclase and orthoclase, brown biotite, green hornblende, titanite, zircon and magnetite and is an ordinary quartzless gneiss. A specimen from the top of Barton Hill was shown by the same form of examination to contain quartz, microperthitic orthoclase in great amount, diallage and hornblende, being very like the rock mentioned above as occurring near "21." These rocks are all gneisses that often but not always become more basic toward the ore body. Sections from the wall rock at Fisher Hill and the Burt Lot mines are practically the same.

Along with the ore or near it in the wall rock, are at times masses of very hornblendic rock. When cracked open these occasionally show small zircons, apatites and very fair titanite crystals.

At the South Pit some excellent red garnets up to 1″ in diameter have been brought to light, in talcose or chloritic material. They were very brittle and crumbled with slight rubbing.

The Lovers Hole pit has also yielded considerable fluorite, which, of white, red and green colors, gave rather fine specimens. It had more or less magnetite disseminated through it. It was probably from a small vein-filling or in part a replacement of the gneiss.

Fine cleavage pieces of plagioclase are also to be had on the dumps. The beautifully striated surfaces contain at times several square inches.

The Pilfershire and Pease Pits. These are now abandoned. They lie along the westerly foot of the range of gneissic hills that separate Mineville and Moriah Center from the lake. Both mines are now full of water. They strike a little west of north and dip 50° to 60° west. The gneiss just to the south of them contains quartz, microcline, orthoclase, very little plagioclase, emerald green pyroxene, and a little magnetite. The lean ore in thin section exhibits magnetite, light green pyroxene and apatite. As elsewhere the gneiss is more basic near the ore.

The Lee Mine. This is just back of Port Henry and in gneiss immediately west of the ophicalcite exposures. The outcrop of ore is in a small steep hill on the west side of the fault figured on the map. The strike at the main opening is west of north and the dip at the skipway is 19° W. Mr Putnam (10th Census Vol. X. p. 115) states that the ore is cut off on the north by a trap dike. The ore is pyritous and is no longer mined. The breast was 8–10 ft. The hanging wall is gneiss and contains microperthitic orthoclase, quartz, green biotite, magnetite and pyrite.

The Cheever Mine. A general section of the Cheever ore body is here given. The mine is situated about two miles north of Port Henry, but the ore belt is prolonged about a mile further in a northerly direction, the Goff mine being in this portion. The Cheever is one of the most interesting of all in its geology, and for this reason the geological section has been prepared based on the outline of the ore body given by Mr Putnam (10th Census Vol. X. p. 113). The upper topography is reproduced from the 20 ft. contour map of the U. S. Geol. Survey and from sketches made on the ground. The section shows that the ore has over it gray feldspathic gneiss 25′ containing green pyroxene, plagioclase, quartz and orthoclase. The lean ore consists of magnetite with some green pyroxene and some plagioclase.

The next 15′ is hornblendic gneiss, containing quartz, microperthite, plagioclase, orthoclase, brown hornblende, green pyroxene, garnet and apatite. Fifty yards from the ore is gray gneiss again, with quartz, microperthitic orthoclase, brown biotite, very little plagioclase, and magnetite. Over this lies black hornblendic schist and white crystalline limestone. Under the ore is gneiss again but 50 feet east of the ore body, foliated gabbro appears consisting of bastite, brown hornblende, and plagioclase represented by a saussuritic alteration product. The bastite is a light yellow, feebly pleochroic, brightly polarizing mineral, very fibrous and with extinctions parallel to the fibres. In the longitudinal sections it shows the trace of a biaxial figure, but in one transverse section a rectangular cleavage still remained with diagonal extinctions. This would suggest diallage as the original of it. A few garnets are also present. A little further the gabbro becomes massive, and contains hypersthene, brown hornblende, magnetite, much garnet and shattered and saussuritic plagioclase. The gabbro extends to the lake. To the west the ore is cut off by a fault, the underlying gabbro being heaved up along the west side. The ore is also cut by several trap dikes all of the diabase type, which upset it short distances. The ore body is not one single continuous bed, but splits at times into two from incoming horses.

It is much narrower than long, and has the usual lenticular cross-section forming a great pod or elongated lense, with its axis running about S. 60 W, thus showing the invariable southwest pitch with a westerly dip. Two cross sections are given by Putnam, who made them underground. At my visit the mine was full of water. Borings across the gulch to the south have shown a thin bed at 300′ depth. The geology of this ore body presents points of interest not shown by others. At first sight it might appear like a great contact deposit near the junction of gabbro and limestone, but so much gneiss intervenes that difficulties are in the way of this view, and the shape, structure, associates and character of the ore all connect it with the usual lenses in the gneiss. It lies however in the gneiss near the overlying limestone, and also near the intruded gabbro. It differs from the ores in the gabbro by having but slight traces of titanic oxide. The general composition is very much like that of the Mineville ores.

Other Mines in Moriah

The county atlas mentions an opening near the house of James Lewis, and inquiry of Mr Lewis elicited the fact that he believes that he has opened a large ore body. I did not visit the openings, but specimens gathered from the hill in the rear of his house are gneissoid gabbro, and if in these rocks the ore would prove titaniferous. There is also an old series of prospect holes two miles or so south of Lewis's. These show traces of ore but nothing serious. The wall is gneiss and consists of orthoclase, green pyroxene, much titanite and a little hornblende. A small prospect has been ill-advisedly run in on a fine diabase dike, on the east side of a hill a mile west of Moriah Center. A considerable plant has been set up at the Coat Hill Mines, on Bullwagga Mtn. Both walls and ore consist of crushed quartzes, chloritic matter, rotten feldspar and scattered magnetite grains. There are no surface indications of any ore body of serious moment.

General Remarks. The present state of the iron business and the small prices at which Lake Superior ores are now sold in the east offer slight encouragement to new ventures. The productive ones do however occur along common lines of strike, and any prospecting would best be done with these as ranges. Disturbances of strike and dip should however be looked for with care, as in such a broken region, they are common and might throw one off the track. As already mentioned cross gulches are often caused by faults.

Iron Mines of Westport. There are at present no producing mines in Westport, and such as have been opened have been idle for many years. Except perhaps the second bed at Nichols Pond all that we visited were clearly in the gabbro series and gave thus every reason to infer that they are titaniferous and such analyses as have been available, have carried out this impression.

The Nichols Pond Mines. These are situated high up on a mountainous ridge, above Lake Champlain, and just north of Nichols Pond. There are two beds ; the southerly one is in gneissic gabbro, and is about 9′ thick. It strikes nearly East and West, and dips south about 80°. The ore is magnetite mixed with hornblende and is lean. The second bed lies more to the north, and shows the following section, with a strike and dip like the last. 1, Hanging wall gneiss. 2, Ore 12′–15′, shot ore consisting of magnetite and quartz. 3, Lean Ore not worth separating 20′, but of same general character as 2. 4, Compact feldspathic rock, 15′. 5, Lean shot ore and quartz same character as 2, not worked. 6 Foot wall coarse gneiss. There was a large separator in operation some 25 years ago at Nichols Pond, and a tramway ballasted with tailings runs down to the highway to the eastward. As stated by Professor Smock, (Bull. N. Y. State Mus. No. 7. p. 36) these mines are in lots 166 and 168 of the Iron Ore Tract and on Campbell Hill.

The Ledge Hill Mines. This name may not be the most common or correct one, but it is the one given us in Westport. The mines are near the summit of a hill, two miles west of Westport and are several hundred feet above Lake Champlain. They are in gabbro of a gneissic habit, but at times quite massive at points not far from the ore. There are two ore bodies. The ore is richest in the middle and becomes lean towards the walls, with abundant hornblende and garnets. In the lowest opening there are 4′–6′ of richest ore. Fifty feet higher up there is another opening on the same ore. The strike is east of north and the dip is high to the west. A little to the east is a second ore body, opened by a cut about 6′ feet wide at the bottom. The walls are gabbro. The mines are in lot 163 of the Iron Ore Tract.

The Split Rock Mines. These are opened in Split Rock

Mtn., about 100 feet above Lake Champlain, and show very considerable excavations, which are practically dry, as the situation for mining is very convenient. The ore is 10′ thick, strikes N. 70–80° E. and dips 50° south. Gabbro forms the walls right up to the ore on both sides. It is the metamorphosed variety with the copious reaction runs of garnets. The writer was told that there is another opening to the south. There is a separator on a level with the lake, and above the mines, in a terrace in a break in the hills, are the old boarding houses. From this terrace there is a most superb view of the lake and the Green Mountains. The mine is just across from Fort Cassin. The analysis of the ores given in the opening table shows that they contain from 13–16 TiO_2 with 32.5 to 44.7 Fe.

GENERAL REMARKS

There seems little if any prospect of profitable mines in Westport in the future. Those ores that are reasonably near the lake are certainly titaniferous and cannot be used under the present calculation of blast furnace slags and mixtures. The non-titaniferous ores which may be in the western limits of the town, are extremely inaccessible if indeed in any quantity.

In their scientific relations the titaniferous ores are of great interest. They invariably occur in dark, basic gabbros and in such relations as to make the inference unavoidable, that they are excessively ferruginous or basic, portions of the original igneous magma. There is no sharp line of demarcation between ore and wall but a gradual passage of one into the other, although in a short space. We are coming to recognize titaniferous magnetites in these relations in many parts of the world, and Wadsworth* in this country, Derby† in Brazil, and Vogt‡ in Sweden have already called attention to such.

*M. E. Wadsworth. The Iron Ore or Peridotite of Mine Hill, Cumberland, R. I. Bull. Min. Comp. Zool. 1880. VII.

†O. A. Derby. Magnetite Ore Districts of Jacupiranga and Ipanema. Sao Paulo, Brazil. Amer. Jour. Sci., April, 1891. 311.

‡ J. H. L. Vogt. Bildung von Erzlagerstätten durch Differentiations-processe in basischen Eruptivmagmata; Zeitschrift für praktische Geologie, I. pp 4, 125, 257. This paper appears in its completest and latest form in the reference given, although the conclusions had been previously published elsewhere.

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I. Geological Map of Moriah and Westport Townships, Essex Co., New York

by J. F. Kemp

University of the State of New York

BULLETIN

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Vol. 3 No. 15

September 1895

MINERAL RESOURCES

OF

NEW YORK STATE

BY

FREDERICK J. H. MERRILL, Ph. D.,

Director New York State Museum

ALBANY

UNIVERSITY OF THE STATE OF NEW YORK

1895

PREFACE.

This bulletin is in part the outgrowth of the work done in preparation for the Scientific Exhibit of New York at the World's Columbian Exposition. In collecting a representative series of specimens of the economic products of the State much information was obtained concerning the various mineral deposits. As sufficient space was not available in the text of the report of the Superintendent of the Scientific Exhibit to discuss fully the data at hand, and as it was necessary that the economic and geologic map should be accompanied by a description of the various economic minerals and their relations, it seemed advisable to prepare a bulletin containing a synopsis of the facts. This bulletin is designed to answer many questions concerning the mineral resources of New York which have hitherto been answered by correspondence, and though it is not offered as an entirely com plete record, it is hoped that it may in a measure supply a want which has long been manifest and that in a future revised edition it may be made more perfect. In the brief time available for the preparation of the bulletin it has not been possible to write original articles on all the economic minerals of the State. Extracts have, therefore, been made from various reliable articles already in print wherever it seemed advisable to use them, and references are given to other literature.

FREDERICK J. H. MERRILL.

ALBANY, *March*, 1895.

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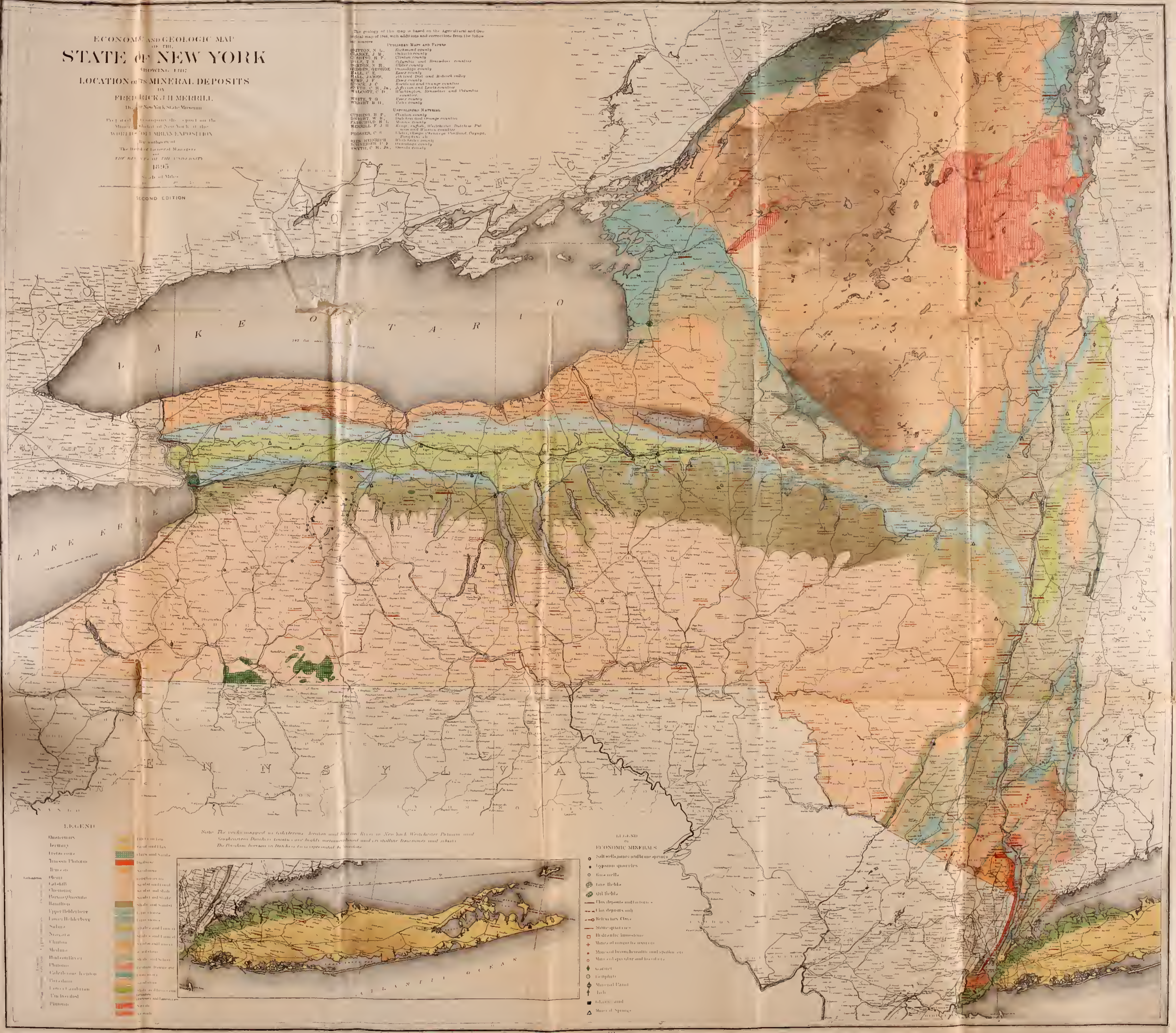
ECONOMIC AND GEOLOGIC MAP
OF THE
STATE OF NEW YORK
SHOWING THE
LOCATION OF ITS MINERAL DEPOSITS
BY
FREDERICK J. H. MERRILL
1895
SECOND EDITION
LAKE ONTARIO
LAKE ERIE
LEGEND
ECONOMIC MINERALS

Economic and Geologic Map.

The map which accompanies this bulletin was prepared to illustrate the report of the Superintendent of the Scientific Exhibit of the State of New York at the World's Columbian Exposition and is intended to show the distribution of the principal mineral deposits which are of economic value.

As a geologic base was necessary to the proper differentiation of the formations which are of economic importance, and as no geologic map of New York had been published since 1844, the want could only be supplied by the compilation of a new one. Since but little time was available for this purpose, in consequence of the fact that the report on the Exhibits of New York at the World's Fair was already in press when the Superintendent was asked to contribute the map, it is not to be expected that errors have been entirely avoided, and the incomplete state of geologic knowledge has left many gaps which in the present map have been filled by inference, but the belief that this map will be of practical use to teachers, students and business men throughout the State leads the author to publish it without prolonged apology for unavoidable inaccuracies. Those who wish for more minute information concerning the distribution of the geologic formations of New York are referred to the new geologic map of the State now in preparation by the State Geologist Prof. James Hall. This will be on a very much larger scale and will show more clearly and accurately the geologic detail.

The work of preparing the geologic base for the economic map has brought to light serious deficiencies in our knowledge of the geologic formations of New York State.

Although New York is the mother state in geologic nomenclature and contains a more complete and extensive series of the formations below the carboniferous than any other state, and although the rocks have been studied for more than sixty years by professional geologists and students, our recorded knowledge of geologic detail is far from complete. This is especially true of the Pre-cambrian formations which consist of metamorphic and igneous rocks. This is not, however, very remarkable when we consider that accurate methods of rock study and classification have had their greatest development since 1873, when through the labors of Zirkel and Rosenbusch the microscope was successfully applied to the study of rocks. In mapping the Pre-cambrian formations of New York the author is, therefore, unable to give any great amount of detail. In Westchester, Putnam and southern Dutchess counties his personal studies during a number of years, with the assistance of Messrs. E. M. Blake and H. Ries, have enabled him to differentiate the areas of metamorphosed palæozoic limestones and schists from the subjacent gneisses which can be traced northward through Westchester county and are apparently continuous with the banded gneisses which rest upon the granite of Putnam county. The small scale of the map makes it impossible to show the full detail of these narrow belts of rock which owe their existence to the folding and erosion which has taken place within that region. Within the Pre-cambrian area of Putnam county, which is generally known as the "Highlands," in addition to the banded gneisses which contain the beds of magnetite, there are large masses of granite which appear along the axes of the mountain folds, being flanked by the gneisses. The author regards these as igneous granites made plastic in the process of mountain making which created the folds in which they occur. No attempt has been made to differentiate these granites in the mapping, nor has any field work been undertaken with this end in view. The southwestern extension of this Pre-cambrian area through Rockland and Orange counties into New Jersey has precisely the same component rocks and structure. Besides the "Highlands" Pre-cambrian area just mentioned, there is the greater area of the Adirondack wilderness. This is known to include two principal formations of Pre-cambrian age. First, an area of metamorphic rocks, extending from Lake Champlain to the Black river and from southern Fulton county nearly to the Canadian boundary. Secondly, in the eastern part of the wilderness and touching at two points the shore of Lake Champlain is a mass of basic plutonic rock chiefly composed of hypersthene and labradorite which may be called norite. In the work of the original Natural History Survey of New York, which culminated in the publication of the reports on the four geological districts of the State in 1842 and 1843, this region was investigated by Prof. Ebenezer Emmons. This geologist recognized clearly the striking lithological difference between the massive norite and the stratified gneisses which environed it, but gave no accurate description of their boundaries, doubtless for want of an accurate map of the wilderness. In 1883 a map of Essex county by C. E. Hall was published in the annual report of the State Geologist, which gives approximately, the boundaries between the norite and the gneisses. In 1892 Prof. J. F. Kemp, of Columbia College, undertook the study of Essex county under the auspices of the State Museum, and the results of his work are embodied in the economic map.* While Prof. Kemp's observations have not been carried around the whole periphery of the plutonic mass, they go sufficiently far to show that it occupies but a small part of the Adirondack wilderness and can be included in a circle of about fifty miles diameter, with its center in the vicinity of Keene Valley. Within this plutonic area are the principal peaks of the Adirondack mountain group. The extension of this area into Franklin county as shown on the map is based on the observations of Ebenezer Emmons. The northwestern part of the metamorphic area is believed by Prof. James Hall to contain rocks of Huronian age. The study of this region is now in the hands of Prof. C. H. Smyth, Jr., of Hamilton College, and to him we look for the elucidation of this question. He classifies under the name of Oswegatchie series a group of crystalline limestones and gneisses. The geology of the Adirondack region as given in the map is based upon the original work of Ebenezer Emmons and Lardner Vanuxem with additions by C. E Hall, J. F. Kemp and T. G. White in Essex county, and by F. J. H. Merrill in Warren and Hamilton counties. In St. Lawrence, Jefferson and Lewis counties Prof. Smyth has given information cencerning the distribution of the gneisses and other Precambrian rocks. On the north side of the wilderness Prof. H. P. Cushing, of Adelbert College, Cleveland, Ohio, has been conducting some field work and has revised the lower boundary of

*See also Bull. No. 13. N. Y. State Museum.

the Potsdam in Clinton county. An examination of the shores of Lake George was made for the Museum in 1891 by Mr. E. M. Blake.

From the base of the palæozoic upward the geologic formations of New York were quite accurately studied in the original survey, but the work of mapping the boundaries was not very carefully done, and though at the present time there is much new information in the possession of those who have made special studies of these formations, but little new material has been published, and it has not been possible within the time at the author's disposal to consult those in possession of unpublished material. The author's personal observations on the palæozoic groups have been chiefly confined to the upper and lower Helderberg limestones and the strata immediately adjacent to them, in Greene, Albany and Schoharie counties and at various points to the westward along the principal lines of railway. The principal guide used in the preparation of the geologic base was the Agricultural and Geological map of New York, published by authority of the Legislature in 1844. In revising the boundaries given on this map the four geologic district reports of New York have been carefully studied, and from them many corrections have been introduced, although the old map was based on the material contained in those reports. This was particularly noticeable in mapping the outcrop of the upper Helderberg limestones, which on the old map is shown far to the northward of Otsego and Schuyler lakes, although Vanuxem reported the occurrence of the corniferous limestone at Richfield Springs, in the town of Springfield at the head of Otsego lake and at Cherry Valley; a similar error occurs in the mapping of these limestones in Seneca county, where they are shown in a straight belt between Seneca and Cayuga lakes, far to the south of Seneca outlet, although Prof. James Hall reported the occurrence of the upper Helderberg limestone on Seneca outlet west of Waterloo. In the new map the two Helderberg limestones have not been differentiated for three reasons: First, because the scale of the map was too small to permit it; second, because the author had not sufficiently accurate information to enable him to separate them, and, third, because the map, being chiefly economic, it seemed best to represent the two limestones in one belt. The boundary between the Hamilton and Portage group accords very nearly with the views of Prof. C. S. Prosser.

In addition to the text of the reports, the following published maps have been consulted :

Geologic maps of Jefferson and Clinton counties, by E. Emmons, Natural History of New York, Report on the Geology of the Third District, 1842; a geologic map of Ontario county, by J. M. Clarke, Report of the State Geologist for 1885; a geologic map of Yates county, by B. H. Wright, Thirty-fifth Annual Report of the New York State Museum, 1881; a geologic map of Onondaga county, by Geo. Geddes, Report of the New York State Agricultural Society, 1859; a sketch map of the Mohawk Valley, by James Hall, Report of the State Geologist for 1885; a geologic map of Washington, Rensselaer and Columbia counties, by C. D. Walcott, American Journal of Science, vol. 35, p. 399; geological maps of parts of Dutchess and Columbia counties, by J. D. Dana and W. B. Dwight, American Journal of Science, a geologic map of parts of Orange and Ulster counties, by John C. Smock, part of geologic map of New Jersey, 1868; a map of Richmond county, by N. L. Britton, Annals of New York Academy of Sciences, vol. 2, revised by C. A. Hollick. The work of T. Nelson Dale, in Rensselaer county, Thirteenth Annual Report Director United States Geological Survey, has also been used. McFarlane's Geological Railway Guide has been freely consulted. To Prof. James Hall, State Geologist, the thanks of the author are due for information concerning the geology of many localities.

To the second edition of the map Prof. Dwight has contributed an original map of Dutchess county, and Profs. H. L. Fairchild and P. H. Hargitt have respectively contributed to the geology of Rochester and Syracuse.

Mr. N. H. Darton's work in Ulster county, published in the Report of the State Geologist for 1893 has also been used.

The localities of iron mines are chiefly taken from the map of Prof. J. C. Smock.* The stone quarries are chiefly from Prof. Smock's map,† with additions by Wm. G. Eberhard, E. M., and

* Bulletin of the New York State Museum, No. 7.

† Bulletin of the New York State Museum, No. 10.

Wm. C. Clarke, E. M. The clay localities were mapped by M
Heinrich Ries,* the oil pools by Messrs. C. A. Ashburner and I
Van Ingen, the salt wells by R. D. White, Jr., C. E., and th
gypsum quarries by Wm. C. Clarke, E. M. The other miner
localities were mapped by the author.

In preparing the base, various practical difficulties had to b
met. Among these were the lack of accurate information co
cerning the boundaries of the Chemung and Catskill formatio
in New York, the impossibility of undertaking any new fiel
work, and the lack of sufficient funds to permit of more than fi
teen printings in the press work of the map. It has, therefor
been necessary to emphasize the economic character of the ma
rather than the geologic character, to associate in color, rocks c
similar economic or lithologic features, and for lack of inform
tion and funds for printing, to indicate without differentiatio
the great mass of sandstones, shales and conglomerates include
between the base of the Portage and the top of the Catskill.

When the large geologic map of New York, now in prepar
tion by the State Geologist, is published and distributed, ther
will be a definite expression of opinion on the boundaries c
these formations, but at present there is no official presentatio
of the subject.

The map will be found in the pocket of the cover of the bull
tin and the legend will explain the various tints and symbols use

Geologic Map of Westchester and New York Counties.

Since the scale of the State economic map is not sufficientl
large to give in detail the areas of building stone, in New Yor
and Westchester counties, a map of that region is publishe
on a scale of four miles to one inch. This map is based on th
studies of the author and shows the present state of geologi
knowledge in that region.

Economic Minerals of New York.

Under this head are described the minerals of New Yor
which are commercially important. So far as possible a director
of the producers has been prepared for each mineral product

* Bulletin of the New York State Museum, No. 12.

References are given to the literature of the various materials which have been fully described in other publications, and in some cases abstracts have been made from reliable authorities. Wherever new information is at the disposal of the author a brief synopsis of it is given.

It was originally hoped that statistics of the production of the various minerals could be given, but this project was abandoned because it involved more labor and expense than was possible up to the time of publication.

Building Stone

This important class of material has been discussed at length by Prof. John C. Smock in Bulletins Nos. 3 and 10 of the New York State Museum, and these two publications contain nearly all that is known at present.

Since Bulletin No. 10 is out of print a large portion of it has been incorporated in the following pages.

The directory of producers gives the latest information.

GEOLOGY AND GEOGRAPHIC DISTRIBUTION OF BUILDING STONE IN NEW YORK.

By John C. Smock. Revised by F. J. H. Merrill.

GRANITIC ROCKS

Granites, Gneisses, Syenites, Trap-Rock and Norites.

Granites. Typical granite is a crystalline, granular mixture of feldspar, quartz and hornblende. In addition to these essential constituents, one or more accessory minerals may be present. The more common are the micas, muscovite and biotite, garnet, tourmaline, magnetite and pyrite. The character of the rock is often determined by the presence of these accessory constituents in quantity, as in some cases the hornblende is entirely replaced by mica.

The chemical composition also varies from that of the average or typical kind. The mineralogical differences mark the varieties, thus there are: hornblende granite, biotite granite, tourmaline granite, etc.

The texture of granites is determined by the aggregated minerals entering into their composition. They vary from coarse-crystalline, in which the individual crystals may be an inch or more in length, to fine-crystalline and aphanitic, wherein the minerals are hardly visible to the eye. In consequence of the wide variation due to the mode of arrangement of the mineral constituents, there is an equally great variety noticeable in the texture.

The color also is dependent upon the minerals. As feldspar is the predominant constituent it gives character to the mass, and the red varieties owe their color to the red or pink feldspars in them, as in the case of the granite of Grindstone Island in the St. Lawrence. The shades of gray are due to the varying amount of the dark-colored mica mixed with the feldspar and quartz; and the darker-colored varieties owe their color, in most cases, to hornblende or tourmaline which may be present.

The beauty, ease of working, durability and value of the granites for use in construction is related closely to their mineralogical composition. Their arrangement in the mass and their relative proportion determine the color and give beauty. The presence or absence of certain species influence the hardness and homogeneous nature and the consequent ease with which the stone can be dressed and polished. For example the mica, if disposed in parallel surfaces, gives a foliated structure and tends to produce what is known as rift, and the granite is more readily split in the planes of the mica than across them. Again the mica flakes may be so large and irregularly massed that the surface is not susceptible of a uniform degree of polish. Hornblende, on account of its superior toughness, is less brittle than pyroxene under the polishing, and the hornblende granites are said to be preferred to those rocks which contain pyroxene in quantity.

The more nearly alike in hardness and the more intimately interwoven the texture of the minerals, the more capable it is of receiving a good polish. Hence it follows that the very coarse crystalline granites are not so well suited for ornamental work.

The enduring properties of granites vary with the nature of the minerals in their composition. Although popularly they are regarded as our most durable building stone, there are some notable exceptions, which are evident in the natural outcrops, where this rock is found decayed to the depth of 100 to 200 feet, and in the active disintegration which is in progress in structures of the present century. Foliated varieties placed on edge in buildings, tend necessarily to scale under the great changes of temperature in our northern cities and towns.

The more rapid decomposition of the micas makes those varieties in which they occur in large flakes or aggregations more liable to decay. The condition of the feldspar also is often such as to influence the durability. When kaolinized in part, it is an element of weakness rather than of strength. The presence of the easily decomposable varieties of pyrite is not only prejudicial to strength and durability but also to the beauty of the stone as soon as it begins to decay.

The term "granite" as used among builders and architects is not restricted to rock species of this name in geologic nomenclature, but includes what are known as gneisses (foliated and bedded granites), diorites, gabbro and other crystalline rocks whose uses are the same. In fact, the similar adaptability and use have brought the latter species into the class of granites. For example, the Au Sable granite of Essex county is a norite. The term is applied in some cases to the diabases or trap-rocks, as the "granite quarries" of Staten Island.

Another massive crystalline rock which is used in building is norite, consisting of labradorite and hypersthene, with some brown mica. It is a common rock in the Adirondack region, and is known commercially as a granite.

The massive crystalline rocks are of common occurrence in New York, but not in outcrops over extensive areas, excepting in the Adirondack region and in the Highlands of the Hudson. The schistose crystalline rocks are developed extensively in the Highlands of the Hudson and on the borders of the Adirondack region. On New York island and within the city limits the gneissic rocks have been quarried at many points. In Westchester county there are belts of gneiss and mica schist, in which quarries have been opened near Hastings; near Hartsdale, east of Yonkers; at Kensico; at Tarrytown and at Ganung's, west of Croton Falls. In Putnam county there are quarries of granite near Peekskill and near Cold Spring. West of the river there are quarries on Iona island; at West Point; near Suffern's; at Ramapo; on Mount Eve, near Florida, and on Storm King mountain, near Cornwall. The outcrops of the gneissoid and granitoid rocks are so numerous in the belt of the Hudson Highlands that quarries can be opened at many points. The supply of stone is inexhaustible. On the Hudson river, between Peekskill and Fishkill, there is a fine section of these rocks exposed.

On the borders of the Adirondack region quarries have been opened in the towns of Wilton, Hadley and Greenfield, in Saratoga county; at Whitehall, in Washington county; at Little Falls, in Herkimer county; and near Canton, in St. Lawrence county. The inaccessibility of much of this region and the distance from the large city markets have prevented the opening of more quarries in the gneissic rocks on the borders of the Adirondacks.

Description of Granite Quarries.

New York, Manhattan Island.— The outcropping ledges of gneiss rocks, from Twenty-ninth street (on the west side) to the Spuyten Duyvil creek, and from about Sixteenth street northwards, on the eastern side of the island, have been cut through and graded down in so many places that a large amount of stone has been furnished, ready for laying up foundations and for common wall work. These gneisses are generally bluish-gray in color, medium fine-crystalline, highly micaceous and schistose in structure. The beds are thin and tilted at a high angle and in places are in a vertical position. The more micaceous rock is apt to flake and disintegrate on long exposure, especially when the blocks are set on edge. The more feldspathic stone of the granitic veins and dikes and the more hornblendic strata afford a better building material.

The Croton reservoir, Fifth avenue and Forty second street and St. Matthew's Lutheran church, Broome street, are constructions of the best of the island gneiss.

The gneissic rocks have been quarried extensively in the Twenty-third and Twenty-fourth wards, New York city, and in the adjacent southern towns of Westchester county.

The gray variety of gneiss has been most largely employed for the better class of building.

New York City, Fordham.—A micaceous gneiss is quarried on the property of St. John's College, on the corner of the Boulevard and Pelham avenue. It is of a bluish-gray shade of color, and is known locally as "bluestone." The new buildings of the college are constructed of this stone.

Hartsdale, Westchester County.— Gneissic rock is quarried near Hartsdale station, on the Harlem railroad, for the local market. The county buildings at White Plains are built of this stone.

Southeast of White Plains gneiss is quarried, and an example in construction is seen in the M. E. church on the main street.

Scarsdale, Westchester County.— The Seely quarries are a half mile west-northwest of the Scarsdale station, and near the road to Greenville. The stone obtained from this locality consists of feldspar, quartz, hornblende and a little black mica, and these minerals in parallel lines give it a foliated aspect. The exposed ledges near the quarry are firm and solid and show very little alteration due to weathering. This stone has been used in bridge work for the Bronx river aqueduct, and also in the Williams Bridge reservoir gatehouse.

Hastings, Westchester County.— There are three quarries in the vicinity of Hastings. One is owned and worked by the N. Y. C. & H. R. R. R. Co., one mile south of the railroad station. The Munson quarry* is three-quarters of a mile east-southeast of the village, and adjoining it on the same ridge is the Ferguson quarry.

The stone of these quarries consists of orthoclase, quartz, hornblende and biotite, arranged generally in parallel lines or thin layers, which give the rock a gray and striped appearance. The product is shipped to New York city for foundation walls, and is used for common wall work in the adjacent country.

Yonkers, Westchester County.— The Valentine quarry opened on the top of the hill, two miles southeast of Yonkers, and on the Mount Vernon road, is worked at long intervals. The stone is fine-grained, a mixture of reddish feldspar, quartz, and a little hornblende.

Tarrytown, Westchester County.— The old Beekman quarry, one and a quarter miles north of the station, and at the side of the railroad track, was worked largely in former years.

Kensico, Westchester County.— A gneissic rock has been quarried extensively on the east side of the Bronx river reservoir, and used in the construction of the reservoir dam.

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* Operated by Wm. G. Lefurgy.

Union Valley, Putnam County.— The quarries of — Jackson† and E. C. Ganung are located four miles from Croton Falls, and in the town of Carmel. The stone has a striped appearance, due to black mica and white feldspar alternating in thin layers. Its main use is for posts and foundations; some of it has been used for monuments and buildings.

Ramapo, Rockland County.— The quarry of Henry L. Pierson* is in the hillside near the N. Y., L. E. and W. R. R., south of the village. The stone is a quartz-syenite, consisting of orthoclase, quartz and hornblende. It is especially suited for heavy masonry on account of its strength and the large size of blocks which can be obtained. Some of this stone has been used for monumental work, and some for the Erie railway bridges.

Sufferns, Rockland County.— Granite for cemetery posts and monumental bases has been quarried in a small way from ledges on the roadside west of Sufferns station. It is greenish-gray in color, hard to cut and dress, but is durable.

Peekskill, Westchester County.— There is a granite quarry on the bank of the river two miles northwest of Peekskill.

Iona Island, Rockland County.— There is a large quarry on Round Island near Iona Island, owned by Daniel E. Donovan, whence stone is obtained for heavy masonry and for macadam material. A large amount is sold annually for road-making. Some of the stone used in the New York and Brooklyn bridge came from this quarry.

West Point, Orange County.—West of the military academy buildings a gneissoid granite has been quarried at several points for the construction of government buildings. The stone occurs in thick beds and the solid, outcropping ledges indicate the durability of the stone where exposed to the weather. The library building, the old riding academy, three of the professors residences and the long lines of retaining wall are constructed of the stone taken from these quarries.

Garrisons.— King's Quarry. A large quarry of fine gray granite is operated by the King Granite Company.

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* Not now in operation. † Full name not obtained.

Storm-king Mountain.— The granite quarry at the south-eastern face of Storm-king mountain, near the West Shore railroad track, and a half mile south of Cornwall station, has not been in operation for several years.

Break-neck Mountain Quarry. — Granite has been quarried at several points on the southwest side of this mountain and north of Cold Spring. The quarry sites extend nearly a mile back from the river; and the work has been to detach blocks of large size by blasting and then to break them up into building stones or paving blocks as called for. The Hudson River Broken Stone and Supply Company is now working on the lands of Lewis J. Bailey, producing stone for railroad track ballast.

Mount Adam, Warwick, Orange County. — Granite was quarried at a locality, opened in 1889, on the north end of Mount Adam.

Little Falls, Herkimer County. — A hornblendic-gneiss rock, known as "blue rock," is quarried at Little Falls for the local market. It was used in the construction of the Erie canal, the N. Y. C. & H. R. R. R., in the R. C. and the Pres. churches, besides several mill and store buildings in the town. The stone has a greenish-gray color, moderately fine-crystalline texture, and is made up of orthoclase, quartz and hornblende. Some of it has a reddish tinge, due to iron stains.

Granite has been quarried in the town of Wilton, two miles north of Saratoga, in the town of Greenfield, and at Wolf Creek, in the town of Hadley. None of these quarries are worked regularly or uninterruptedly.

Adirondack Granite Company, Westport, Essex County.— The granite quarry on Splitrock mountain near the lake, and three miles from Whallonsburg, has been abandoned. Very little stone has been quarried here and little is known of it.

Ausable Granite, Essex County. — The Ausable granite is obtained from quarries on the north and west slopes of Prospect Hill, one and a half miles south of Keeseville. The principal openings are the property of the Ausable Granite Co., whose establishment for dressing the stone is located in Keeseville. This stone is moderately fine-crystalline in texture and is composed of labradorite feldspar, hypersthene and biotite. Small grains of pyrite and hematite are occasionally seen in the mass. The stone is hard and expensive to dress but it is susceptible of a high polish and is especially adapted for decorative work and for monuments. The dark, polished surface, with its chatoyant play of colors, contrasts well with the gray dressed surfaces. The glaciated ledges near the quarries show little alteration due to weathering, and are evidence of the durability of the stone. In some of the weathered surfaces the feldspars appeared changed to kaolin, and the hypersthene is badly decomposed.*

Grindstone Island, Jefferson County.—A red granite is quarried extensively on this island in the St. Lawrence river, northwest of Clayton. There are many outcrops, especially on the western side of the island, and small quarries have been opened at more than twenty different points.

There are three large quarries which are worked extensively and with little interruption. The granite of these quarries is rather coarse crystalline, red to bright red in color and consists of flesh colored feldspar, quartz and mica, with very little magnetite as an accessory constituent. Its resemblance to the Scotch granite has given it the name of "International Scotch granite." Examined under the microscope the feldspars show kaolinization. The durability of the stone is witnessed in the unaltered or scarcely altered rock which crops out on the two sides of the quarry. Blocks of large size can be obtained up to the limit in handling and shipping. An examination of a representative specimen of this granite shows that it has a specific gravity of 2.713, equivalent to a weight of 169 pounds per cubic foot. The absorption test indicated 1.55 per cent. of water absorbed. The loss in a dilute solution of sulphuric acid was 0.13 per cent. Freezing and thawing produced no

* Tests of the strength of this stone made by Dr. Thos. Egleston, of Columbia College School of Mines, show that it stands 27,000 pounds and breaks at 29,000 pounds to the square inch. Dr Egleston's series of tests made for the company show further, that when heated to a bright red heat by a blast of a Bunsen burner the stone was not cracked badly; and at a temperature of 800°-1350° F. and then quenched in cold water the specimens changed in color but otherwise were hardly altered, except at the highest heat. "The outside of the piece was rendered rather crumbly and granular * * * but the piece as a whole was still hard and resists moderate blows of the hammer." [From report made to the Ausable Granite Works.]

apparent change. Exposure to a temperature of 1200 to 1400 degrees F. caused vitrifaction, destruction of color and impaired the strength so that the specimen crumbled with a blow. The greater part of the product of these quarries is in the form of paving blocks and is shipped to western cities, principally Cincinnati and Chicago. The International Granite Company of Montreal uses a large amount for monumental work and building. Examples of this granite can be seen in the large columns of the Senate Chamber of the New Capitol, Albany, and in the Nordheimer building in Montreal.

Trap-Rocks.

Trap-rock or trap is the common name given to a class of eruptive rocks because of a structural peculiarity, and has no distinctive significance in mineralogical composition. The rocks of the Palisade mountain range and of the Torn mountain, which extends from the New Jersey line, on the west shore of the Hudson river to Haverstraw, are known as trap-rocks. There is an outcrop on Staten Island, near the north shore, where a large amount of stone has been quarried at the so-called "granite quarries."

The trap-rock of the Palisades range is a crystalline, granular mass of a plagioclase feldspar (labradorite usually) augite and magnetite. It is generally finer-crystalline than the granite. The colors vary from dark gray through dark green to almost black.

This trap-rock is hard and tough, but some of it is split readily into blocks for paving. It has been used extensively in New York and adjacent cities for street paving, but since the introduction of granite blocks this use has nearly ceased. On account of its toughness it makes an admirable material for macadamizing roadways. It is so hard that only rock-face blocks are used in constructive work. Several prominent buildings in Jersey City and Hoboken are built of it. There is a large quarry on the river at Rockland lake, the output of which is for street work and road material almost exclusively. There are also quarries at Piermont and at Graniteville, Staten Island.

SANDSTONES

Sandstones consist of grains of sand which are bound together by a cementing material.

The grains may be of varying sizes, from almost impalpable dust to small pebbles, and may be angular or more or less rounded in form. The cementing matter also may vary greatly in its nature. From this variation, both in the grains and in the cement, there is an almost endless gradation in the kinds of sandstone.

Quartz is the essential constituent, but with it there may be feldspar, mica, calcite, pyrite, glauconite, clay or other minerals, and rock fragments common to stone of sedimentary origin. These accessory materials often give character to the mass, and make a basis for a division into feldspathic, micaceous, calcareous sandstones, etc., as one or another of them predominates.

The texture of the mass also is subject to a wide range of variation, from fine-grained, almost aphanitic, to pebbly sandstone, or conglomerate, or a brecciated stone in which the component parts are more or less angular.

Some of the brown sandstones of the Triassic age, quarried near Haverstraw, are such conglomeratic and brecciated sandstones. Accordingly as the grains are small or large the stone is said to be fine-grained or coarse-grained.

The variety of the cementing material also affords a basis for classification. Silicious sandstones have the grains bound together by silica. They consist almost exclusively of quartz, and grade into quartzite. The ferruginous varieties have for their cement an oxide of iron, often coating the grains and making a considerable percentage of the whole. The iron is usually present as ferric oxide. Calcareous sandstones are marked by the presence of carbonate of lime. When it exceeds the quartz in amount, the sandstone becomes a silicious limestone. In the argillaceous varieties, the binding material is a clay, or an impure kaolin.

The cementing material determines in most cases the color. The various shades of red and yellow depend upon the iron oxides; some of the rich purple tints are said to be due to oxide of manganese.

The gray and blue tints are produced by iron in the form of ferrous silicate or carbonate. By an irregular association of masses of different colors a variegated surface is produced, or by an alternation of white and variously-colored laminæ a striped appearance is given to the mass.

Sandstones occur stratified and in beds of greater or less thickness, and they are said to be thick-bedded or thin-bedded. In some cases the beds are so thick, and the stone of such a uniform texture, that the stone can be worked equally well in all directions, and is known as freestone. When fine-grained it is often designated as liver-rock. A laminated structure is common, and especially in the thin strata, or when the stone is micaceous. When the beds can be split into thin slabs along planes parallel to the bedding, it is called a flagstone. A less common structural character is what is termed lenticular or wedge-shaped, in which the upper and under surfaces lack parallelism, and the beds wedge out. It makes the quarrying more difficult, and produces more waste material.

These variations in the nature of the component grains, and binding material, in their arrangement, and in the forms of bedding, produce a great variety of stone, and the gradations from one to another are slight. The hardness, strength, beauty and durability are determined by these varying elements of constitution. The hardness depends upon the quartz, and the strength of the cement holding the grains or fragments together. Without the cement, or in the loosely aggregated stone, the grains are readily torn apart, and the mass falls with a blow,— a heap of sand. Generally the more silicious the stone and the cement, the greater the degree of hardness and strength. The size, color and arrangement of the component grains are the elements which affect the appearance and give beauty to the sandstone. The durability is connected intimately with the physical constitution and the chemical composition. As a rule calcareous and clayey cementing materials are not as enduring as the silicious and ferruginous. The stone best resisting the action of the atmospheric agencies is that in which the quartz grains are cemented by a silicious paste, or in which the close-grained mass approaches in texture a quartzite.

The presence of minerals liable to decomposition, as feldspar, highly kaolinized, of mica, marcasite, and pyrite, of calcite in quantity, and clays, affects the durability and tends to its destruction.

Sandstones are classified according to their geologic age also. They are found occurring in all the series, from the oldest to the most recent formations. Those of a given age are generally marked by characteristic properties, which serve for their identification, aside from the fossil organic remains by which their exact position in the geologic series is fixed. This persistence in characters is exemplified in the Medina sandstones of the State, in the Devonian bluestone of the Hudson River valley, and in those of Triassic age.

Sandstones occur in workable quantity in nearly all the greater divisions of the State.

Quarries have not, however, been opened everywhere in the sandstone formations, because of the abundant supply of superior stone from favorably situated localities. There are, in consequence, large sandstone areas and districts in which there is an absence of local development, or abandoned enterprises mark a change in conditions, which has affected injuriously the quarry industry in them.

Following the geologic order of arrangement and beginning with the Potsdam sandstone, the several sandstone formations are here briefly reviewed.

Potsdam Sandstone.

This formation is the oldest in which, in this State, sandstone is quarried for building purposes.*

The bottom beds are a fine, silicious conglomerate; above are sandstones in thin beds generally. It is gray-white, yellow, brown and red in color. In texture it varies from a strong, compact quartzitic rock to a loosely coherent, coarse-granular mass, which crumbles at the touch.

Outcrops of limited area occur in Orange and Dutchess counties, and in the Mohawk valley. In the Champlain valley the formation is well developed at Fort Ann, Whitehall, Port Henry and Keeseville, and quarries are opened at these localities. The stone is a hard, quartzose rock, and in thin beds. North of the Adirondacks the formation stretches westward from Lake

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* Some of the sandstones east of the Hudson and in the Taghkanic range may belong to the Lower Cambrian. See Amer. Jour. of Science, iii series, vol. 35, pp. 399–401. But there are no quarries opened in these localities.

Champlain to the St. Lawrence; and there are quarries in the towns of Malone, Bangor and Moira in Franklin county; in Potsdam and Hammond in St. Lawrence county; and in Clayton, Jefferson county. In parts of Clinton county the stone is too friable for building.

The most extensive openings are near Potsdam, and the stone is hard, compact and even-grained, and pink to red in color. Some of it has a laminated structure and striped appearance. It is an excellent building stone and is widely known and esteemed for its beauty and durability.

The Hammond quarries produce a gray to red stone. Nearly all of the output is cut into paving blocks and street material.

Hudson River Group.

The rocks of this group outcrop in Orange county, northwest of the Highlands and in the valley of the Hudson river northward to the Champlain valley in Washington county. From the Hudson westward the Mohawk valley is partly occupied by them. The belt increases in breadth, thence in a northwest course across Oneida, Oswego and Lewis counties, and continues to Lake Ontario.

The rocks consist of shales and slates, sandstones and silicious conglomerates. The slates are noticed under the heading slates, and in the notes on quarry districts.

The sandstones are generally fine-grained and of light-gray or greenish-gray color. They are often argillaceous and not adapted for building purposes. But the even bedded and well-marked jointed structure makes the quarrying comparatively easy, and the nearness to lines of transportation, and to the cities of the Hudson and Mohawk valleys have stimulated the opening of quarries at many points

For common rubble work* and for local uses the quarries in this formation have furnished a large amount of stone. The more important quarrying centers are now at Rhinecliff-on-the-Hudson, New Baltimore and Troy, in the Hudson valley; at Aqueduct, Schenectady and Duanesburg, Schenectady county; and Frankfort Hill, Oneida county.

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* Prof. Amos Eaton gave the name of "rubble stone" to the sandstone in the upper part of the formation.

These quarries have a local market and do not supply much, if any, stone to distant points. Nearly all of the stone is used in foundation and common wall work.

Oneida Conglomerate.

This formation is developed to its greatest thickness in the Shawangunk mountain in Orange and Ulster counties.

It is recognized in the Bellevale and Skunnemunk mountains, also, in Orange county. In the central part of the State it is traced westward in a narrow belt from Herkimer county into Oneida county. The prevailing rocks are gray and reddish-gray, silicious conglomerates and sandstones, which are noted for their hardness and durability. The cementing material is silicious. The jagged edges and angular blocks and the polished and grooved surfaces of the glaciated ledges, so common on the Shawangunk range, afford the best proof of the durable nature of these rocks. The bottom beds, near the slate, contain some pyrite. No attempt has been made to open quarries for stone, excepting at a few localities for occasional use in common wall work. The grit rock is quarried near Esopus Creek for mill-stones.

The accessibility of the outcrops to the New York, Lake Erie and Western railroad, the New York, Ontario and Western rail-road, the West Shore railroad and the Delaware and Hudson Canal lines is an advantage, as well as the comparative nearness to New York. And no other formation in the State exhibits in its outcrops better evidence of ability to resist weathering agents

Medina Sandstone.

The Medina sandstone is next above the Oneida conglomerate. It is recognized in the red and gray sandstones and the red and mottled (red and green) shales of the Shawangunk and Skunne-munk mountains in Orange county. A large amount of the red sandstone has been quarried on the north end of the Skunnemunk range, in the town of Cornwall, for bridge work on the railroads which cross the range near the quarry.

The red sandstone is seen exposed in the cuts of the Erie rail-way northeast of Port Jervis. This formation reappears in

Oswego county, and thence west to the Niagara river in a belt bordering Lake Ontario.

Prof. Hall describes it as follows: "The mass is usually a red or slightly variegated sandstone, solid and coherent in the eastern extremity of the district, becoming friable and marly in the western extension, and admitting an intercalated mass of gray quartzose sandstone, which contains marine shells; while in the red portions are rarely found other than marine vegetables or fucoids."*

Quartz is the principal mineral constituent associated with some kaolinized feldspar. The cementing material is mainly oxide of iron, with less carbonate of lime. The stone is even-bedded and the strata dip gently southward The prevailing systems of vertical joints, generally at right angles to one another, divide the beds into blocks, facilitating the labor of quarrying.

Quarries have been opened at Fulton, Granby and Oswego, in Oswego county; at several points in Wayne county; at Rochester, on the Irondequoit Creek, and at Brockport, Monroe county; at Holley, Hulburton, Hindsburg, Albion, Medina and Shelby Basin, in Orleans county; and at Lockport and Lewiston, in Niagara county. The Medina sandstone district proper is restricted to the group of quarries from Brockport west to Lockport.

The leading varieties of stone are known as the Medina red stone, the white or gray Medina and the variegated (red and white) or spotted. The quarries in this district are worked on an extensive scale, and their equipment is adequate to a large annual production. The aggregate output is larger and more valuable in dimension stone for dressing than that of any other quarry district in the State. Including the stone for street work, the total value is greater than that obtained from the stone of any other geological formation in the State. The stone has gained a well-deserved reputation for its value as a beautiful and durable building material; and its more general employment, both in construction and in paving, is much to be desired. The extent of the outcrops offers additional sites for quarrying operations, and the greater use of this stone, and the increase of the producing capacity of the district are here suggested.

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* Survey of the Fourth Geological District, James Hall, Albany, 1843, p. 34.

Clinton Group.

The rocks of this group are shales, thin beds of limestone and shaly sandstones. They crop out in a narrow belt from Herkimer county west to the Niagara river and bordering the Medina sandstone on the south. Sandstone for building has been quarried in the southern part of Herkimer county; at Clinton, near Vernon and at Higginsville in Oneida county, from this formation. The nearness of the Medina sandstone, with its more accessible quarries and superior stone, has prevented the more extensive development of the quarrying industry in the sandstone of the Clinton group.

Oriskany Sandstone.

The Oriskany sandstone formation is best developed in Oneida and Otsego counties. The rock is hard, silicious and cherty in places, and generally too friable to make a good building stone. No quarry of more than a local importance is known in it.

Cauda Galli Grit and Schoharie Grit.

These rocks are limited to Schoharie and Albany counties and to a very narrow belt which stretches south and thence southwest to Ulster county. The Cauda Galli sandstones are argillaceous and calcareous and are not durable. They are used in Albany county for roadmetal. The Schoharie Grit is generally a fine-grained, calcareous sand-rock which also is unsuited for building. Quarries in these rocks have local use only.

Marcellus Shale.

As its name implies, this formation is characterized by shaly rocks, which are not adapted to building. The abundance of good building stone in the next geologic member below it — the Corniferous limestone — whose outcrop borders it on the north throughout the central and western parts of the State, also prevents any use which might be made of its stone. A single quarry was at one time opened in it at Chapinville, Ontario county

Hamilton Group.

The rocks of the Hamilton group outcrop in a narrow belt which runs from the Delaware river, in a northeast course, across

Sullivan and Ulster counties to the Hudson valley near Kingston; thence north, in the foot-hills, bordering the Catskills, to Albany county; then, bending to the northwest and west across the Helderberg mountains into Schoharie county; thence, increasing in width, through Otsego, Madison and Onondaga counties, forming the upper part of the Susquehanna and Chenango watersheds; thence west, across Cayuga, Seneca, Ontario, Livingston, Genesee and Erie counties to Lake Erie. In this distance there is some variation in composition and texture. In the western and central parts of the State there is an immense development of shales and the few quarries in the sandstones referable to this group are unimportant.* In the Helderbergs, in the Hudson valley and thence, southwest, to the Delaware river, the sandstones predominate, and all of the beds are more sandy than at the west. There is a great development of the bluish-gray, hard, compact and even-bedded sandstone, which is known as "Hudson river bluestone," and is used so extensively as flagging. Some of the thicker beds yield stone for build. ing also. The sandstone occurs interbedded irregularly with shales at most localities. The bluestone or flagstone beds are generally in the upper part of the Hamilton and they continue upward into the horizon of the Oneonta sandstone. The number of quarries in this blue-stone district, in Sullivan. Ulster, Greene, Albany and Schoharie counties, is large and can be increased indefinitely, as nearly the whole area of the formation appears to be capable of producing stone for flagging or for building. The difficulty of indicating the division line between the Hamilton and the Oneonta and the Hamilton and the Portage group of rocks makes it impossible to refer to localities more particularly. The quarries near Cooperstown, in the lake region, particularly at Atwater, Trumansburg, Watkins' Glen and Penn Yan belong to the Hamilton group.

Portage Group.

In this is included the Oneonta sandstone, the limits of which at the east can not be indicated and the flagstone beds of the Hudson valley and of the eastern part of the State continue up

* Geology of New York. Survey of the Fourth Geological District, by James Hall, Albany 1843, pp. 184–5.

into the Oneonta sandstone horizon. Many of the quarries are in the latter formation. The more western and northwestern and higher quarries are in it; and some of the Chenango county quarries also.

The Portage rocks in the western part of the State consist of shales at the base; then shales and flagstones; and the Portage sandstone at the top. In the last division thick beds with little shale are marks of this horizon. The stone is generally fine-grained. The quarries near Portage and near Warsaw are in it; also the quarries at Laona and Westfield in Chautauqua county.

Although not of as great extent in its outcrop as the Hamilton group the Portage rocks are developed to a thickness of several hundred feet along the Genesee river at Mount Morris and at Portage; and form a belt having a breadth of several miles through Tompkins, Schuyler, Yates, Ontario and Livingston counties, and thence west to Lake Erie.* The formation is capable of supplying an immense amount of good building stone and flagstone throughout its undeveloped territory.

Chemung Group.

The rocks of the Chemung group crop out in the southern tier of counties, from Lake Erie eastward to the Susquehanna. The shales are in excess of the sandstones in many outcrops, and there is less good building stone than in the Portage horizon. The variation in color and texture is necessarily great in the extensive area occupied by the Chemung rocks, but the sandstones can be described as thin-bedded, generally intercalated with shaly strata, and of a light-gray color, often with a tinge of green or olive-colored. The outcropping ledges weather to a brownish color.† Owing to the shaly nature of much of the sandstone of the Chemung group, the selection of stone demands care, and the location of quarries where good stone may be found is attended with the outlay of time and money, and with great chances of possible failure. Quarries have been opened near the towns and where there is a market for ordinary grades of common wall stone, and also for cut stone, but the larger part of their product

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* Report of Prof. Hall above cited, pp 238-9.

† Prof. Hall's Report on Fourth District (cited above), pp. 251, 252.

is put into retaining walls. At Elmira and Corning good stone has been obtained, which is expensive to dress, and does not compete for fine work with sandstones from districts outside of the State. The quarries at Waverly, Owego, Elmira and Corning, and nearly all of the quarries in Allegany, Cattaraugus and Chautauqua counties are in the Chemung sandstone.

Catskill Group.

As implied in the name, this formation is developed in the Catskill mountain plateau in the eastern part of the State. Sandstones and silicious conglomerates predominate over the shales. The thicker beds of sandstones are generally marked by oblique lamination and cross-bedding, which make it difficult and expensive to work into dimension blocks. Except for flagging and for local use but little is quarried. There are no large towns in the district, and consequently the demand is light. There are, however, some good quarries, which are worked for flagging, chiefly along the New York, Ontario and Western railroad and the Ulster and Delaware railroad lines in Ulster and Delaware counties; and in the Catskills, in Greene county, there are quarries in Lexington, Jewett, Windham, Hunter and Prattsville.

Triassic Formation.

This formation, which is known as New Red Sandstone, or locally, as the red sandstone, is limited to a triangular area in Rockland county, between Stony Point on the Hudson and the New Jersey line, and to a small outcrop on the north shore of Staten Island.

The sandstones are both shaly and silicious, and the varieties grade into one another. Conglomerates of variegated shades of color also occur, interbedded with the shales and sandstones. Formerly these conglomerates were in favor for the construction of furnace hearths. They are not now quarried. The prevailing color of the sandstone is dark-red to brown, whence the name "brownstone." In texture there is a wide variation, from fine conglomerates, in which the rounded grains are somewhat loosely aggregated, to the fine, shaly rock and the "liver rock" of the quarrymen. Oxide of iron and some carbonate of lime are the cementing materials in these sandstones.

The well-known Massachusetts Longmeadow sandstone and the Connecticut brownstone are obtained from quarries in the Connecticut valley region, and of the same geological horizon. The Little Falls, Belleville and Newark freestones are from the same formation in its southwest extension into New Jersey.

Quarries were opened in this sandstone more than a century ago, and many of the old houses of Rockland county are built of this stone. Prof. Mather reported thirty-one quarries on the bank of the Hudson near Nyack. The principal market was New York city, and the stone was sold for flagging, house trimmings and common walls. The Nyack quarries have been abandoned, with one or two exceptions, as the ground has become valuable for villa sites and town lots. There are small quarries at Suffern, near Congers Station, near New City, and west of Haverstraw, at the foot of the Torn mountain. They are worked irregularly and for local supplies of stone. The stone is sometimes known as "Nyack stone," also as "Haverstraw stone."

DESCRIPTION OF SANDSTONE QUARRIES

Potsdam Group.

Fort Ann, Washington County.— A gray sandstone is quarried two miles north of the village, and at the side of the canal. It is used in Whitehall.

Whitehall, Washington County.— The cliffs of Potsdam sandstone, east of the town, yield stone for local use. The stone is hard and strong, and is valuable for foundations, retaining walls, and where it can be used without much cutting or dressing.

Port Henry, Essex County.— The outcrops of the Potsdam sandstone in the town and west of it afford quarrying sites. The quarry of L. W. Bond is worked for the local market, and the towns on the line of Delaware and Hudson Canal Company's railroad in the Champlain valley. The stone is hard, of a gray shade, excepting the surface beds, which are weathered to a rusty-red color. It is nearly all silica, and is capable of resisting the ordinary atmospheric agents for years, when the blocks are laid on their bedding planes A serious drawback to its more extensive use is the cost of cutting and dressing.

Examples of this stone in construction are seen in the Presbyterian church, and in the Sherman Library building, and the railroad depot in the town.*

Keeseville.— The Ausable river, the boundary line of Essex and Clinton counties, has at this place, and at the famous chasm below the village, worn its bed down deeply into the sandstone, and along its bank quarries have been opened in both counties for local supply.

The thin beds make a fairly good flagging-stone. The heavier beds yield good stone for ordinary wall work; and a great amount of it has been put into buildings in Keeseville. In color it is gray-white. It is rather more granular and not as hard as the Port Henry sandstone.

Malone, Franklin County.— The sandstone of the Potsdam horizon is opened by small quarries at this point, and at localities to the west, but they are unimportant, and the next group to be noted is at

Potsdam, St. Lawrence County.— The formation is so well developed in the valley of the Raquette river, southeast of the village of Potsdam, that it has been named the Potsdam sandstone.

Thomas S. Clarkson's estate† and Mrs. Charles Cox, the latter operating under the name of the Potsdam Red Sandstone Company, have quarries along the river, at an average distance of three miles, east-southeast of the village. The beds range in thickness from a few inches to six feet, and afford blocks of varying sizes. In most of the beds there is a more or less laminated structure, especially in the darker-red colored stone.

The color is light-pink, light-red or salmon colored, and red to reddish brown, varying in the several openings.

A representative specimen, taken from the company's quarry, has a specific gravity of 2.604, equivalent to a weight of 162 pounds to the cubic foot. Its percentage of silica is relatively large, and the cementing material appears to be silicious also. The oxide of iron, as determined by analysis, is 0.36 (ferrous oxide) in amount.

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* This quarry yielded the trails of trilobites upon ripple-marked beds, fine specimens of which are in the State Museum, and the American Museum, New York. (See Forty-second Annual Report, New York State Museum, pp. 25-29.)

† A. Clarkson, Secy.

In the absorption test 2.08 per cent. of water was absorbed by the dry stone. There was no loss of weight in repeated treatment with water containing carbonic acid gas and with sulphurous acid gas. A solution of 1 per cent. of sulphuric acid occasioned a slight loss in weight, equivalent to 0.02 per cent. The test of freezing and thawing left the stone apparently unchanged. When heated to 1,200 ° –1,400 ° F. and suddenly cooled, the color was unaltered, there were no checks, and the strength of the specimen was but little impaired.

Potsdam sandstone has been tested severely in its home. The wide range of temperature between the maxima of summer and the minima of winter, and the large annual precipitation, of which a considerable part is in the form of snow, present the conditions which demand material with resisting capacity. The houses of General Merritt and Senator Erwin, and other buildings, erected about sixty years ago, are solid structures to-day. The arris and corners are as sharp as when first cut, and the faces show no sign of scaling or flaking. The pavements also show how well the stone wears under use, not becoming smooth and slippery when wet. The Normal school buildings, the town hall, the Cox block, and the Presbyterian, Universalist and Episcopal churches are the more prominent structures of this stone in Potsdam. In the last-named church there is much carved work, making it very expensive on account of the hardness of the stone.

The Potsdam stone finds a wide market, and the demand for it is growing, as its beauty, strength and durability are better known and appreciated.

On account of its hardness, and the cost of fine tool dressing, the stone is best adapted to rock-face, ashlar work. It may be seen in the "Florence," South Salina street, Syracuse; All Saints' Cathedral, Albany; Columbia College and Rutger's Protestant Episcopal Church, Seventy-second street, New York city; Reid building, Seventh avenue and Sterling street, Brooklyn; the State Asylum, at Matteawan; the New York State Asylum and City Opera House, Ogdensburg; and in the Dominion Parliament buildings at Ottawa, Canada.

Hammond, St. Lawrence County.— Sandstone is quarried at three localities in the town of Hammond, and on the line of the Rome, Watertown and Ogdensburg railroad. The stone lies in beds which dip about 5° eastward and, owing to the well-defined joints and the evenness of the bedding, blocks are worked out readily which are suitable for cutting into curbing and flagging stone, or for making paving blocks. Its color is gray-white — in places striped, red and white. It is hard, and is nearly all silica. Unlike the quarries at Potsdam there is little earth covering, and the beds worked are not deep.

The output of the Hammond quarries is nearly all consumed in street work, and goes to Utica, Syracuse, Rome, Binghamton, Ogdensburg and to western cities.

Clayton, Jefferson County.— The Potsdam sandstone formation crops out at Clayton, and affords a hard and durable stone for local demands.

Hudson River Group.

Highland, Ulster County.— Quarries on the river bank, two miles north of Highland station, were formerly worked extensively.

Rhinebeck, Dutchess County.— The New York Central and Hudson River Railroad Company continues work at its quarry, a half mile south of the station.

New Baltimore, Greene County.— The sandstone is here on edge, and is generally in thick beds, interstratified with a black, shaly rock. The quarries are not worked to the same extent as in former years. The stone is dark gray to slate colored. Much stone has been obtained here for the Hudson river dyking and for dock-filling.

Troy, Rensselaer County.— Sandstone is quarried on Pawling avenue, near the Memorial Church, and on Fourth street, near and south of the Poestenkill. It is used for foundations and common wall work in the city, exclusively. The quarries are in operation at such times as the demand for stone requires.

Aqueduct, Schenectady County.— Three quarries have been opened at this point. The stone is gray to blue in color and fine-grained. It is known in the market as "Schenectady bluestone," and is used in common wall work in Albany, Cohoes and Troy.

Stone with natural-face (joint) surfaces and even-bedded is broken into rectangular blocks and is used in ashlar work. Some of the older stone buildings in Albany have their walls of these natural-face blocks.

Schenectady.—Albert Shear & Co. have a quarry on the canal, one mile east of the railroad depot, which is the source of supply to a large extent, for stone used in the city, although shipments are made to Albany, Waterford, Cohoes, Troy, Mechanicville and Saratoga.

This stone can be seen in the Memorial Hall of Union University and in the East Avenue Presbyterian Church; in the new armory, Albany; in the church at Menands Station, and in St. Patrick's Roman Catholic Church in West Troy. The stone has a bluish shade of color and is fine-grained.

Duanesburg, Schenectady County.— A quarry in a bluish-colored sandstone, probably of the same geological horizon as that of the Schenectady quarry, is here worked by Albert Shear & Co. The stone is rather coarse-grained but is stronger than the Schenectady bluestone.

The shaly nature of much of the Hudson river group of rocks in the Mohawk valley, west of Schenectady, and the accessibility of good limestone for building purposes, has prevented the opening of quarries in it. Further west, and near Rome, there are small quarries which are referred to this horizon, but they are unimportant. The stone is generally gray in color, fine-grained and hard, and in moderately thick beds. None of these quarries do much more than a small local business; and they are not in operation all of the working season of the year.

Good building stone of the Hudson river horizon is said to have been obtained at quarries southeast of **Rome**; also at **Woodruff's, Oneida County**[*].

Clinton Group.

This formation furnishes a building stone in Herkimer and Oneida counties, and quarries are opened in the towns of Frankfort, New Hartford, Kirkland and Verona. The city of Utica uses the greater part of the stone from the quarries at **Clinton**

Survey of the Third Geological District, Lardner Vanuxem Albany, 1842, p. 261.

and those on **Frankfort Hill**. The stone of the latter place is dark-gray and red-brown in color, medium fine-grained and hard, so that dressing is costly. It is used for foundations and common wall work, mainly. Grace Protestant Episcopal Church, on Genesee street, and the Lutheran Church, on Columbia street, are built of this stone.

Sandstone has been extensively quarried at **Higginsville, Oneida County**, by a Utica company. It is dark-gray and olive green in color; hard, and dressed with difficulty. Some of this stone has been used in Rome. Fine examples of it are the Baker and Gilbert houses, on Genesee street, Utica.

Medina Group.

Oswego, Oswego County.— Quarries for the supply of stone for foundation and retaining walls in the city are opened on the lake shore, east of the Fort Ontario grounds.

Oswego Falls, Oswego County.— The river cuts through the sandstone here and offers facilities for small quarry operations in the bluffs on the left bank. A dark-red sandstone is obtained under earth and shaly rock. The First Presbyterian Church in Syracuse is an example of badly selected stone and set on edge in many cases. A great deal of it has been used in Fulton, Oswego and Syracuse.

A specimen from the quarry of Hughes Brothers of Syracuse was found to have a specific gravity of 2.62, and an equivalent weight of 163.5 pounds to the cubic foot. It contained 0.59 per cent of ferrous oxide, and 1.71 per cent. of ferric oxide. The absorption test gave as a result 3.53 per cent. It lost weight in the treatment with acid solutions. In the freezing and thawing it checked badly, and at a high heat its color became brick-red, and its strength was impaired.

Granby, Oswego County. — The Granby Brownstone Company, O. J. Jennings, manager, works the quarry on the line of the Delaware, Lackawanna and Western railroad, two miles south of Fulton. The stone is fine-grained, purplish-red in color, and admits of fine-tool dressing. It has been used in the following structures in neighboring towns and cities: Second National

Bank building, Oswego; Protestant Episcopal church, and a block of stores in Cortland; and new Jewish synagogue, Buffalo.

Small quarries are opened westward in this formation at

Camden, Oneida County
Sterling, Cayuga County
Wolcott, Wayne County
Penfield, Monroe County

At **Rochester** the gorge of the Genesee river exposes to view a fine section of the formation. Formerly some stone was obtained from quarries in the river bluffs. In Monroe county generally this sandstone is *too argillaceous to be durable.**

What is more particularly known as the Medina sandstone district, is that portion of the outcrop which extends from Brockport in Monroe county west to Lockport. The belt is narrow, and the quarries are opened in it near the Erie canal. They are grouped here as follows:

Brockport, Monroe County
Holley, Orleans County
Hulberton, Orleans County
Hindsburg, Orleans County
Albion, Orleans County
Medina, Orleans County
Shelby Basin, Orleans County
Lockport, Niagara County

Brockport.— Two quarries are opened at this place.

Holley, Orleans County.— There are five quarries at Holley. Those of Downs & Bowman, Michael Slack, and O'Brien & Co., Fletcher & Sons,† and the Big Six Stone Company are near the canal and the New York Central railroad. The beds lie nearly horizontal, and under a light stripping of earth and boulders. The stone is of a light-red color and fine-grained.

The output is largely in the form of blocks for street paving, curbing, crosswalks and gutter stone.

Rochester, Buffalo, Syracuse, and western cities, as far as Kansas City, are markets.

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* Prof. Hall's Report on the Survey of the Fourth District, Albany, 1843, pp. 432–3.
† Not at present in operation.

Hulburton, Orleans County.— This group of quarries is west of the village, on the north side of the canal, stretching along a distance of two and a half miles.* They are all worked to a depth below the canal water-level, and pumping is necessary to drain them. The stripping of drift-earth does not exceed ten feet. Some of the beds are thick, and blocks of large size are obtained. The stone is mostly fine-grained, and light to dark-red in color. The best quality is shipped for building stone. The greater part of the product is split into paving blocks and crosswalks and curbstone, which are shipped to Rochester, Buffalo and western cities.

Much of the Hulburton stone is sold under the name of Medina block. Examples in construction are the Delaware Avenue Methodist Episcopal Church, Buffalo, and Sibley College, Cornell University, Ithaca.

Albion, Orleans County.— The largest quarries of Medina sandstone are at Albion. They are east of the town, between the canal and the New York Central railroad. The parties here at work are: Goodrich and Clark Stone Company, Albion Stone Company, and Gilbert Brady, of Rochester. The stripping on the sandstone is from three to fifteen feet thick. The beds dip a few degrees to the south, and are of varying thickness, from a few inches up to six feet. Regular systems of joints facilitate greatly quarrying operations. There is considerable variation in the nature of the stone in the several beds, and even in the same bed, as followed in the same quarry. Generally it is of a light-red color, and fine-grained.

A specimen representing the best building stone, as quarried by Mr. Brady, has a specific gravity of 2.598, and a weight (calculated) per cubic foot of 162 pounds. The percentage of oxide of iron is comparatively low, being 0.51 and 0.09 for ferrous oxide and ferric oxide, respectively. The absorption test gave 2.37 per cent. The losses in weight, in the tests with carbonic acid gas and sulphurous acid gas, were 0.09 and 0.29 per cent. The treatment with sulphuric acid, 1 per cent. solution, occasioned a loss of 0.08. The alternate freezing and thawing pro-

* Sturaker & Sullivan, Thomas Lardner, R. O'Reilly, A. J. Squire, L. Cornwell, C. Von York, C. F. Gwynne, M. Scanlon, Hebner Brothers, George Hebner, E. Fairhen and A. H. Ford have quarries here.

duced no visible effect. After a subjection to a high temperature and sudden cooling, the strength was but little impaired and the color was slightly changed.

These quarries employ from one hundred and fifty to two hundred men each, and the aggregate product, annually, amounts to many thousands of tons. The bulk of the stone quarried by the Albion Stone Company, and the Goodrich and Clark Stone Company, is used for street purposes, as paving, curbing, gutters and crosswalks. Platforms of large size, and smooth and true surfaces, are cut from some of the thick beds.

The paving blocks are sold principally to western cities — Erie, Akron, Cleveland, Toledo, Columbus, Detroit, Chicago and Milwaukee. The Brady quarry produces stone for building, principally.

These quarries are conveniently located for working, at the side of canal and railroad, and are well equipped for a large business.

Some examples of the Albion stone are the Presbyterian church, Albion; the Iroquois Hotel, Young Men's Association building and Trinity Protestant Episcopal Church in Buffalo; Guernsey building, No. 160 Broadway, New York city; steps of the new staircase, Capitol in Albany.

Medina, Orleans County.— Medina has given name to this sandstone formation because of its development and the characteristic fossils which are abundant in some of the gray beds at this locality. Within a mile and a half of the railroad station there are, north and northeast of the town, the quarries of Kearney & Barrett, A. M. Holloway, Sara J. Horan, Buffalo Paving Company, Noble & Lyle and C. A. Gorman. The working season is naturally from the first of April to the middle of November. The rest of the year is given to stripping off the overlying earth and waste rock. As compared with the stone of the quarries in the Medina sandstone formation, eastward, the color is lighter gray, and there is the variegated, or spotted red and white, and a light red. Generally it is harder. Oblique lamination in the beds is more common than at Albion or Hulberton. Pyrite-coated seams and joint faces are seen, chiefly in the older quarries now idle. Formerly the light-colored gray stone was in demand, and was quarried for building; now nearly all of the gray variety is split into paving blocks, and the fashion for building calls for the red and the variegated stones. At the extreme northeast the Noble & Lyle quarry produces a reddish-brown stone which is more like the Hulberton stone, and is rather softer than that of the quarries to the west and southwest. It is used for building almost exclu sively. In this quarry, and in some of the others, a red, shaly rock, known here as "red horse," is found under the quarry beds which is waste. The dip is south at a small angle; a regular system of vertical joints runs an east west course, with a north-south system, less well defined. The total thickness of quarry beds is in places as much as thirty feet, and the range is from two inches to six feet. The larger part of the aggregate production of these quarries is put into street material. The chief markets are Syracuse, Rochester, Buffalo, Erie, Cleveland, Columbus, Toledo, Detroit, Milwaukee and as far west as Omaha and Kansas City.

Lockport.— Quarries in the Medina sandstone formation were opened near the town, to the north, as early as 1824, and much of the stone was used in buildings, which are good examples of its durability. The quarries are on the right bank of the Eighteen Mile creek, and are connected with the New York Central railroad by a branch road one mile in length. Stone for flagging, paving blocks, and for building is obtained. Gray, red and mottled varieties occur in these openings. Formerly these quarries furnished stone to outside buyers; at present, they are worked almost exclusively for local market

Lewiston, Niagara County.— The same formation has afforded some building stone and some flagstone at this location.

Hamilton and Portage Groups.

Hudson River Bluestone.

The term "Hudson River Bluestone" is used to designate the blue, fine-grained, compact and even-blended sandstone, which is so largely employed for flagging and house trimmings in New York city, and to some extent in all of our middle Atlantic coast cities and towns. "The belt of country in which it is quarried is nearly one hundred miles long in New York, stretching from the southwestern towns of Albany county, across Greene and Ulster and the western part of Orange and eastern part of Sullivan counties to the Delaware river. In Albany and Greene counties it is narrow, as also in Saugerties in Ulster county, making the foot hills, as it were, on the east and east southeast of the Catskill mountains, and bounded on the east by the older limestone formations. It widens in the towns of Kingston, Woodstock, Hurley, Olive and Marbletown, and in them the quarries are distributed over the 500-foot plateau which borders the mountains on the southeast. To the northwest, and in the valley of the Esopus creek, many localities near the line of the Ulster and Delaware railroad have been opened and worked. They are a part of the bluestone district geographically, although the geological formations are not the equivalent of the main belt at the southeast. There are scattering localities in the towns of Rochester and Wawarsing and thence southwest, in Sullivan county, which furnish bluestone for local markets, and for exportation where they are situated near enough to lines of shipping."

The belt, as above described, has in it outcrops of shales and sandstones, belonging to the several geological formations, from the Hamilton period to and including the Catskill, in short, rocks of the Upper Devonian age. There are quarries along the Hudson river at New Baltimore, and thence southward, at Coxsackie and Catskill and near Rondout, but they are not in the typical bluestone, but in sandstone of the Hudson River group. The quarries of Palenville and vicinity, of West Saugerties, High Woods, Boiceville, Phœnicia, Woodland Hollow, Shandaken, and Pine Hill are above the horizon of the Hamilton formation and probably all in the Catskill group of rocks. The Oneonta sandstone, which is the equivalent of the Portage group, may form a part of the belt near the foot of the mountains, but it is impossible to define its limits and to designate the quarries in it. The quarries at Roxbury and Margaretville and their vicinity are in the Catskill formation. The openings along the Port Jervis, Monticello and New York railroad, in Sullivan county, are probably in the same horizon. The main bluestone belt, where it has been so extensively opened, as in the towns of Saugerties, Kingston and Hurley, is of the Hamilton period.

"Beginning at the northeast, there are small quarries at Reidsville and Dormansville, seven miles west of the Hudson river, and in Albany county. They have furnished a great deal of stone for flagging in the city of Albany. The stone of these quarries is gray in color and rather coarser-grained than the typical bluestone of the Hudson river quarries.

"In Greene county there are several small quarries near Leeds, which are worked mainly for the Catskill market. In the vicinity of Cairo stone is quarried at several places, and shipped by rail. On the line of the Stony Clove and Catskill Mountain railroad, and along the Kaaterskill railroad, quarries have been opened, from the mountain houses southwest to Phœnicia."

Ulster county is the largest producer of bluestone, and its quarry districts are the following: Quarryville, West Saugerties and High Woods, in the town of Saugerties; Dutch Settlement, Hallihan Hill, Jockey Hill, Dutch Hill and Stony Hollow, in the town of Kingston; Bristol Hill, Morgan Hill, Steenykill and West Hurley, in the town of Hurley; Marbletown, Woodstock, Brodhead's Bridge, Shokan, Boiceville, Olive, Phœnicia, Woodland Hollow, Fox Hollow, Shandaken, Pine Hill and Rochester and Wawarsing quarries, in the valley of Rondout creek and its tributaries.

There is much variation in the several quarries of these localities both in the nature and thickness of the overlying earth or stripping, and in the number and thickness of the workable quarry beds. A large number of quarries have been opened, and at many places the valuable stone has been removed and the quarries abandoned. At other localities the thickness of the overlying earth and the long distance from transportation lines have prevented their further development. The tendency of later years has been to open quarries nearer the lines of railroad, and to leave localities more distant, so that the number of quarries in the territory adjacent to the Ulster and Delaware road has been greatly increased. The aggregate output of this part of the territory has not materially increased within the last few years, in consequence of the abandonment of many quarries and the restrictions placed upon the quarry industry by the business relations to which it is subject.

The quarry beds range from an inch to three feet and, in some instances, up to six feet in thickness. The top beds are generally thin. In most cases these thick strata can be split along planes parallel to the bedding and the cap-layer is raised by means of wedges. The size of blocks obtained is determined by the natural joints which divide the stone vertically. Stones sixty feet by twenty feet have thus been lifted from a bed. The facilities for handling and lifting really limit the size. The thicker stone are cut into curbing, crosswalk and sidewalk stones and large platforms, yielding what is known as flagstone. The thinner beds furnish flagging for towns and villages. A part of the thinner stone is cut into dimension work for water-tables, sills, lintels, posts and window-caps or house trimmings in general.

"The stone obtained in these several districts varies in color, hardness and texture and consequently in value, from quarry to quarry, and even in the same quarry. In nearly all of the localities the beds vary a little from top downward; rarely is there much variation horizontally, or in the same bed. Hence, any given bed may be said to have a certain character; that is, produces a given grade of stone. The color is predominantly dark-gray or bluish-gray, and hence (more by contrast with the red sandstones) a "bluestone" Reddish-brown and some greenish gray stones occur in the quarries higher in the mountain sides, as in the valley of the Esopus creek above Shokan and in the Palenville quarries. There is a decided preference for the typical "bluestone" over the reddish or brownish-colored grades. In texture the range is from the fine shaly or argillaceous to the highly silicious and even conglomeratic rock. The best bluestone is rather fine-grained and not very plainly laminated, and its mass is nearly all silica or quartz, which is cemented together by a silicious paste and contains very little argillaceous matter. Hence, the stone is hard and durable and has great strength or capacity of resistance to crushing or compression. Coarse-grained sandstones and even fine conglomerates occur and are quarried in some localities. These sandstones are not often found loosely cemented together and friable; and they are rarely open and porous."

A representative specimen of the best Hudson river bluestone, and obtained from the Bigelow Bluestone Company* of Malden, was subjected to a series of tests, with the following result: specific gravity, 2.751; weight per cubic foot, 171 pounds; ferrous oxide, 4.63 per cent.; ferric oxide, 0.79 per cent.; water absorbed, .82; loss in dilute sulphuric acid solution, .20 per cent.; alternate freezing and thawing, unchanged; at temperature of 1200°–1400° Fahr. color changed to dull red, slightly checked and strength somewhat impaired.

"The bluestone territory southwest of Ulster county is confined to a narrow belt crossing the towns of Mamakating, Thompson, Forestburg and Lumberland in Sullivan county and Deerpark in Orange county. There are quarries near Westbrookville, near Wurtsboro, along the Port Jervis, Monticello and New York railroad and on the Delaware river at Pond-Eddy and Barryville."

Flagstone is obtained along the lines of the New York, Ontario and Western railroad, and of the Ulster and Delaware railroad at Westfield Flats, Trout Brook, East Branch, Margaretville, Roxbury and Grand Gorge. All of these quarries are in the Catskill group of rocks, and the stone from them is more generally a reddish or brown-tinted sandstone.

It is more open-grained and not so dense and strong as the best Ulster county stone. It reaches the market with the product of the Ulster county quarry and is included in the bluestone production. The principal shipping points whence bluestone comes to the market are Malden, Saugerties, Kingston (including Wilbur and Rondout). A great deal of stone is cut for house trimmings, in mills in Malden, Brodhead's Bridge, West Hurley, Wilbur, Kingston and Rondout, but the larger number of feet is sent into market simply quarry-dressed, for flagging and curbing. Its superiority as a flagging-stone is recognized generally by residents of New York city and adjacent towns where it has been so extensively used.

"It is so compact as not to absorb moisture to any extent, and hence soon dries after rain or ice; it has the hardness to resist abrasion and wears well; it is even-bedded, and thus presents a good and smooth natural surface; and it has a grain which pre-

* Now the Ulster Bluestone Co.

vents it becoming smooth and slippery as some of our granites, our slates and our limestones, when so used in walks. It is strong, and is not apt to get broken. But owing to the many thin beds and the use of too thin stones, sidewalks often become unsightly and bad because of breaks, a fault common to all flagstone when laid in such thin beds or blocks.

"For use in houses and business buildings Hudson river bluestone is having an increasing market. It is admirably adapted for lintels, window-caps, sills, doorsteps, water-tables, etc., with brick, both because of its strength and its durability. None of our sandstones from other districts, and not even our best granites are as strong to resist transverse pressure or strain. Tests (comparative) show that it is fully three times as strong, in this way of resistance, as granite, marble, Ohio sandstone and Connecticut and New Jersey brownstones. To resist compression it is not much superior to these sandstones, and not equal to the best granites. Its strength against transverse strains fits it for lintels, sills, caps and water-tables especially."

Oxford, Chenango County.—The F. G. Clarke Bluestone Company, successor of F. G. Clarke & Son, has the large quarry on the northwest of the village, and in the hillside west of the Chenango river.

The strata are horizontal and thin at the top; below the thick-bedded "liver rock" is found, from which blocks of large size are cut. The stone is blue, fine-grained and homogeneous in texture. Its specific gravity is 2.711, and its weight per cubic foot is 168.9 pounds. The absorbed water was found to be 1.11 per cent. It was not materially affected by the freezing and thawing tests. At a high temperature, 1,200°–1,400° F., the color was changed to dull red, and the stone was checked badly.

A partial analysis showed the presence of 3.46 per cent. and 0.16 per cent. of ferrous acid and ferric acid respectively. A crushing test of the strength of this stone, made in 1884, showed a resistance of 13,472 pounds to the square inch.

Architects and builders object to this stone in common with other bluestone, for work in which there is much carving and fine tooling, on account of its hardness and the greater expense involved in working it, as compared with softer sandstones and limestones.

The plant includes a planer, rubbing-bed and three gangs of saws, driven by steam power, besides quarrying machinery proper.

The principal use is for house trimmings and large platforms and steps. During the quarrying season one hundred and fifty men are employed, and in 1889 one thousand four hundred carloads of stone were shipped. The market is in the cities of the eastern States.

The lower portion of Aldrich court, 41–43 Broadway, the steps, residence of Cyrus Clark, Riverside avenue and Ninetieth street, New York; steps in the terrace approaching the Capitol, Washington, District of Columbia; steps, platforms and column bases of Capitol, Trenton, New Jersey; St. Lawrence Hall, New Haven, Connecticut; part of State Prison for Insane Criminals, Matteawan, New York, are some of the examples of construction in which the Oxford blue sandstone has been employed.

Small quarries producing flagging stone mainly are opened at

South Oxford, Chenango County
Coventry, Chenango County
Smithville Flats, Chenango County
Guilford, Chenango County
Oneonta, Otsego County
Cooperstown, Otsego County

They are worked at irregular times as demand calls for stone.

Trumansburg, Tompkins County.— In the vicinity of Trumansburg there are twenty or more quarries which produce four hundred thousand square feet of flagging annually. Two of them only do a little business in uilding stone, the quarries of D. S. Biggs & Sons and of the Flagstone and Building Stone Company. That of the latter is one mile east of the village and less than a mile from Cayuga lake. The grayish bluestone of the lower course of the quarry is fine-grained, and is cut into lintels, sills and curbing at the company's works at Cayuga, or shipped to their yards at Mott Haven, New York.

The Biggs quarry is on the Taughannock creek about two miles west of the lake and near the Geneva, Ithaca and Sayre railroad line. The stone here is known as the blue sandstone, and resembles in appearance the Hudson river bluestone, but is harder to work and apparently a little more dense. Stone from this quarry is seen in the large vault in Grove cemetery, Trumansburg. A part of the product is monumental bases.

The stone from these quarries is carried by boats to Cayuga, whence it goes to New York and to cities in the central and western part of the State.

Ithaca, Tompkins County.— Nearly all of the stone for foundations and retaining walls, and much of the flagging-stone used in Ithaca, comes from local quarries. There are two quarries on the hill south of the town whence flagging-stone is taken. Some of the stone for the university buildings was quarried on the University grounds. The sandstone of these quarries is of a greenish-gray shade of color, fine-grained, and is durable, when selected with care. The natural-face blocks are often rusty-looking, ironstained, or dirty yellow. Cascadilla Hall is an example of the best of it.

Penn Yan, Yates County. — Sandstone for foundation work is quarried near Head street, and on the east side of the lake, three miles north of the village.

Portage, Livingston County. — The Portage Bluestone Company's quarry is on the west side of the Genesee river, two miles south of Portageville and three miles from Portage Station, on the New York, Lake Erie and Western railroad. The Western New York and Pennsylvania railroad line is a few rods east of the quarry. The quarry beds have a total thickness of twenty-five feet. The best stone is olive-green in color, fine-grained, homogeneous in texture, and soft enough to dress well and to be easily cut. It is said to harden on exposure to the weather. A representative specimen from this quarry was found to have a specific gravity of 2.695 and equivalent to a weight of 168 pounds per cubic foot. The absorption test indicated 2.97 per cent. of water absorbed; treated with dilute solution of sulphuric acid the loss amounted to 0.42 per cent.; freezing and thawing tests produced slight scaling. In the test, at a temperature of 1200°–1400° F., the color changed to dull red. There were no checks, and the strength of the specimen was but little impaired.

The greater part of the stone quarried here is shipped to New York city, where it is worked up into house trimmings. Some of it is sent to Rochester, where it is cut into dimension stone at the Pitkin yard. The Aldrich Court building, Nos. 41 and 43 Broadway, New York, has Portage stone in the trimmings, in the first and second stories. Some of this stone was used in the United States Government building, at Binghamton.

Warsaw, Wyoming County. — There are two sandstone quarries near this place. The Jameson & Warsaw Manufacturing Company's quarry is two miles west of Rock Glen, on the New York, Lake Erie and Western railroad. It was opened many years ago, but was idle in 1888–9. Some of the stone in the City Hall, Rochester, was taken from this quarry. The Warsaw Blue-Stone Company's quarry is located one-half mile from Rock Glen station, and south of Warsaw; a side track runs from the quarry to the main line of the New York, Lake Erie and Western railroad. The Warsaw bluestone is very fine-grained, harder than the Ohio sandstone, and retains its color on exposure. It has been used for more than thirty years, in Warsaw and vicinity, for monumental bases and buildings.

A specimen from the company's quarry showed a specific gravity of 2.681, equivalent to a weight of 167 pounds per cubic foot. It contains 3.22 per cent. of ferric oxide and .23 per cent. of ferrous oxide. The absorption test gave as a result 2.99 per cent.; the freezing and thawing tests produced slight checking. At the high temperature (1200°–1400°F.) there was a slight vitrification, somewhat of checking, and the color was changed to dull-red. The quarrying plant has been largely increased, and the machinery for sawing and dressing the stone has been set up. The output during the year 1889 was largely in excess of that of any previous year. The principal use of this stone is for house trimmings. The markets are New York city, Syracuse, Elmira, Corning, Binghamton, Philadelphia and Washington. The Alpine, corner of Sixth avenue and Thirty-third street, New York city, the United States Government building, Binghamton and the Colgate Library building, Hamilton College, are more prominent examples of the Warsaw bluestone.

Chemung Group.

Waverly, Tioga County.— Two quarries are opened and worked at intervals in the vicinity of this place. The stone is blue to gray and rather fine-grained. It has been used in bridge building on the line of the Delaware, Lackawanna and Western railroad, and in several business blocks in Waverly and vicinity.

Elmira, Chemung County.— Four quarries have been opened in the sandstone in the western face of the hill which here bounds the valley. The stone is fine grained, and has a gray and greenish-gray color. It is all sold in the rough and used in Elmira for common wall work, and some of it for curbing. The average cost is about $1 a perch in the city.

Corning, Steuben County.— There are four quarries in the sandstone at Corning, in the southern outskirts of the town. The stone of these quarries is generally fine-grained, and of a grayish color. It is hard, durable, and does not absorb much moisture, but in consequence of flint-like seams in it, it can not be dressed or fine-tooled economically. The natural-face blocks are often weathered dirty yellow or brown, and hence the need of careful selection of stone. For ordinary wall work and foundations it answers well. The Corning stone has been used in Elmira, in the Congregational church and in the State Reformatory buildings. In Corning, the old arsenal, built about thirty years ago, the Roman Catholic, Protestant Episcopal and First Presbyterian Church buildings are all of this stone. The best example can be seen in the basement-wall of the high school, and in the basement of the residence, near the public school, in which work great care was taken to select large stones and of uniform shade of color.

Dansville, Livingston County.— Sandstone for building purposes and for street work is obtained from the quarry, one mile northeast of the village. The stone is bluish-gray in color, fine-grained and hard, but accompanied by much waste rock.

The Chemung sandstone is opened in Steuben county at Cohocton, Bath, Hornellsville, and in the town of Greenwood.

At the **Cohocton** quarry the output is all cut into flagging, which is used in the adjacent towns.

In the town of **Bath** two quarries are worked. The stone is of a light-gray color, fine-grained and rather hard. Curbstone, flagging and common wall stone are obtained from these quarries. The county buildings and the Protestant Episcopal and Baptist churches are built of this stone.

Two quarries are opened and worked in the vicinity of **Hornellsville.** The stone has a bluish color, is hard and fine grained. The product of these quarries is mostly common building stone, and is cut at Hornellsville. The Park schoolhouse, the electric light building and several stores and residences are built of it.

In Allegany county sandstone quarries are opened at Belmont, at Belvidere, near Belfast, and in the towns of New Hudson and Cuba. The **Belmont** quarry affords a light-blue stone, which, when cut, has a light gray shade, and is rather soft and easily dressed. The principal markets are Belmont, Wellsville and Angelica. Vanderhoef's block, in Belmont, besides other buildings, are of this stone.

The **Belvidere** quarry is worked in a small way, mainly for the local market. Some of the stone is used at Friendship, Angelica, and a little of it in Wellsville and Hornellsville.

Two miles south of **Belfast** sandstone is quarried to a limited extent for a supply of the town. The Baptist church is constructed of this stone.

Flagstone is quarried in the town of **New Hudson,** near the west line of Belfast. The quarry is worked to a small extent, and its output is considered the best in this part of the State.

Olean, Cattaraugus County.— The Olean Bluestone Company quarries a sandstone two and a half miles south of Olean, and about 700 feet above the Allegany river. Stone for building and flagging is obtained and is put on the market as "Olean bluestone." It goes to Buffalo and Rochester. The stone is fine-grained and has a greenish-gray shade of color.

Jamestown, Chautauqua County. — There are six small quarries in the eastern part of the town, near the lake outlet. Bedded with the quarry stone there is much shale, and consequently a great deal of waste material has to be removed in quarrying. The bottom beds, from twelve to twenty inches thick, furnish stone for cut work. The stone of the upper strata is used for rubble work. The Jamestown stone is olive-green in color, fine-grained, soft and breaks with a conchoidal fracture. It has had an extensive use at Chautauqua and in Jamestown, both for foundations and retaining walls and for house trimmings.

Other localities in Chautauqua county are in **Panama**; in the town of **Clymer**; in **Westfield**, near Lake Erie; and at **Laona**, in Pomfret. The quarries at these places are too small and comparatively unimportant for general description.

Bluestone Quarries of New York by Wm. G. Eberhardt, E. M.

The area in which bluestone is quarried in New York State extends from the west shore of the Hudson river, in Albany, Ulster and Greene counties, in a southwesterly direction through Ulster, Delaware and Sullivan counties to the Delaware river; and there is a small isolated region in Chenango county, in the towns of Oxford and Norwich.

The region has been opened in the towns of Kingston and Saugerties, Ulster county, and Catskill, Athens and Coxsackie, Greene county, at numerous points from which the stone is carted by the quarrymen to the Hudson, where it is bought by various dealers along the lines of the Ulster and Delaware railroad, the Port Jervis and Monticello railroad, the New York, Ontario and Western railroad, the Erie railroad, and the Delaware and Hudson canal. The last-named district extends through the towns of Mamakating, Sullivan county, and Wawarsing and Marbletown, Ulster county. Very little quarrying is done in the district at present.

Of the quarries whose output is shipped *via* the Hudson river the most important are in the town of Saugerties, Ulster county The quarries in this township are located at Quarryville, West Saugerties, Highwood, Bethel and Unionville. This district has been extensively opened and much stone is produced, although here, as also in the Ulster and Delaware district, the business of quarrying has greatly diminished in recent years. The largest quarries in the town of Saugerties are at Quarryville, about four miles west of the Hudson. The quarries here are on ledges of stone, running parallel to the Hudson up into Greene county. Besides a number of small quarries there are two large openings. One of these is abandoned, owing to inadequate pumping facilities.

Hand and horse-power pumps were used, and found to be of too small capacity to handle the water. The owners intend putting in steam pumps.

About one-half mile north of the village, on the same ledge, is the other opening, in which four parties are engaged in quarrying—Patrick Kelly, Cornelius Harvey, John S. Mower & Co., and A. Carnwright. The total length of the quarry face is about 300 feet. Each quarry employs eight to twelve men, and produces $4,000 to $6,000 in stone per year. No steam machinery is used. Pumps are worked by hand or horse power. The quarries are below the level of the surrounding country, and there is no natural drainage. The water is pumped behind a common dam, extending the length of the workings. The average thickness of the workable bed in these quarries and in the district is about thirteen feet. On this lies a stratum of worthless rock, about three feet thick, which is overlaid by two to twenty feet of earth. The stone is of three grades as to color and hardness. The top layers of the bed are gray and very hard, while those of the bottom are blue and softer. Between these an intermediate grade can be distinguished.

This change in color and hardness occurs in almost all quarries. A bed of bluestone is rarely uniform throughout its entire thickness. Usually the color becomes darker as the distance below the surface and also the distance from the face of the ledge increases. Sometimes, however, the stone is darker in the upper layers. The thickness of the several layers also increases with depth and distance from the face of the ledge. Usually the stone in the second block is about twice as heavy as that in the first. The "lifts" or layers of stone in this district vary from three inches to four feet in thickness. The stone taken from the lower lifts does not stand weathering well. It contains seams and "reeds," invisible seams, which open when the stone is exposed to frost. That from the upper lifts is more compact and durable. The stone is carted to Malden, distant five or six miles by road. The rough stone is worth forty-eight to sixty cents per cubic foot, or four to five cents per inch.

A general description can be given of the method of quarrying throughout the bluestone district, which will apply to all quarries, with the exception of a very few where steam machinery is used.

The equipment consists of sledge hammers, wedges, plugs and feathers, crowbars, shovels, wheelbarrows, and a hand derrick in most of the large quarries. Pumps are rarely necessary. The bed is first stripped of the overburden. The "stripping" of "top," as the overburden is called, is usually earth and worthless stone. In the most favorable case it is simply a layer of earth. The worthless rock may be solid, in which case its removal is an expensive item in quarrying, or it may be very much broken up or shaly (called "pencil stuff"), when it is easily removed. The top rock is removed with the aid of blasting powder and dynamite, and large blasts are sometimes fired when it is heavy. Thirty kegs of powder have been fired in one of these blasts. The stripping is done mostly during the winter, and actual quarrying about nine months in the year.

The beds of stone are divided naturally into blocks by seams and joints at right angles to each other. In the direction of the strike of the ledge are the "side seams," which are very marked, and, where large areas are stripped, may sometimes be seen running straight and truly parallel for several hundred feet without interruption. At right angles to the side seams, and less regular than these, are joints which form two opposite sides of a block. The area of blocks varies greatly. That of large ones may be 1,000 square feet or more. The bed being stripped, the layers or "lifts" of good stone are successively raised by means of wedges driven into the natural bedding planes. Large lifts are broken to desired sizes by plugs and feathers. The plugs are driven home at the same time as the wedges and aid in dislodging the stone from its bed. The thickness of lifts varies from one inch to six feet.

In the Highwoods district the quarries are all small, and worked by two or three men. Two men get out about $1,000 to $1,200 in stone per year. These small quarries are worked until the good stone gives out, or more frequently until the top becomes too heavy to be economically handled on so small a scale. The beds of stone in this district are very uncertain. Layers of shaly rock are interstratified with the good bluestone, and pockets of the same material are irregularly distributed through the beds. The district is said by quarrymen to be nearly exhausted. The stone found here is of a good blue color, hard and heavy. All thicknesses are found up to three or four feet. It is sold to dealers at Saugerties and Glasco, seven or eight miles distant. The cost of cartage is about $1.75 per 100 square feet two inches thick.

The quarries at West Saugerties, Bethel and Unionville are all small like those in the Highwoods district. The stone is sold to dealers in Malden, Saugerties and Glasco. The stone is also carted to Malden and Saugerties from Palenville, Catskill township, Greene county. This stone is of greenish tint. From Woodstock, also, stone is carted to Malden. Burhans & Brainard have yards and a mill at Saugerties, and the Ulster Bluestone Company at Malden. Other dealers having yards but no mill are, Sweeney Bros. and James Maxwell, at Saugerties, and W. Porter, at Glasco.

In the town of Kingston there are a few small quarries at Dutch Settlement, Hallihan Hill and Jockey Hill, but very little stone is quarried at these places. It is sold to dealers at Wilbur. The Ulster and Delaware railroad has opened up the bluestone country in the towns of Kingston, Hurley, Olive and Shandaken, Ulster county, but the active quarries in this region are much less numerous than in former years. The largest are near Stony Hollow, in Kingston township, and West Hurley, in Hurley township. Some of the stone from these places is carted to Rondout and Wilbur, and some shipped by rail to Rondout. Farther up the road quarries are small and not numerous. Stone is obtained from all stations along the road as far as Allaben, in Shandaken township. Some of the largest quarries are Grant's, Hewitt Boice's and James O'Neill's, at West Hurley. James O'Neill's quarry is situated about one-half mile south of the village of West Hurley, on a ledge running north and south and dipping slightly west. The bed averages about twelve feet, but it is not uniform; about three feet of it is poor stone unevenly distributed through the bed. The stripping varies from five to fifteen feet. The quarry has been opened for about 300 feet, but it worked only on a small scale. The thickness of lifts varies from four to twenty inches. The bottom lifts are of better color than those nearer the top, whose faces are brown, probably from the presence of iron. The stone is shipped by rail to Rondout.

Beside the true bluestone there is a brownish variety quarried at some localities above West Hurley. This is not a handsome stone and not suitable for ornamental purposes.

In the towns of Middletown and Roxbury, Delaware county, a reddish sandstone is found of about the same density and strength as the bluestone of Ulster county. Very little of it is quarried. It is sent to Rondout *via* the Ulster and Delaware railroad. Experiments on bluestone from West Hurley have given the following results: Density, 2.721; crushing st ength, 22.45 pounds per square inch. At Rondout Hewitt Boice has extensive stone yards and a mill. Sweeney Bros. and Julius Osterhoudt have yards and mills at Wilbur.

The bluestone territory has been extensively opened in Sullivan county and to a smaller extent in Delaware county and in the town of Deerpark, Orange county. There are quarries along the lines of the Port Jervis and Monticello, Erie and New York, Ontario and Western railroads in these counties. Along the Port Jervis and Monticello railroad there are quarries at Rose Point, Paradise and Oakland, town of Deerpark, and at Hartwood and Gilmans, town of Forestburg, Sullivan county. They are all small and their output is sold to dealers in Port Jervis who ship it east *via* the Erie. Terbell & Ridgeway, who have a stone yard at Port Jervis, handle most of this stone.

In the valley of the Delaware river, along the line of the Erie railroad, there are quarries in New York State from Deerpark, Orange county, to the town of Sanford, Broome county. In the t wn of Deerpark there are small quarries at Mill Rift, which sell their output to Louis E. Bliss, New York. At Stairway, Lumberland township, Sullivan county, there are large quarries owned by F. A. Kilgour, which are at present idle, but will be reopened. At Pond Eddy, in the same township, A. H. Woodward operates several quarries and buys the output of others. The quarries on the New York side of the Delaware are not as large or as numerous as those on the Pennsylvania side. The best stone here is more uncertain and of a more pockety nature than that of Ulster county, and the stone is harder. All the stone in the Delaware valley from Deerpark to Callicoon, Delaware township, is quite hard. Beyond this point it becomes gradually softer and is more easily worked. Most of the stone on the New York side at Pond Eddy is shipped to Woodward's mills at Newark, N. J., *via* the Delaware and Hudson canal and the Hudson river, although the freight rates by this route are one dollar and sixty-five cents per ton as against one dollar and fifteen cents per ton *via* Erie railroad.

Other places in the town of Lumberland at which bluestone is quarried are in the district opposite Parker's Glen, Penn., and Barryville. At the first named of these places the total output is probably less than $100 per month. The stone quarried is suitable only for flagstone. Prices paid for the stone by dealers are from forty-two to forty-five cents per cubic foot or three and one-half to three and three-fourths cents per inch. Very little stone is quarried at Barryville. That district is nearly exhausted.

In the town of Tusten quarrying is carried on extensively opposite Mast Hope, Penn., and at Tusten. Many small quarries are worked at these places, besides a number of larger ones employing ten to fifteen men operated by J. Q. A. Conner & Son of Mast Hope, and C. W. Martin, of Middletown, N. Y. The stone is quite hard, but not uniformly so, and of several shades of blue; but hardness and color are quite uniform in the same quarry. The thickness of lifts varies from one to eighteen or twenty inches. At Mast Hope a reddish stone is quarried, but only true bluestone is found on the New York side of the river at this point. At Narrowsburg, in the same township, there are a number of quarries. Jeremiah Partridge works three quarries at this point. Two of them are within one-fourth of a mile and the third within three-fourths of a mile of the stone docks at Narrowsburg. The stone in all of them is of good blue color and readily worked. The lifts in the farther quarry are heavier and the stone somewhat harder. The owner intends putting steam drills in this quarry. In Cochecton township there are some small quarries at Cochecton village, but only a few of them are being worked.

In Delaware township there are quarries at Callicoon and at Rock Run. The quarry of Persbacker Bros. & Co., at Callicoon, is about one-half mile northwest of the village. During fifteen months that it has been worked about fifty carloads of fifteen to eighteen tons each have been shipped from it. All this stone has been taken from a single block twenty-five by forty-three feet in area. Five men are at work in this quarry. Most of the material taken out is flagstone, but some ten and twelve-inch lifts have been raised. The stone is of good color, bluer in the top layers than in the bottom, and very hard. The bed has been worked downward twelve feet, below which the depth is unknown. The top is mostly loose earth and varies from two to ten feet in depth.

There are several large quarries at Hankins in the town of Fremont. The largest is operated by Manny & Ross. It is one and one-fourth miles northeast of the village, and employs about twenty men in the active season. A quarry face of 300 to 400 feet in length has been opened, but only a small part of it is worked. The workable bed is twenty to twenty-five feet in thickness. Lifts of all thicknesses up to twenty inches are taken out. The quarry has been worked for eight years and a large quantity of stone is still in sight, but most of it is covered by a very heavy top of rock. The hardness of stone in this locality varies considerably. Louis E. Bliss buys stone at this place.

At Long Eddy and Basket, in the same township, there are extensive workings. Kenney Brothers have a large quarry at Long Eddy, about one-fourth of a mile from the railroad. This quarry has been worked three or four years and has yielded 400 to 500 carloads of stone. The bed is eighteen feet deep, and the ledge on which the quarry is situated runs nearly north and south. The top is quite heavy, being mostly rock, twelve to twenty feet deep, but much broken up and easily removed with the aid of powder. Lifts are from one to twelve inches in thickness. The stone is all blue, soft and easily worked. C. W. Martin, F. A. Kilgour and L. E. Bliss get stone from these quarries.

In the town of Hancock, Delaware county, quarrying is carried on very extensively. There are quarries in the Delaware valley at Lordville, Stockport and Hancock, and also on the line of the New York, Ontario and Western railroad. Of the quarries in the Delaware valley, the largest are at Lordville and Stockport. The stone from these places is very well suited for ornamental purposes. It is durable and easily worked. That from Lordville is handled by F. A. Kilgour, Randall & Underwood and Kirkpatrick Bros. The Stockport stone is claimed to be especially free from "reeds," making it well adapted to stand frost and weathering. It is handled by Kirkpatrick Bros., of Hancock. Farther up the valley there are quarries at Hale's Eddy and Deposit, Tompkins township, Delaware county, and also a few in the town of Sanford, Broome county, along the Erie R. R. At Hale's Eddy all the stone is quarried or bought by O. M. Kingsbury & Co. Randall & Underwood are the most extensive operators at Deposit. The stone from these places is very soft, and of different shades of color, from gray to dark-blue. Some of the gray stone is very coarse-grained.

Along the line of the New York, Ontario and Western railroad there are quarries in Sullivan county in the towns of Liberty and Rockland; in Delaware county, in the towns of Colchester, Hancock, Tompkins and Walton; and in Chenango county, in the towns of Oxford and Norwich. Very little quarrying is done in Liberty township. In Rockland township there are several quarries at Roscoe, the largest of which are worked by Wm. Youman. Farther up the road there are quarries at Cook's Falls, town of Colchester, and in Hancock township at Trout Brook, East Branch, Fish's Eddy and Hancock Junction. The stone from all these places is of very much the same character as to color and hardness. Geo. S. Harris quarries and buys all the stone at East Branch. The quarries at this place are all small. At Fish's Eddy the quarries are larger. Storie & Hollywood work four quarries at this place.

In the town of Tompkins, Delaware county, there are quarries at Apex and Rock Rift. At the latter place E. C. Inderlied has several quarries and a mill. At Walton, Walton township, several quarries are worked. Jas. Nevins & Sons have a quarry and mill on the Delhi division of the Ontario and Western railroad, about four miles from Walton Junction. The mill has been removed from Weehawken to Walton, as it is cheaper to ship the stone dressed than in the rough state. The workable bed in the quarry is thirty feet in thickness and is covered by a light top. The F. G. Clarke Bluestone Company quarries extensively in the town of Oxford, Chenango county. The quarries of this company are located at Oxford and at Coventry, four miles to the southwest of Oxford, on the Delaware, Lackawanna and Western railroad. The stone from both places is dressed at the mill of the company at Oxford. The thickness of the bed in the Oxford quarry is sixteen feet. The top is very heavy, consisting of about forty feet of loose earth and twenty-five feet of solid rock. In order to make a profit under such unfavorable conditions, the quarry is worked on a large scale, and steam machinery is employed in quarrying and handling the stone. A channeling machine is part of the equipment. The stone is handled in the quarry by derricks worked by steam, and is taken out by carts and a wire tramway. The stone is of very fine quality. Its color is a good blue and very uniform throughout the bed. It is softer than Ulster county stone and easily worked, which makes it desirable for ornamental purposes. The lifts are too heavy for small flagstones, but many large ones, measuring from fifteen to twenty feet or more on a side, are taken out. Stone up to six feet thick can be obtained at this quarry. Powder is used instead of plugs and feathers in getting out large blocks. Deep holes are drilled with steam drills and reamed out, making a hole about two inches in diameter. A small charge is placed in each hole, which is tamped so that the force of the explosion is exerted against an elastic cushion of air, and the block is thus loosened from its bed without unnecessary splitting. The charges are fired simultaneously by electricity. This method is found more satisfactory than channeling.

Stone is quarried at Norwich for local and foreign consumption. A very dark stone is quarried here which is valuable for ornamental purposes.

Triassic or New Red Sandstone.

Nyack, Rockland County. — Two quarries, located on the shore of the river, are worked more or less steadily; one by Daniel T. Smith, the other by Nelson Puff. The stone of these quarries is worked into lintels, sills and platforms. The product is mainly for the local market.

Haverstraw, Rockland County. — The sandstone quarries at Haverstraw are worked only at long intervals, and then for common building stone which is used in the place.

Formerly these Nyack and Haverstraw quarries were worked on a large scale, and stone for building was shipped thence to New York and cities along the Hudson valley.

The house still standing near the Smith quarry, which was built in 1768, shows the durable nature of the stone. The Cornelius house in Nyack is another example.

GLACIAL DRIFT

This formation, consisting of unsorted clays, sands, gravels, cobbles and boulders, is found in all parts of the State. The nature of the imbedded stone varies greatly both as to variety and amount. In places the deposits are full of large blocks of stone and of more or less rounded and scratched boulders; in other localities the hard, quartzose cobbles and small boulders predominate. In the sandstone districts of the southern and western parts of the State the surface deposits of glacial drift contain much sandstone, as in the Medina sandstone belt, the Hudson River bluestone territory and the red sandstones at Haverstraw and Nyack. In the Highlands and in the Adirondacks the rounded, crystalline, granitoid and gneissic rocks predominate. On Long Island the terminal moraine includes a great amount of stone, and of many kinds.

The cobblestones were formerly used for paving roadways, but this kind of pavement is no longer laid. From the fact of the stone being picked off the fields in the clearing of land for tillage, the stone of the drift has been known as "field-stone;" and they were used in the earlier constructions for walls, foundations and buildings, in localities where no quarries had been opened, and even before resort was had to quarry stone.

Some of the oldest houses on the western end of Long Island, and in the Hudson River counties are built of such field stone. At Yonkers the excavations for foundations and in street grading afford an abundant supply of stone for common wall work. In parts of Brooklyn the drift furnishes a great deal of stone in the shape of huge boulders.

The stone of the drift is generally hard and durable, having resisted the wear of rough transportation. The economic use of the surface stones of the drift in constructive work, where they can be laid up in walls, is a desirable utilization of what is still in many parts of the State worse than waste — a nuisance in the tilling of the soil. This formation can not, however, be considered as one of the important sources of stone in the quarry industry, although capable of yielding a great deal of rough stone. It will no doubt do so in the future clearing and improvement of the country.

SLATE

Argillite or clay-slate, which is marked by the presence of cleavage planes, and can be split into thin plates of uniform thickness — roofing slate — is a characteristic rock in the Hudson River group and the Lower Cambrian or Georgia group.

Slate suitable for roofing has been found in many localities, and quarries have been opened in Orange, Dutchess, Columbia, Rensselaer and Washington counties. The openings in Orange county have not resulted in productive quarries. In Columbia county quarries were worked many years ago, east of New Lebanon.* The Hoosick quarries, in Rensselaer county, were more extensively worked, and produced a good, black slate. Outcrops of red slate are noted east of the Hudson, from Fishkill and Matteawan northward, but no attempts have been made to open quarries in them.

The productive slate quarries of the State are in a narrow belt, which runs a north-northeast course through the towns of Salem, Hebron, Granville, Hampton and Whitehall, in Washington county.

This slate belt is divided by the quarrymen into four parallel ranges or "veins," which are: East Whitehall red slates; the Mettowee, or North Bend red slate; the purple, green and variegated slates of Middle Granville; and the Granville red slates. The latter is close to the Vermont line. Further to the east, but over the State line, in Vermont, is the range of the sea-green slates.

The quarry localities are at Shushan, Salem, Black Creek valley, in the town of Salem, Slateville, in Hebron, Granville, the Penrhyn Slate Company's quarries, Middle Granville, Mettowee or North Bend quarries, and the Hatch Hill quarries in East Whitehall.

The quarries of Washington county have not yet been worked down to as great depth as some of those in Northampton and Lehigh counties, in Pennsylvania, and the deepest has not reached a vertical depth of 100 feet.

The quarries at the southwest, in Shushan and Salem, produce purple, variegated and green-colored slates. At Salem some

* Wm. W. Mather, Geology of the First Geological District, Albany, 1843, pages 419-421.

stone for flagging and foundation work is obtained. At the quarries west and northwest of the village of Salem, and at Slatesville, in Hebron, the slate is red.

The principal range of red slate is that which runs from Granville north — passing east of Middle Granville. It is narrow, being in places less than thirty rods wide. There are numerous openings in it, and it has yielded a large amount of red, and some unfading green, roofing slate.

In Middle Granville the purple, green and variegated varieties are found. North of the village, a quarter to three-quarters of a mile, are the large openings of the Penrhyn Slate Company, which produce purple, unfading green and variegated (green and purple) slates. A large part of the output of these quarries is worked up in their mills into plain, marbleized, decorative and enameled material, as mantels, steps, house trimmings, table tops, laundry tubs, wainscoting and floor tiles.

The Mettowee or North Bend quarries, three and a half miles north of Middle Granville, are worked by two companies. Their product is a red roofing slate.

The Hatch Hill group of quarries is six miles southeast of Whitehall. There are four openings.

The slate is of a bright-red color. A part of it is split at the quarry into roofing material. Perhaps an equally large amount is cut into floor-tiling, billiard table tops and house trimming materials. These quarries are much deeper than those of the Granville red slate range, and the slate has a brighter red color, and is more easily worked than that of the latter range.

Their product, mostly finished stock, has to be carted by teams six miles to Whitehall or to Middle Granville, shipping points.

The green slate of these Washington county quarries is almost all of the unfading variety, which is more durable and more valuable than the sea-green slate. The variegated (purple and green) also is durable, but is softer and less valuable than the red, which is esteemed for roofing and tiling purposes.

The purple and green slates are more abundant, and are used more for marbleizing.

A specimen of the red roofing slate of Washington county was tested and found to have a specific gravity of 2.84, equivalent to a weight of 177 pounds per cubic foot. It contained 1.87 per cent. of ferrous oxide and 7.36 per cent. of ferric oxide. Its absorptive percentage was 0.15. It lost 0.07 per cent. in weight in the sulphuric acid solution test. It remained unchanged in tests of alternate freezing and thawing.

The estimated production of red roofing slate in 1889 was 5,000 squares. The ruling prices per square were as follows:*

Red	$8 00 to $10 00
Purple	3 50 to 4 00
Unfading-green	3 50 to 4 00
Sea-green	2 75 to 3 00
Variegated	2 50 to 2 75

NOTE.— A recent bulletin of the United States Census gives a list of firms producing slate, and the statistics of production, labor, wages, etc. According to this report there are sixteen quarries in this State, which produced in 1889 17,167 squares of roofing slate, and slate for other purposes valued at $44,877, making a total value of $130,603.

LIMESTONE AND MARBLE

Limestones consist essentially of calcium carbonate. They are, however, often quite impure; and the more common accessory constituents are silica, clay, oxides of iron, magnesia, and bituminous matter. And these foreign materials may enter into their composition to such an extent as to give character to the mass, and hence they are said to be silicious, argillaceous, ferruginous, magnesian, dolomitic, and bituminous.

The chemical composition is subject to great variation, and there is an almost endless series of gradation between these various kinds of varieties. Thus, the magnesium carbonate may be present, from traces, to the full percentage of a typical dolomite. Or, the silica may range from the fractional percentage to the extreme limit where the stone becomes a calcareous sandstone. Crystallized minerals, as mica, quartz, talc, serpentine and others, also occur, particularly in the more crystalline limestone.

In color there is a wide variation—from the white of the more nearly pure carbonate of lime through gray, blue, yellow, red, brown, and to black. The color is dependent upon the impurities.

The texture also varies greatly. All limestones exhibit a crystalline structure under the microscope, but to the unaided eye there are crystalline and massive varieties. And there are

* Letter of Hugh Williams of Middle Granville, January 22, 1890.

coarse crystalline, fine crystalline, and sub-crystalline, according as the crystals are larger, smaller, or recognized by the aid of a magnifying glass only. The terms coarse-grained and fine-grained may apply when there is a resemblance to sandstone in the granular state of aggregation. Other terms, as saccharoidal (like sugar), oolitic, when the mass resembles the roe of a fish; crinoidal, made up of the stems of fossil crinoids, also are in use, and are descriptive of texture. The state of aggregation of the constituent particles varies greatly, and the stone is hard and compact, almost like chert, or is loosely held together and crumbles on slight pressure, or again it is dull and earthy as in chalk.

The crystalline, granular limestones, which are susceptible of a fine polish, and which are adapted to decorative work, are classed as *marbles*. Inasmuch as the distinction is in part based upon the use, it is not sharply defined and scientific. Generally the term is restricted to those limestones in which the sediments have been altered and so metamorphosed as to have a more or less crystalline texture. There is however some confusion in the use of the terms, and the same stone is known as marble and limestone, e. g., the Lockport limestone or marble; the limestone and coral shell marble of Becraft's mountain, near Hudson; the Lepanto marble or limestone near Plattsburg, and others.

The fossiliferous limestones are made up of the remains of organisms which have grown in situ, as for example, the coralline beds in the Helderberg and Niagara limestones, or have been deposited as marine sediments. In the case of the latter the fossils are more or less comminuted and held in a calcareous matrix. Generally the fossil portions of the mass are crystalline. The Onondaga gray limestone from near Syracuse, and the Lockport encrinital limestone are good examples.

The fossil remains are less prominent and scarcely visible in some of the common blue limestones, as in the lower beds of Calciferous and in some of the Helderberg series. These rocks are compact, homogeneous and apparently uncrystalline and unfossiliferous. They are usually more silicious or argillaceous, that is, they contain quartz or clay, the latter often in seams rudely parallel with the bedding planes. On weathering, the difference in composition is often markedly apparent at a glance. Similar differences in composition are seen in the more crystalline marbles, and are evident either by variation in color, or in the presence of foreign minerals, as mica, quartz, hornblende, pyrite, etc.

The variation in the strength and durability is as great as in the composition and texture. Some are stronger than many granites in their resistance to crushing force, and equally enduring ; others consist of loosely cohering grains, and are friable and rapidly dissolved by atmospheric agencies. The more silicious and compact limestones are generally the more durable and stronger; in the marbles the well-crystallized and more homogeneous texture consists with endurance and strength. Both the magnesian and dolomitic varieties are good stone as is proven by the Calciferous and the Niagara limestones, and in the marbles of Tuckahoe and Pleasantville, in Westchester county.

Crystalline limestones occur in New York city and Westchester county, and in the Highlands of the Hudson. In the Adirondack region there are numerous localities. The rock in many of them is too impure and has too many foreign minerals to admit of its use as marble. Quarries have been opened in Westchester, Putnam and Dutchess counties, which have yielded a large amount of fine white marble. In the northern part of the State, the Port Henry and the Gouverneur quarries have been productive. The geological horizon of some of these marbles is in doubt. The belt in the eastern part of Dutchess and Putnam counties belongs to the Vermont marble range, and is probably metamorphosed Trenton limestone. The Westchester marbles may be of the same age.

The limestones which furnish building stone in this State are the Calciferous, Chazy, Birdseye, Black River, Trenton, Niagara, Lower Helderberg, Upper Helderberg, or Corniferous, and Tully. The geographical distribution is given in the following notes, and in the order of geological succession, from the lowest to the highest.

Calciferous Sandrock.

The rocks of the Calciferous formation in the Mohawk valley and in the Champlain valley are more silicious than at the southwest, in Orange county and in the Hudson valley, and hence the designation as a sandrock. Much of it at the north is a limestone rather than a sandstone, and may be termed a magnesian or siliciomagnesian limestone. Nearly all of the limestones, which are quarried for building stone, in Orange and Dutchess counties are from this formation. The stone occurs generally in thick and regular beds. It is hard, strong and durable and is adapted for heavy masonry as well as for fine cut work. The quarries near Warwick, Mapes' Corners and near Newburgh in Orange county and those on the Hudson River, near New Hamburg, are in the Calciferous. The Sandy Hill quarry and those at Canajoharie and Little Falls are also in it.

Trenton Limestone.

Under this head the Chazy, Birdseye, Black River and Trenton limestones are included.

The Chazy limestone crops out in Essex and Clinton counties and in the Champlain valley — its typical localities. The beds are thick and generally uneven. Regular systems of joints help the quarrymen in getting out large blocks. Quarries at Willsboro Point and near Plattsburg are in the horizon of the Chazy. The stone is suitable for bridge work and for heavy masonry.

The members of the Trenton above the Chazy limestone are recognized in many outcrops in the southeastern part of the State; in the Hudson-Champlain valley; in the Mohawk valley; in the valley of the Black River and northwest, bordering Lake Ontario; and in a border zone on the north of the Adirondacks, in the St. Lawrence valley. In a formation so widely-extended there is, as might be expected, some variation in bedding, texture and color. Much of the Trenton limestone formation proper is thin-bedded and shaly and unfit for building stone. In the Birdseye also the stone of many localities is disfigured on weathering, by its peculiar fossils. Generally the stone is sub-crystalline, hard and compact and of a high specific gravity and dark-blue to gray in color. But the variation is wide, as for example, between the black marble of Glens Falls and the gray, crystalline rock of the Prospect quarries near Trenton Falls. The variation is often great within the range of a comparatively few feet vertically; and the same quarry may yield two or more varieties of building stone. In several quarries the Birdseye and Trenton are both represented. Many quarries have been opened in the formation and there are many more localities where stone has been taken from outcropping ledges, which are not developed into quarries proper. The more important localities which are worked steadily are: Glens Falls, Amsterdam, Tribes Hill, Canajoharie, Palatine Bridge and Prospect in the valley of the Mohawk; and Lowville, Watertown, Three Mile Bay, Chaumont and Ogdensburg in the Black River and St. Lawrence valleys The railroad and canal lines, which traverse the territory occupied by these formations, afford transportation facilities and offer inducements to those who are seeking new quarry sites where these limestones may be found in workable extent.

Niagara Limestone.

The Niagara limestone formation is well developed west from Rochester to the Niagara river; and there are large quarries in it at Rochester, at Lockport and at Niagara Falls. The gray, sub-crystalline stone in thick beds is quarried for building purposes. It is filled with encrinital and coralline fossils and the unequal weathering of the matrix and the fossiliferous portions are sometimes such as to give the dressed surface a pitted appearance with cavities which roughen and disfigure it. For foundations and heavy masonry it is well adapted. It has been extensively employed in the western part of the State.

Lower Helderberg Limestones.

The Water-lime, Tentaculite and Pentamerus limestones are included in this group. The outcrops are in the Rondout valley, southwest from Kingston to the Delaware river; in the foot-hills east of the Catskills — in Ulster and Greene counties; on Becraft's mountain, near Hudson; and in a belt stretching west from the Hudson valley, along the Helderbergs and across Schoharie into Herkimer county.

The Tentaculite limestone is dark-colored, compact and in thick beds and can be quarried in large blocks. Some of it can be polished and makes a beautiful black marble, as for example, that of Schoharie.

The Pentamerus limestones, both the lower and the upper, are in thick beds and are gray, sub-crystalline in texture, and look well when dressed. They are adapted to heavy masonry as well as for cut work.

Quarries are opened in this group of limestones in the Schoharie valley, at Howe's Cave, Cobleskill, Cherry Valley and in Springfield. The quarries west of Catskill and in Becraft's mountain, near Hudson, are also in it.

Upper Helderberg Limestones.

The Upper Helderberg formation appears in the Hudson valley at Kingston; thence it runs in a belt west of the river, to the Helderberg mountains, bending to the west-northwest, and then west it continues across the State to the Niagara River and Lake Erie. The subdivisions are known as the Onondaga, the Corniferous and the Seneca limestones. The first is more generally recognized as the "Onondaga gray limestone" and the last as the Seneca blue limestone.

There is much diversity in the limestones of this group in its long range of outcrop. The Onondaga gray stone is gray in color, coarse crystalline; and makes beautiful ashlar work, either as rock face or as fine tooled, decorative pieces.

The Corniferous limestone is hard and durable, but it is so full of chert that it can only be used for common wall work.

The Seneca blue limestone is easily dressed and is a fairly good building stone.

Limestone of the Upper Helderberg epoch is quarried extensively at Kingston, Ulster county, and is a valuable building stone. In Onondaga county there are the well-known Splitrock and Reservation groups of quarries, which have produced an immense quantity of excellent and beautiful stone and which has found a market in all of the central part of the State. They are in the lower member of the group. Going west, there are the large quarries in the Seneca limestone at Union Springs, Waterloo, Seneca Falls and Auburn. The LeRoy, Williamsville, Buffalo and Black Rock quarries are in the Corniferous limestone.

The aggregate output of the quarries in the Upper Helderberg limestones exceeds in value that of any other limestone formation in the State. The many quarries of the Trenton probably produce more stone.

Tully Limestone.

The Tully limestone lying above the Hamilton shales, is a thin formation which is seen in Onondaga county and to the west — on the shores of Cayuga lake — in Seneca county and disappearing in Ontario county. It does not furnish any stone other than for rough work and in the immediate neighborhood of its outcrops.

Calcareous Tufa

As a supplement to the limestones the quarry in calcareous tufa at Mohawk, in the Mohawk valley, should here be mentioned, although the quarry is of no importance and there is no outcrop large enough for much work in it.

DESCRIPTION OF MARBLE AND LIMESTONE QUARRIES

Marbles

New York City.—A white, crystalline limestone was formerly quarried at Kingsbridge and used in the construction of buildings in the city. The same limestone is now exposed in the deep cut made for the Harlem ship canal. Crystalline limestone has been quarried at Morrisania and Mott Haven also, but they can scarcely be called marbles in a proper sense, although used for ordinary construction.

Tremont, New York City.— Four quarries have been opened in the white marble in Tremont, and worked for house trimmings and ordinary construction. The Tremont marble can be seen in the new buildings of St. John's College, Fordham, where it has been used effectively with the dark-blue gneiss. The output of these quarries is small and unimportant.

Tuckahoe, Westchester County.— The Tuckahoe Marble Company and the New York Marble Company quarry marble at Tuckahoe. The first-named company works what was formerly known as Young's quarry. The latter company has a large quarry adjoining it on the north. The stone of these quarries is coarsely-crystalline in texture and pure white. In composition it is a true dolomite. A sample from the New York Quarry Company (J. M. Masterton) was found to contain

30.63 per cent. of lime, and 2).77 per cent. of magnesia, and 0.91 per cent. of insoluble matter. The specific gravity was 2.868, equivalent to 178 pounds per cubic foot. The absorption test indicated 0.14 per cent. of water absorbed. The loss in weight when acted upon by sulphuric acid gas amounted to 0.25 per cent. Freezing and thawing produced no apparent change. At a high temperature the specimen was calcined and crumbled at the touch. The Tuckahoe quarries have been worked since 1820, and have produced a large aggregate of marble, which has been put in large and expensive buildings in cities along the Atlantic coast from Boston to New Orleans. It is comparatively durable and resists the action of the weather better than much of the Vermont and the foreign marbles, which have been used in New York city. A noticeable change from long exposure is a slight yellowish shade of color, which can be seen in the United States Assay Office building, Wall street, in the building of the National Shoe and Leather Bank, and in the houses of the cardinal and of the archbishop on Madison avenue. Some of the more prominent structures in which Tuckahoe marble has been used are the following: The United States Post-Office, United States Naval Observatory and the Soldiers' Home, Washington, D. C.; the City Hall, Brooklyn; the A. T. Stewart buildings on Broadway and Fifth avenue, New York, and the Sears building, Vendome Hotel and Revere Bank in Boston.

Pleasantville, Westchester County.— The Snowflake Marble Company's quarry is one mile southeast of the village of Pleasantville. This marble is white and very coarse-crystalline It is much harder than the Vermont marbles and does not compete with them for monumental work. The chemical analysis shows it to be a dolomitic limestone or marble. Examples of its use are: St. Patrick's Roman Catholic Cathedral, Fifth avenue, and the Union Dime Savings building, Sixth avenue and Thirty-second street, New York city; also the Methodist Episcopal church in Sing Sing.

Hastings, Westchester County.— The marble quarries near Hastings produce a white, fine-crystalline, dolomitic stone. They have been idle for many years.

Sing Sing, Westchester County.— The crystalline limestone east of the State prison and on the State property was formerly worked for marble; and the prison buildings and the State Hall at Albany are built of stone which came from these quarries.

White limestone in the Dover Plains — Patterson valley has been opened at several points between Patterson on the south and Dover Plains on the north, and a white marble has been obtained and worked up largely for monumental bases and gravestones. The stone of these quarries is bluish white and fine crystalline in texture and is readily dressed. They have been idle for several years past.

Towner's Four Corners, Putnam County.— The old quarry at this locality was opened two years ago for stone to be used in the construction of the Sodom dam. The stone is gray and white, rather coarse-crystalline and contains many crystals of white pyroxene scattered through the mass. The friable and decomposed condition of the ledges near the quarry leads to the belief that the stone is not very durable.

Gouverneur, St. Lawrence County.— At Gouverneur there are three companies working marble quarries. The works and quarries are located about one mile southwest of the village and near the R., W. & O. railroad line. There are two leading varieties of stone obtained in these quarries; a light-gray at the top and a dark-blue at the bottom. The latter resembles, when dressed, some of the gray granites. Both varieties are coarse-crystalline in structure. A specimen from the St. Lawrence Marble Company's quarry was found to have a specific gravity of 2.756, equivalent to a weight of 171 pounds per cubic foot; 51.57 per cent. of lime, 3.29 per cent. of magnesia and 1.29 per cent. insoluble matter. The absorbed water amounted to 1.16 per cent. The loss, when acted upon by sulphurous acid gas, was 0.15 per cent.; freezing and thawing produced no apparent change. At a high temperature, (1200°–1400°) the specimen was fully calcined.

"The Gouverneur marble was employed at least fifty years ago for gravestones, and in the Riverside cemetery, at Gouverneur, these old gravestones, bearing dates from 1818 onward, can now be seen. As compared with the white marble headstones from Vermont it is more durable; and there is not so luxuriant a growth of moss and lichen as on the latter stone, but in the case of the older Gouverneur stone some signs of decay and disintegration, particularly on the tops, are noticeable, and small pieces can be chipped off with the knife blade. The durability of the stone for building purposes has been tested in some of the older structures in Gouverneur."

The leading use of the Gouverneur marble is for monuments. A large amount is sold for rock-ashlar, for buildings, principally to western markets. It may be seen in several business blocks in Gouverneur; Hubbard House, Malone; in the Presbyterian church Canton; in the Flower Memorial Chapel, Watertown; and the State Asylum for the Insane at Ogdensburg, and Merrick block, Syracuse.

Canton, St. Lawrence County.— A grayish-white marble is opened in this town, four miles easterly from Canton. It has not been worked lately.

Verd-Antique Marble.

Thurman, Warren County.— The verd-antique marble locality is open in this town, eight miles northwest of Thurman, and five miles from Glendale station. The quarry was worked for three years and then abandoned. The stone is of a yellowish-green color and not the deep rich green, characteristic of precious serpentine.

Bolton, Warren County.— Localities of serpentine marble are known in this town, but they have not been developed into quarries.

Port Henry, Essex County.— The Burlington Manufacturing Company has a quarry of verd-antique marble about one-quarter of a mile north of the Cheever ore bed. The stone is coarse-granular, green and white, speckled, in color and is capable of taking a good polish. The place has been idle since 1886.

Limestones.

Warwick, Orange County.— The blue, magnesian limestone formation here affords a good building stone for the local supply, and the quarries are worked at intervals, according to the demand.

Mapes Corner, Orange County.— The quarries on Mount Lookout near Orange Farm station of the Pine Island Branch railroad furnish stone to Goshen, Chester and the adjacent country. The stone occurs in thick beds and is adapted for massive wall work. The Presbyterian, Methodist Episcopal and Roman Catholic churches in Goshen and the Roman Catholic church in Chester are examples in construction.

Newburg.— Blue limestone is quarried southwest of the city, near the old Cochecton turnpike, and on the north slope of Snake Hill. It has been used largely for retaining walls and foundations in the city. St. George's Protestant Episcopal Church is built of stone from this range. North of the city there is a small quarry on the river road.

New Hamburg, Dutchess County.— The quarry, two miles north of New Hamburg, is worked for bridge stone for the N. Y. C. & H. R. R. R. Co. and for ballast.

Kingston, Ulster County. — The outcrops of the Onondaga limestone formation in the city have afforded stone for building from the earliest settlement of the place, and the old stone-houses are in part built of this stone. Quarries have been opened from the Kingston and Rondout railroad on Main street, and near Union avenue southwest to the cemetery, and near Washington and Pearl streets in the western part of the city. The beds are from two to eight feet thick. Two well-marked systems of vertical joints divide the rock into blocks of a size convenient for quarrying. Freshly-fractured surfaces of this limestone are of a dark-blue shade; weathered surfaces are gray, in some cases brown-yellow. Thin seams of argillaceous or more clayey rock, from one-sixteenth to one-fourth of an inch, alternating irregularly with the calcareous portions, cause unequal wear in exposed faces and develop lines of dirty yellow in the gray background of the stone, which are unsightly. They do not, however, impair seriously its strength or durability, except when the stone is set on edge. Some chert and scattering crystals of pyrite occur in some of the surface beds, but the lower and thicker beds appear to be free from these minerals. The stone is best adapted for foundations and for heavy masonry as it is hard, dense, very strong and to be had in large blocks. These quarries have furnished the great bulk of stone used in Kingston. The piers of the Poughkeepsie bridge ; part of the anchorage and piers of the New York and Brooklyn bridge ; locks at Cohoes and Waterford, and St. Patrick's Roman Catholic Church in Newburgh are examples of the Kingston limestones. These quarries are not worked continuously.

Greenport, Columbia County.— The quarries near Hudson in the town of Greenport are opened on the north end, and in the western escarpment of Becraft's mountain. Geologically they are in the Upper Pentamerus and Encrinal limestone divisions of the Lower Helderberg horizon and the stone is a nearly pure carbonate of lime. It is gray to reddish gray in color, sub-crystalline to crystalline and highly fossiliferous. The beds are from four inches to six feet thick, and afford blocks of large size. The stone is susceptible of a high polish, and is adapted to decorative purposes, preferable for interior work. It has been known as "coral-shell marble" and "scutella marble." Nearly all of the foundations and retaining walls in the city of Hudson are of this stone. The Presbyterian church is a good architectural example of its use. The quarries of F. W. Jones are worked continuously and the railroad connects them with the New York Central and Hudson River railroad and the river.

Champlain Valley.

Saratoga Springs, Saratoga County.— Blue limestone for common masonry has been quarried at several places in the town.

The largest quarries are those of Charles G. Slade and Isaac F. Wager, about three miles west of the village. The geological horizon is Calciferous and Trenton.

The stone is of a dark-blue shade. That of the thick beds is rather easily dressed and is worked up into dimension blocks for curbing, and house-trimming and heavy bridge work on the Delaware and Hudson Canal Co.'s railroad lines. It has to be carted to Saratoga, where a large part of the total output is used in house-work.

Sandy Hill, Warren County.— The Sandy Hill Quarry Company has extensive quarries two miles from the Sandy Hill railroad station, and a half mile northeast of the canal.

The formation is that of the calciferous sand rock. A large area has been worked over to a slight depth. There is a thin covering of earth from one to two feet thick; then quarry beds one to seven feet thick, down at least to forty feet. The dip is less than five degrees to the south.

Open and vertical, dirt-filled joints are a peculiar feature and facilitate the removal of huge blocks. The long working face and natural drainage are also advantages. And with a complete equipment of steam drills, derricks and movable railways, the capacity of production is large. The annual output in cubic yards is greater than that of any other single building-stone quarry in the State, and is increasing from year to year.

The stone is of a light blue color, and fine-grained. Its specific gravity is 2.764 and its weight per cubic foot 172 pounds. A partial chemical analysis gave 27.35 per cent of matter insoluble in dilute hydrochloric acid. The lime and magnesia are present in proportions approximating to a dolomite. The absorption capacity was found to be 0.14 per cent. When treated with a 1 per cent. solution of sulphuric acid the loss in weight was 2.51 per cent. Freezing and thawing did not produce any apparent effect. Exposed to a heat of 1200° to 1400° F. the stone was partially calcined and crumbled with a blow. On account of its hardness, it can not be dressed economically, and very little of it is used for housework. It is specially adapted to heavy masonry. It was used in the Arthur Kill bridge on Staten Island sound, in the rear wall on Governor's Island, in the walls of the sunken track of the Harlem railroad, in the Croton aqueduct gatehouse, New York city, the Poughkeepsie bridge piers, and in the battle monument at Bennington, Vermont.

Glens Falls.—There are two large quarries in the Trenton limestone, one on each side of the Hudson river at Glens Falls. That of the Morgan Lumber and Lime Company on the Saratoga county side is no longer worked for building stone. The quarry on the left bank, in Warren county, belongs to the Glens Falls Company, and is worked for black limestone or "marble."

There is a long working-face in which a gray, crystalline limestone is seen in thin beds at the top, then the black marble, which has, in two beds, a total thickness of twelve feet.

The gray limestone is sold in the rough for common wall work, or cut into house-trimming material.

The black marble is fine-grained and compact, hard and brittle, but can be dressed in any style. It takes a brilliant polish and is jet black. Its specific gravity is 2.718 and its weight per cubic foot 169.4 pounds. According to analysis it is a magnesian limestone, carrying a high percentage (30.18) of matters insoluble in hydrochloric acid. The percentage of water absorbed is relatively low, 0.08. The specimens remained unchanged in the tests by alternate freezing and thawing. At a high heat (1200°–1400°) the stone was calcined and crumbled to the touch.

For tiling it is particularly well adapted, as it does not wear slippery. It is worked up in a mill at the quarry, and tiles, shelves, mantels, lintels, coping-stone, wainscoting, billiard table tops and material for all inside, decorative work, are cut. Among the examples of inside work, the building of the Equitable Insurance Company, Broadway, New York, is perhaps the best. The market for it is all over the country.

The quarry is at the side of the Champlain canal (feeder) and one-half mile from the Delaware and Hudson Canal Company's railroad.

Whitehall, Washington County.— The quarry of the Arana Marble Company at the side of the railroad, about half way between Whitehall and Fair Haven, has not been worked except for stone for flux in iron furnaces.

Crown Point, Essex County.— The quarries in this town have not been worked recently.

Willsboro Neck, Essex County.— The Chazy limestone on this Neck, has been opened in two large quarries. A large business was done in 1854 and thereafter for about twenty years, and much of the stone was used in the foundations of the Capitol at Albany, and in those of the New York and Brooklyn bridge.

The stone can be seen in the Reformed Church, Swan street, Albany, and in the State Street M. E. Church in Troy. It has been known in the market as "Lake Champlain bluestone." The stone is light-blue in color, weathering to a light-gray.

The light stripping necessary to open the quarries, the uniform thickness of the beds, the regular, vertical joints, and the location on the lake accessible by boats, are notable advantages. One quarry only is now worked and that in a small way.

Plattsburg, Clinton County.— In the vicinity of Plattsburg there are several small quarries in the Chazy limestone which furnish stone for construction in the town. The St. John's Roman Catholic Church and the First Presbyterian Church are built of this stone.

South of Plattsburg three and a half miles, the Burlington Manufacturing Company has a quarry where a limestone is obtained, which is known in the market as "Lepanto marble" It is fine-crystalline in texture, gray to red in color, and takes a high polish. The specific gravity is 2.709, and its weight per cubic foot is 168.8 pounds. It contains 1.54 per cent. only of matter insoluble in dilute hydrochloric acid and 94.87 per cent. of calcium carbonate. The absorption test showed 0.145 per cent. of water absorbed. In freezing and thawing there was no change, but at a high heat the stone was fully calcined and crumbled to the touch.

The stone has to be hauled by teams to the lake, one mile east of the quarry. It is dressed at the company's works in Burlington, Vermont.

The principal markets for it are Burlington and Plattsburg.

Mohawk Valley.

In Schenectady county there are two small quarries on the south side of the Mohawk river, and near **Pattersonville** station, which are worked at infrequent intervals for the local market. They are in the horizon of the Trenton limestone.

Amsterdam, Montgomery County.— The Birdseye limestone and the Trenton limestone outcrops in the valley of the Chuctanunda creek afford sites for quarrying building stone, and four quarries have been opened north of the town of Amsterdam, and at a height of 180 to 250 feet above the Mohawk valley. The stone is in beds from six inches to three feet thick which are almost horizontal. The rough stone is sold for making lime, the best is cut into platforms, sills, lintels, and house-trimming materials. The principal markets are Amsterdam, Albany, Cohoes and Troy. Shanahan's quarry furnished a large amount of stone for the foundation of the Capitol at Albany. The other quarries are Hewitt's and Vanderveer's.

Tribes Hill, Montgomery County.— There are two large quarries near the station of the N. Y. C. & H. R. R. R. at Tribes Hill: that of Henry Hurst & Son, a few rods west of the depot, and one east of it, belonging to James Shanahan. The former is worked steadily and mainly for constructions in the neighboring towns; the latter has been idle for several years.

The upper strata in both quarries are of blue limestone suitable for common rubble work or for lime making. The graystone of the thicker and lower beds is fine-crystalline to sub-crystalline in texture, and having a specific gravity of 2.718. The computed weight per cubic foot is 169 pounds. It contains, according to analysis, matters insoluble in dilute hydrochloric acid 2.48 per cent, and of lime 53.57 per cent. or equivalent to 95.68 per cent., of calcium carbonate. The absorption percentage was found to be 0.14. Freezing and thawing produced no change. At a red heat it was reduced to lime.

The markets for Tribes Hill limestone are Albany, Troy, Cohoes, Stillwater, Mechanicville, Hoosick Falls, Johnstown and Gloversville.

The Edison House, Schenectady, is an example in construction.

Fine-tooled surfaces are of a light-gray shade of color; polished, it looks almost like a black marble.*

Quarries have been opened at many points in the valley of the Mohawk between Amsterdam and Little Falls, and in the Trenton and Birdseye limestone formations. Some of them have been idle for many years; others have furnished small quantities of stone for home use, and hence are only of local importance.

Canajoharie, Montgomery County.— There are three building-stone quarries opened in and near Canajoharie, and in the Calciferous formation, two of which are worked continuously. The openings are large, and there is much variation in the beds. The leading varieties are a bluestone and a gray, sub-crystalline stone, the latter of which is cut for monumental bases, sewer blocks, house trimmings and canal lock construction. A specimen of the gray variety from the quarry of A. E. Shaper was

* There is a fine cubical block from Mr. Shanahan's quarry in the State Museum collection whose polished face is almost jet black.

examined and gave an analysis 46.92 per cent. of lime, equivalent to 83.92 per cent. of calcium carbonate and 10.06 per cent. of insoluble matters. The specific gravity was 2.726 and the weight 169.9 pounds per cubic foot. Its absorptive capacity was found to be 0.07 per cent. The alternate freezing and thawing produced no change, but the high temperature calcined the specimen so that it fell to pieces in handling. The stone of these quarries can be seen in the churches of Canajoharie and Fort Plain, and in some of the large mill buildings of Utica.

Palatine Bridge, Montgomery County.— On the north or left bank of the Mohawk there are two large quarries which furnish blue and gray limestones for common wall work and for cut work. These quarries are in the same formation as those across the river in Canajoharie, and the stone resembles closely that of the latter quarries. In all of them the beds dip southerly 5° to 10°, and the stripping is comparatively light.

At Fort Plain and St. Johnsville, Montgomery County, the Birdseye limestone is opened in small quarries for local use.

Little Falls, Herkimer County. — There are three quarries in the Calciferous sandrock, in the bluff north of the town, which produce stone for common wall work for local use. The stone is fine-grained and of a bluish-gray shade of color, weathering to gray. Northwest of the town one and a half miles, there is a quarry on the Wilcox property and in the Trenton and Birdseye limestone. The stone is sold for curbing and flagging mainly.

Newport, Herkimer County. — In this town there are three quarries in the limestone, which furnish stone for local use, and for canal lock construction.

Holland Patent, Oneida County. — The quarries in the Trenton limestone at this place are of local importance only.

Prospect, Oneida County. — The cañon of the West Canada creek has exposed the Trenton limestone between this place and Trenton Falls, and made the upper beds easily accessible, and workable to advantage.

On the west side of the creek (Oneida County) Evan T. Thomas and H. & L. N. Jones have quarries; on the east side, in Herkimer county, there are two quarries, worked by Edward Callahan and

George & Griffith of Utica. The covering of soil and earth is light, and is thrown into the gorge with waste rock. The beds lie nearly horizontal and are thin so as to be cut to advantage for platforms, flagging-stone, lintels, sills and water-tables. The stone is carted to Prospect station, one and a half miles, and there shipped.

A representative specimen of the best stone from the quarry of Evan T. Thomas was found to have a specific gravity of 2.725 and a weight per cubic foot of 169.8 pounds. The percentage of lime 53.10 found, indicates 94.82 per cent. of calcium carbonate. The absorption percentage is 0.14. The freezing and thawing tests produced no apparent change; heating to 1200°–1400° F., and cooling suddenly made it a crumbling mass of lime.

The stone of these quarries is known as "Trenton gray limestone." It has been employed extensively in Utica, Rome, Norwich and other places. Examples of it are in the United States Government building, in St. John's Roman Catholic and in St. Paul's Lutheran churches in Utica; in the Roman Catholic churches at Little Falls and at Sandy Hill; and in the Methodist Episcopal church in Herkimer. Some of the stone is cut at Utica into monumental bases. The best cut stone is gray in color and sub-crystalline in texture.

It fades after long exposure to the atmosphere and loses its freshness of surface.

Leyden, Lewis County.— Blue limestone has been quarried near Talcottville, on Sugar river at Leyden station, and near Port Leyden. Much stone for canal lock construction has been obtained at some of the Leyden quarries.

Lowville, Lewis County.— L. H. Carter and Hiram Gowdy have quarries southeast of the village, and east of the R., W. & O. R. R. line. The geological horizon is that of the Trenton and Birds-eye limestones. The beds are nearly horizontal, and some of them are two to three feet thick. The heavy beds furnish stone for bridge abutments.

The Lowville stone is generally much darker in shade than the Prospect stone and looks well when fine-tooled. The principal market is Lowville and adjoining towns. Much of the stone has been used on the U. & B. R. branch in bridge abutments.

Watertown, Jefferson County.— The gray of the Trenton and the heavy beds of the Black river limestones are finely exposed to view in the gorge of the Black river at Watertown. They are not worked.

Three Mile Bay, Jefferson County.— At this place the limestone is so thinly covered as to be readily opened, and stone for local use is obtained in several small quarries. Barron's quarry is close to the lake shore, and half a mile from the railroad station.

The lower beds are worked into cut stone for house trimming and cemetery work. Watertown and the lake ports are the chief markets.

At **Brownsville** some limestone is quarried at the side of the Cape Vincent branch railroad for local use.

Chaumont, Jefferson County.—There are several large quarries at Chaumont, two of which, Adams Bros. and Duford & Sons, are run steadily. The former has a quarry face a mile in length. They are in the horizon of the Black river and Trenton limestones. The beds dip westward at a small angle and are divided into large blocks by vertical joints.

There is a blue limestone at the top which is made into lime, or used for common wall work. Under it is the gray sub-crystalline variety, in what are known as the 32-inch and the 16-inch beds, besides thinner beds lower down. The surface courses furnish stone for lime manufacture. The stone of the thicker beds is cut for lock facing and bridge work; the thin beds are worked into house trimmings. These quarries are on the shore of the bay, convenient to navigation and are near the railroad also. The product is increasing from year to year. Much of the Chaumont stone has been put into Erie canal locks.

The Protestant Episcopal Church, the County Clerk's office and City Opera House in Watertown are examples in construction.

Oswego, Fulton and Utica are other markets.

Ogdensburg, St. Lawrence County.— The number of stone buildings in Ogdensburg is comparatively large, and the material is almost all out of local quarries in the Chazy limestone formation.

The Town Hall and the St. John's Protestant Episcopal Church are beautiful examples of the stone which is found here. The quarry which is now worked for the local supply is on the Oswegatchie River, two miles south of the town.

Norwood, St. Lawrence County.— A blue limestone is quarried one and a half miles from Norwood on the O. & L. C. R. R. line. It can be seen in the Presbyterian churches at Malone, Waddington and Canton; the Roman Catholic church at Hogansburg, and in the county buildings at Canton.

Schoharie, Schoharie County.— Limestones of the Lower Helderberg and Water-lime groups crop out in the valley east of the village of Schoharie, and afford excellent building stone. The black, tentaculite limestone is very compact and takes a high polish. The use thus far is for the town only.

The Reformed Dutch Church and Revolutionary Stone Fort in the lower Schoharie valley, built in 1766, shows how well the limestone resists the weather.

Howe's Cave, Schoharie County.— Formerly a large amount of building stone was quarried here in the bluff above the hydraulic limestone beds. The latter only are now worked.

Cobleskill, Schoharie County.— William Reilly has two quarries near this place, one a half mile northwest of the village and the other about two miles to the northeast. Both are in the Upper Helderberg limestone.

Two principal kinds of stone are taken out — a hard bluestone and a gray, sub-crystalline variety, which is cut and dressed for dimension work. A specimen of the latter was examined and found to contain 53.86 per cent. of lime, or 96.18 per cent. of carbonate of lime, and 2.26 per cent. of matter insoluble in dilute hydrochloric acid. Its specific gravity was 2.713, equivalent to a weight of 169 pounds to the cubic foot. The absorption percentage was 0.109. Unaffected apparently by alternate freezing and thawing, it was calcined at a high heat (1200°–1400° F.).

The stone of this quarry has a home market; it is shipped to Binghamton, Oneonta, Cooperstown, Albany and other places on the Albany and Susquehanna railroad. It was used in the German Methodist Episcopal church, Clinton and Alexander streets; in the Roman Catholic church, Central avenue, and in the Hawk street viaduct, Albany.

Sharon Springs, Schoharie County.— The Lower Helderberg limestones at Sharon Springs and its vicinity are opened at several points, and stone is obtained for local use in flagging, crosswalks and housework. The limestones of the Upper Helderberg epoch in their westward extension into Otsego county crop out in many ledges in the towns of **Cherry Valley** and **Springfield**, and afford good building stone for local use. The Presbyterian church and Belcher House, in the village of Cherry Valley; the Otsego County Jail, Fenimore House, and the house of Edward Clark in Cooperstown, are examples in construction of the stone from these quarries. In the town of **Stark**, in **Herkimer** county, a small quarry has been worked in the same gray limestone.

The Corniferous limestone was opened many years ago in small quarries at **Cassville**, **Waterville** and **Oriskany Falls**, in the southern part of Oneida county.

Perryville, Madison County.— Three quarries are worked at irregular times at this place. The stone is the Onondaga gray limestone and is used as there is a demand for it; mainly for bridge work.

In Onondaga county the Onondaga gray limestone is well developed and is quarried extensively. There are quarries at **Manlius**, **Jamesville**, on the **Onondaga Indian Reservation**, and at **Split Rock**.

Onondaga Indian Reservation Quarries.— This group of quarries is six and a half miles south of Syracuse and in the northeast corner of the reservation. There are five parties at work within a range of three-eighths of a mile from north to south. The dip of the beds is generally to the west-southwest, and at low angles.

The upper beds are blue limestone which is waste, excepting a small part which is used for rubble. The gray limestone has a crystalline texture, and a specific gravity of 2.708, equivalent to a weight of 168 pounds per cubic foot. It is dressed readily and fine-tooled surfaces are light gray, resembling the gray granites of Maine, and contrasting well with the rock-face stone which is so much darker colored. It is a strong and durable stone, as is proven in the old buildings in Syracuse and elsewhere. Specimens of fine cut gray limestone, which have been exposed to the weather forty-eight years in the old City Hall, exhibit no indication of decay, and no alteration other than a fading in color. One defect in the stone is the very thin, black, shaly seams which sometimes give it the appearance of checking; but there are no clay seams as in some of our limestones.

In quarrying it is not possible to get as thick beds as in the granites and some of the sandstones, two feet being the average thickness.

A representative specimen from Hughes Bros., of Syracuse, was found to contain 53.76 per cent of lime and 0.60 per cent of magnesia, or 96 per cent of carbonate of lime and 1.26 per cent of carbonate of magnesia. Matters insoluble in dilute acid were 1.52 per cent. The water absorbed was 0.14 per cent. The freezing and thawing tests did not produce any apparent change. Subjected to a temperature of 1200°–1400° F., the stone was fully calcined.

Split Rock Quarries. — This group is in the town of Onondaga, five to seven miles west of Syracuse, and in the north-facing escarpment of the Upper Helderberg rocks. The beds are thinly covered by earth, and one or two beds, at most, are worked. In this way a large area has been quarried over. A great deal of stone for the Erie canal construction was obtained from these quarries.*

The Onondaga gray limestone has been the principal building stone in Syracuse. Among the many fine structures in which it has been used for walls and trimmings, may be noted the following: United States Government building; new City Hall; Hall of Languages; Syracuse University; Onondaga County Savings Bank; St. Paul's Protestant Episcopal Church; St. Mary's Roman Catholic Church, and the May Memorial Church.

Oswego, Binghamton, Elmira and other cities and towns in the central part of the State are markets for the stone.

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* One of the first railroads in Central New York was constructed from the Split Rock quarries to the canal, one mile west of Syracuse. — H. W. Clarke.

Union Springs, Cayuga County.—The Onondaga limestone is opened in a group of quarries at Hamburg, one mile south of Union Springs, and on Daniel Mosher's farm, east of the village. A remarkable feature is the persistence of the quarry beds and their uniformity in the several quarries. The glacial drift on the limestone is from one to ten feet thick; the upper beds (or tiers, as here known) are blue limestone, and from two to twenty-four inches thick; the lower beds are generally thick and of a gray, sub crystalline stone. The thin beds answer for flagging; the heavier beds are worked into dimension blocks for building, canal lock and bridge-pier construction. The markets are reached by boats on line of Erie canal.

The Hamburg quarries were opened more than sixty years ago, and the old grist-mill, the Chase House and the Howland House, show how well the stone has stood for that length of time.

Auburn, Cayuga County.— The Upper Helderberg limestone ledges at Auburn have afforded a good building stone; and a comparatively large percentage of stone buildings in that city are evidence of its enduring property. The Garrett Stone and Coal Company,* L. S. Goodrich & Son, and John Bennett & Son have quarries here. The first named was opened in 1810. The blue limestone of the upper beds is used for rubble-work only. The gray limestone occurring in "tiers" of from six inches to two feet thick, is cut for house trimmings, platforms, curbing and gutter-stones. It is dressed readily, and is of a light-gray color when fine cut; the rock face is dark colored.

It has been used in six beautiful churches; in the City Hall; in the Auburn Theological Seminary buildings; in the State arsenal and State prison, besides many stores and other structures in the city.

The principal outside markets have been Sayre, Pa., Owego, Elmira, Oswego, Geneva, Canandaigua, Newark Valley and Palmyra.

The Corniferous or Upper Helderberg group of limestone, including as the upper part the Corniferous or Seneca limestone,

* Quarry not now in operation.

is well represented in a belt crossing the towns of **Seneca Falls** and **Waterloo**, and quarries are opened in both towns, for local use mainly.

The Waterloo quarries are large, and kept in operation almost all of the year. That of Loren Thomas, a half mile south of the town, has been worked for more than sixty years. Remarkably regular systems of vertical joints, at uniform distances apart, divide the stone into large, rectangular blocks, and facilitate the quarrying.

The beds are from seven to twenty-six inches thick, and fourteen to sixteen in number. The stone of these quarries resembles that of the formation to the east, in Cayuga and Onondaga counties.

The same geological formation appears in Ontario county, and there are small quarries in the towns of **Canandaigua** and **Victor,** which do a local business.

Going west the outcrops of the rocks of this geological epoch have been opened in small quarries in **Mendon, Monroe County**; near **Caledonia**, in **Livingston County**; and in **LeRoy, Genesee County.** There are two quarries at the latter place. They produce stone for common wall work. Some of the limestone found north of the town is said to dress well, and to be capable of receiving a good polish.

Williamsville, Erie County.— Several quarries have been opened at Williamsville, ten miles northeast of Buffalo. J. S. & F. H. Young and D. R. & H. Fogelsonger work quarries for building stone, mainly, for the Buffalo market. They are small, and not deep, as the rock is near the surface. The stone is light-gray, fine-crystalline, and dresses well.

It has a specific gravity of 2.708 and weighs 168 pounds per cubic foot. It contains 93.44 per cent. of calcium carbonate, and 3.82 per cent. of insoluble matter in dilute hydrochloric acid. Its absorption percentage is 0.16. It resisted freezing and thawing tests without apparent change, but was calcined at a temperature of 1200°–1400° F. It is used in Buffalo for cut-stone trimmings. The quarries are six miles from the New York Central railroad line, but nearly all the stone is carted by teams to Buffalo.

Buffalo.— The Corniferous limestone and the Onondaga limestone are quarried extensively in this city for all common wall work.

The Buffalo Cement Company's quarry is the northernmost. South of it is the Yamarthal group of quarries. The drift-earth is thin, covering the quarry beds to a depth of one to four feet, as opened thus far. The limestone is in courses, lying horizontal, and from nine inches to two and a half feet thick. The stone is dark-colored, hard, compact and strong, and is well liked for walls and foundations. It is delivered in wagon loads, in the city, at six dollars per cord.

Black Rock, Erie County.—The Corniferous limestone at this place was formerly quarried for canal construction.

NIAGARA LIMESTONE.

Rochester.—Nearly all of the common building stone used in Rochester is obtained from quarries in the northeastern and in the western quarters of the city. A very small part of the best gray stone is used for rock-face ashlar work. The business is entirely limited to the city.

Lockport, Niagara County.— The Whitmore and Carpenter quarries are on the Erie canal, in the southwestern part of the town. The upper layers of stone are thin, but are succeeded by thick beds, to a depth of twelve to twenty-four feet. The dip is southward at a low angle. The stone is known as the Lockport gray limestone. It is light-gray, in places variegated with red; dense, solid and made up of comminuted crinoidal stems and coralline masses. The fine-cut surface does not differ greatly in shade of color from that of the rock-faced stone. These quarries were opened when the Erie canal was dug, in 1825, and the Carpenters began work here in 1829. The production has diminished greatly, owing to the general use of sandstones.

It has been used in Lockport for common wall work; for house trimmings and monumental uses it has had a wide market. The various buildings in the town show how well it has withstood the action of the weather for years.

The Lenox Library building, Fifth avenue and Seventieth to Seventy-first streets, New York, is an example of its use, but one in which the stone shows crevices and holes, due to unequal weathering of coralline masses and of the more fossiliferous portion. The improper position of the stone in the walls (more than 40 per cent. being set on edge) may explain the serious defects seen in this example.

West of Lockport the Niagara limestone is quarried at **Niagara Falls**, for building in the town. Across the river, on the Canadian side, the same formation near Queenstown, furnishes some stone to Buffalo which is in much favor with some architects and builders.

Road Metal.

By Heinrich Ries; Revised by F. J. H. Merrill.

The rocks used for road metal in New York State are diabase (trap.), granite, gneiss, limestone, sandstone, shale and gravel.

Many of the local stone quarries, which are scattered over the State, sell for road metal the rock obtained in stripping off the upper layers from their quarries.

There are a few large quarries which are operated for obtaining road metal alone and which deserve special mention.

Many tons of material are quarried annually from the Palisades range near Piermont. The material, which is exceedingly tough, is either dressed for paving blocks or crushed for road metal.

Farther up the Hudson river the limestone quarries of Tomkins Cove have been in operation for a number of years and supply large quantities of rock for macadam. It is one of the best materials used. This magnesian limestone is hard and packs easily and makes a good surface, but the cost of maintenance is considerable.

The following is an analysis of the Tomkins Cove Rock:

Lime	60.20
Alumina	11.22
Silica	6.13
Magnesia	10.45
Carbonic acid	8.
Water	4.
	100.

At Iona Island a granite is quarried and crushed to five or six different sizes for road metal and concrete. The fine residue or dust is sold for polishing.

The Hudson River Stone Supply Company has an extensive plant for quarrying and crushing granite, at Breakneck Mt., north of Cold Spring. The same company operates a second plant for supplying crushed limestone at Stoneco, north of New Hamburg.

One of the largest quarries in the State is that of P. Callanan at South Bethlehem, Albany county. The Lower Helderberg limestone is the rock used and it makes a good road.

The Cauda Galli Grit of Albany county is used in small quantities locally and makes an excellent road, though it is not very durable.

At Duanesburg, near Schenectady, sandstone of the Hudson River group is crushed for road metal.

At Port Chester, Westchester county, a coarse-grained granite is quarried and is considerably used locally, but the best macadam roads of that district are of limestone from Tomkins Cove.

The gray gneiss has been considerably used as a road material in Westchester county.

On Staten Island the yellow gravel is much used for road making; also the diabase or trap from the Graniteville quarries, which is being extensively used on a system of county roads with the most satisfactory results.

The materials used for making roads in the State vary with the locality. If the traffic on the road is moderate it is generally safe to use the local material, whatever its nature, unless it be shale, but if there is a heavy traffic it will pay in most instances to get a stone of superior quality from elsewhere.

The requisite qualities of a road metal are hardness and toughness. Where both these qualities are not obtainable in the same stone the latter is perhaps preferable.

Igneous and silicious rocks, though often hard, do not consolidate as well nor so quickly as limestone, owing to the sandy detritus formed by the first two having no cohesion. The detritus of magnesian limestone acts like a mortar.

The most efficient and economical road metals are diabase or trap and syenite.

Granite and gneiss, especially if very micaceous, are apt to disintegrate rapidly and produce dust and mud.

Shale is to be avoided, as it breaks up rapidly, forming a sticky mud.

Gravel, while making a serviceable road, will not pack well, and is not durable. If it has to be used, some of the difficulty may be overcome by cracking half of the pebbles.

DIRECTORY OF QUARRYMEN PRODUCING STONE FOR BUILDING PURPOSES.

By Frederick J. H. Merrill.

* Parties producing in 1894. † Parties producing previous to 1894, now idle.

Parties not marked with asterisk or dagger have not recently been heard from. Where there is uncertainty as to the name of the quarry owner, it is omitted.

N. B.—The localities mentioned in the preceding text are generally the names of the nearest railway stations to the quarries. In the directory the town is the political division in which the quarry is located and its name may differ from that of the railroad station.

GRANITE.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Cold Spring	Bailey, James E.*	Phillipstown	Putnam.
"	Bailey, Lewis J	"	"
Garrison	King Granite Co.*	"	"
Keeseville	Ausable Granite Co. (B. B. Mason agent)	Chesterfield	Essex.
Mechanics and Traders' Exch., New York	Donovan, Daniel E.*	Round Island, town of Stony Point	Rockland.
187 West street, New York	Van Wagner & Duff*	Piermont	"
Montreal	International Granite Co	Clayton	Jefferson.
Montreal	Thousand Island Granite Co.*	Grindstone Island, town of Clayton	"
Peekskill	Hudson River Granite Co	Cortland	Westchester.
Port Chester	Rich, G. H	Rye	"
Port Richmond	Bennett, Frank & Co	Northfield	Richmond.
Sufferns	....	Ramapo	Rockland.
Thurso	Chicago Granite Co	Clayton	Jefferson.

DIRECTORY OF QUARRYMEN PRODUCING STONE FOR BUILDING PURPOSES — SANDSTONE — (*Continued*).

Post-office.	NAME.	Location of Quarry. Town.	Location of Quarry. County.
Thurso	Gordon & Turcotte	Clayton	Jefferson.
Westport	Lake Champlain Granite Co	Westport	Essex.
	GNEISS (GRANITE).		
Croton Falls	Ganung, Edwin C.†	Carmel	Putnam.
Hartsdale	Hitchcock, Welcome G.*	Hartsdale	Westchester.
Hastings	Lefurgy, William G	Greenburg	"
Kensico		North Castle	"
Little Falls	Brady, A. N	Little Falls	Herkimer.
"	McGoup, John	"	"
Scarsdale	Seely, Henry S.†	Greenburg	Westchester.
Tarrytown	Sackett, Stephen J	"	"
West Point		Cornwall	Orange.
Wilton	Jennings, Mrs	Wilton	Saratoga.
Yonkers	Valentine, Mr	Yonkers	Westchester.
	SANDSTONE.		
Albany	Fuller, Wm. & Sons*	New Baltimore	Greene.
Albion	Albion Stone Co.*	Barre	Orleans.
"	De Graaf & Roberts*	"	"
"	Garrett & Atkinson*	"	"
"	Goodrich & Clark Stone Co	"	"
Belfast	Lang, James†	Belfast	Allegany.

Belmont	Johnson, James	Amity	"
Belvidere	Dibble, Albert	"	"
Brockport	Coon, George	Sweden	Monroe.
Camden		Camden	Oneida.
Canajoharie	Shaper, A. E	Canajoharie	Montgomery.
Clayton	Wilber, S. H.*	Clayton	Jefferson.
Clinton	Dawes, Charles*	Kirkland	Oneida.
"	McCabe, John	"	"
"	Moore, Richard	"	"
Clymer		Clymer	Chautauqua.
Cooperstown	Wood, John*	Middlefield	Otsego.
Corning	Bedient, James H	Corning	Steuben.
"	Kelley, John	"	"
Coventry	F. G. Clarke & Sons	Coventry	Chenango.
Cuba		Cuba	Allegany.
Dansville	Schubinehl, Martin J.*	Dansville	Livingston.
Dormansville	Stewart, Wm	Westerlo	Albany.
East Guilford	Mullen & Miller*	Guilford	Chenango.
Elmira	Symonds, A. D	Elmira	Chemung.
Fort Ann	Holmes, Andrew D.*	Fort Ann	Washington.
"	Parrish, Franklin	"	"
"	White, Jenkins	"	"
Fort Jackson	Downey Bros.†	Hopkinton	St. Lawrence.
Frankfort	Joslin, M. T.†	Frankfort	Herkimer.
Frankfort Hill		"	"
Fulton	Granby Brownstone Co.*	Granby	Oswego.
"	Jennings, Orvill J.*	Volney	"
Goodyears	Barger, J. G.*	Genoa	Cayuga.
Grand View	Brown, William H.*	Orangetown	Rockland.
Hammond	Finnegan, Mr	Hammond	St. Lawrence.
"	Foster, H. A	"	"

Directory of Quarrymen Producing Stone for Building Purposes — Sandstone — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Hammond	Parmeter, D. E	Hammond	St. Lawrence.
"	Stanley, W. H	"	"
Haverstraw	Demarest, P. E.†	Haverstraw	Rockland.
Higginsville		Verona	Oneida.
Highland	Clearwater, F. S	Lloyd	Ulster.
Himrods	Cheney, Louis A.*	Himrods	Yates.
Hindsburg	Baldwin & Hinds*	Murray	Orleans.
"	Burns, L. G.*	"	"
"	Chadwick Bros.*	Albion	"
"	Chadwick, Thomas, Jr.*	Murray	"
Holley	Downs & Bowman*	Clarendon	"
"	O'Brien & Co	Murray	"
Hornellsville	Cobb, J. F	Hornellsville	Steuben.
Hulburton	Cornwell, Lafayette	Murray	Orleans.
"	Fancher, Edward*	"	"
"	Ford, A. H.*	"	"
"	Gwynne, C. F.	"	"
"	Hamilton, Charles J.*	"	"
"	Hebner, Jno	"	"
"	Lardner, Thomas	"	"
"	Newsome, William*	Barre	"
"	Phillips, Marcus*	Murray	"
"	Squire, A. J	"	"

"	Sturaker & Sullivan	"	"
"	Von York, Constantin *	"	"
Ithaca	McClune, G C.†	Ithaca	Tompkins.
Jamestown	McVeigh, John	Ellicott	Chautauqua.
Keeseville	Hoag, Richard†	Chesterfield	Essex.
Kingston		Kingston	Ulster.
Kirkland		Kirkland	Oneida.
Kiskaton		Catskill	Greene.
Leeds		"	"
Lewiston	Hotchkiss, L. W.*	Lewiston	Niagara.
Little Falls	Casey, John*	Manheim	Herkimer.
Lockport	Spalding, William*	Lockport	Niagara.
"	Stanthorpe, C. N. & Co.	"	"
"	Whitmore, Charles†	"	"
Malden	Ulster Bluestone Co.*	Malden	Ulster.
Malone	Bashaw, Peter*	Malone	Franklin.
"	Morris, Antoni	"	"
"	Paddock, S. A	"	"
Medina	Garrett, Thos		
"	Gorman, Chas. A.*	Murr'y, Barre & Rdgw'y	Orleans.
"	Gorman & Stork*	Barre	"
"	Gotts & Stork *	"	"
"	Horan, Patrick	Ridgeway	"
"	Horan, Mrs. S. J.	"	"
"	Kearney & Barrett	"	"
"	McCormick, A. J	"	"
"	Mooney Bros	"	"
"	Noble & Lyle	"	"
"	O'Reilly, Bernard*	Murray	"
"	Scanlon, Martin*	Barre	"
"	Slack, Michael*	Holley	"

DIRECTORY OF QUARRYMEN PRODUCING STONE FOR BUILDING PURPOSES — SANDSTONE — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Medina	Stark, Jos.	Ridgeway	Orleans.
"	Wall, Wm. H., sup't Holloway quarries*	"	"
Middleburg	Bishop, Amberson†	Middleburg	Schoharie.
Monroe		Monroe	Orange.
New Baltimore	Matthews, Andrew†	New Baltimore	Greene.
"	Smith & McCabe	"	"
New Hartford		New Hartford	Oneida.
New Hudson	Searle, Mr.	New Hudson	Allegany.
North Cohocton	Whitney, Theo.*	Cohocton	Steuben.
Nyack	Puff, Nelson	Orangetown	Rockland.
"	Smith, Dan. F	"	"
Olean	Olean Bluestone Co.*	Olean	Cattaraugus.
Olive	Bogart, E. H.*	Olive	Ulster.
Oneonta		Oneonta	Otsego.
Oswego Falls	Faulkner, James	Granby	Oswego.
Oxford	Clarke, F. G. & Son*	Oxford	Chenango.
"	Walker, D. & Son	"	"
Palenville		Catskill	Greene.
Panama		Harmony	Chautauqua.
Penfield		Penfield	Monroe.
Penn Yan	Cornwell, Geo. R.†	Milo	Yates.
Portageville	Genesee Valley Bluestone Co.*	Genesee Falls	Wyoming.
Port Henry	Bond, L. W.*	Moriah	Essex.
Potsdam	Clarkson, A. (Secretary)	Potsdam	St. Lawrence.

“	Potsdam Red Sandstone Co	“	“
Rexford Flats	Benedict, Levi†	Niskayuna	Schenectady.
Rochester	Brady, Gilbert*	Albion	Orleans.
Rockville	Searle, Abram	Belfast	Allegany.
Rome		Rome	Oneida.
Saugerties	Burhans & Brainard*	Saugerties	Ulster.
Schenectady	Shear, Albert & Co	Niskayuna and Duanesburg	Schenectady.
“	Smith, Levi	Niskayuna	“
Shelby Basin	Le Valley, John *	Ridgeway	Orleans.
Smithville Flats		Smithville	Chenango.
South Berne	Bailey, David	Westerlo	Albany.
South Hammond	Stanley, W. H	Hammond	St. Lawrence.
Troy		Troy	Rensselaer.
Trumansburg	Biggs, D. S. & Sons*	Ulysses	Tompkins.
Utica	Conley, F. E.*	Verona	Oneida.
Verona		“	“
Warsaw	Warsaw Bluestone Co	Gainesville	Wyoming.
Washington Mills	Griffiths, Wm.*	New Hartford	Oneida.
“	Mallory, J. P	“	“
“	Thompson, E. F.†	“	“
“	Trimbey, H. J.*	“	“
Watkins	Higgins, D. H	Reading	Schuyler.
Watts Flats	Gould, Fred. H.*	Harmony	Chautauqua.
Waverly	Boget, M. L.*	Barton	Tioga.
“	Fleckenstine, J. W	?	“
“	Murray, John H	“	“
Westfield		Westfield	Chautauqua.
Whitehall.	McLaughlin, John	Whitehall	Washington.
Wolcott		Wolcott	Wayne.

HUDSON RIVER BLUESTONE.

H. B.: Sell to Hewitt Boice.
J. N. & Sons: Sell to James Nevins & Sons.
K. Bros.: Sell to Kirkpatrick Bros.

M. & R.: Sell to Many & Ross.
R. & T.: Sell to Roger & Tappen.

U. B. S. Co.: Sell to Ulster Bluestone Co.
W. E. S.: Sell to W. E. Scott.

Post-office.	NAME.		Location of Quarry. Town.	Location of Quarry. County.
ALBANY COUNTY.				
Reidsville	Brate, Chas		Berne	Albany
CHENANGO COUNTY.				
Oxford	Clarke, F. G., Bluestone Co		Oxford	Chenango
"	Walker, Melvin		"	"
Tyner	Loomis, Perry*		Smithville	"
DELAWARE COUNTY.				
Fish's Eddy	Mar'in, George.	*K. BROS.*	Denning	Ulster
"	McGreib, William.	"	"	"
"	Prothra, D. L.	"	"	"
"	Robinson, John.	"	"	"
"	Steib Brothers.	"	"	"
Hale's Eddy	Bagle & Labdell.	"	Tompkins	Delaware.
"	Cole, Fred.	"	"	"
"	Desselberger, A.	"	"	"
"	Doolittle, J. E.	"	"	"
"	Griffin, Pat.	"	"	"
"	Kennedy Brothers.	"	"	"
"	Kingsbury, O. M., & Co.	*W. E. S.*	"	"
"	Mazo & Beagle.	*K. BROS.*	"	"

"	Page, John J.	"	"	"
"	Palmatier & Beagle.	"	"	"
"	Thomas, E. E.	"	"	"
Hamden	Kenny, James.	*J. N. & SONS.*	Hamden	"
"	Merritt, J.	"	"	"
Hancock	Carner, George.	*K. BROS.*	Hancock	"
"	Christian, Byron	"	"	"
"	Cotter Brothers.	"	"	"
"	Kazenstein, George W.	"	"	"
"	Keery, Thomas, Jr.	"	"	"
"	Keery & Weiman.	"	"	"
"	Kirkpatrick Brothers.	"	"	"
"	Schaffer Brothers	"	"	"
Lordville	Adams, Jerry.	"	"	"
"	Chambers & Van Duzer.	"	"	"
"	Curry, John.	"	"	"
"	Denio, L.	"	"	"
"	Fisher, John.	"	"	"
"	Flemming, James.	"	"	"
"	Hinaman, T.	"	"	"
"	Holbert, F. R.	"	"	"
"	Lord, Jacob & Son.	"	"	"
"	Maich, B. & Co.	"	"	"
"	Roloson, A. J.	"	"	"
"	Roloson, F. L.	"	"	"
"	Smith, Frank.	"	"	"
Peakville	Kniffer, D		"	"
"	Merritt, Bros		"	"
"	Pothero, D. H		"	"
"	Pothero & Clark		"	"
"	Ressman, F. W.		"	"

Hudson River Bluestone — Delaware County — (*Continued*).

Post-office.	NAME.	Location of Quarry. Town.	County.
Peakville	Skinner & Buckley	Hancock	Delaware.
"	Staib Bros	"	"
"	Staib & Biffas	"	"
"	Upham, Geo	"	"
Rock Rift	Huntington, E	Tompkins	"
Stockport Station	Fitzpatrick & Burns. *K. BROS.*	Hancock	"
"	Lakin, Edgar "	"	"
"	Morse, J. & Co. "	"	"
"	Watson, L. "	"	"
Walton	Babcock & Morgan. *J. N. & SONS*	Walton	"
"	Babcock & Storie. *K. BROS*	"	"
"	Cash, J. *J. N. & SONS*	"	"
"	Davis, Joseph. *K. BROS*	"	"
"	Dunn, H. *J. N. &. SONS*	"	"
"	France & Bushnell. "	"	"
"	Gray & Marvin.* *J. N. & SONS AND K. BROS*	"	"
"	Merriott, John. *K. BROS*	"	"
"	Nevins, James & Sons	"	"
"	Robinson, Geo. C. *K. BROS*	"	"
"	Sheppard & Baxter. "	"	"
"	St. John, H. E. "	"	"
"	Terry & Robinson. *K. BROS. AND J. N. & SONS*	"	"

"	Wakeman, Ezra.	*K. BROS.*	"	"
"	Warner, G. T.	*W. E. S*	"	"
GREENE COUNTY.				
Palenville	Cook, Asa & Co.	*U. B. S. CO.*	Catskill	Greene
"	Dolan, John.	"	"	"
"	Hommel, Edward	"	"	"
"	Hungerford, Anthony.	"	"	"
"	Lamoree, Frank & Co.	"	"	"
"	Lasher, Fred.	"	"	"
"	Newkirk, Isaac.	"	"	"
"	Post, E & Co.	"	"	"
"	Stone, Sylvester.	"	"	"
"	Winne, James A.	"	"	"
"	Woloen, John H.	"	"	"
SCHOHARIE COUNTY.				
Hunter's Land	Lampman, Robert H.†		Berne	Albany.
SULLIVAN COUNTY.				
Callicoon	Benadim Bro.	*M. & R.*	Callicoon	Sullivan.
"	Lenihaus, A.*	"	"	"
"	Persbacker, Bros.	*K. BROS.*	"	"
"	Schmidt, N.	*M. & R*	"	"
"	Werlaw, John.	"	"	"
Callicoon Depot	Dering, John.*	"	"	"
"	Tyler, I.	"	"	"
"	Tyler & Dering.	"	"	"
Hankins	Bogart, I.	"	Fremont	"
"	Bohn Brothers.	"	"	"
"	Brustman, John.	"	"	"
"	Clark, Michael.	"	"	"

HUDSON RIVER BLUESTONE — SULLIVAN COUNTY — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Hankins	Conroy, James & Co. *M. & R.*	Fremont	Sullivan.
"	Decker, I. "	"	"
"	Henderson Bros. "	"	"
"	Homer, George. "	"	"
"	Kelley, John. "	"	"
"	Lacey & Crawfield. "	"	"
"	Manny & Ross	"	"
"	Mounty, P. & Sons. *M. & R.*	"	"
Long Eddy	Bellows & Ryan. "	"	"
"	Carrick Bros. *K. BROS*	"	"
"	Cuddie, J	"	"
"	Curran, J. *K. BROS*	"	"
"	Dunn & Co. "	"	"
"	Fritz, Fred. *M. & R*	"	"
"	Fritz, I	"	"
"	Hanstine, H. *M. & R*	"	"
"	Hanstine, J	"	"
"	Hughes & Co. *K. BROS*	"	"
"	Hughes & Sperback. *M. & R.*	"	"
"	Jenson, A. M. "	"	"
"	Jenson, H	"	"
"	Kern, John.* *M. & R*	Hancock	Delaware.
"	Kellam, B	"	"

"	Kellam, Wm. M. *M. & R.*	"	"
"	Kenney Bros. *W. E. S*	"	"
"	Miller, I	"	"
"	Miller, J. C. *M. & R*	Fremont	Sullivan.
"	Myers, C & Co. *K. BROS*	"	"
"	Peak, Cyrus.* *M. & R*	Hancock	Delaware.
"	Peak, Henry. "	"	"
"	Peak, William. *M. & R. & K. BROS.*	"	"
"	Rose, J. *M. & R*	"	"
"	Schuman, J. F. "	"	"
Narrowsburg	Engelman, Geo. W. *W. E. S*	Tusten	Sullivan.
Port Jervis	Terbell & Ridgeway	Forestburg	"
Rockland	Signor, Wm. & Son	Rockland	"
Roscoe	Baker & Stickle	"	"
"	Conner, H. C. *K. BROS*	"	"
"	Craft, Israel*	"	"
"	Gregg & Miller*	"	"
"	Kline, C	"	"
"	Sherwood & Stewart *	"	"
"	Supton & Tiffany *	"	"
"	Tiffany, R. H	"	"
"	Tindden, Jas	"	"
"	Youman, Wm.	"	"

Ulster County.

Allaben	McGregor, S. *H. B*	Shandaken	Ulster.
Brodhead	Bishop, E. "	Olive	"
"	Bishop, M. "	"	"
"	Cornish, W. "	"	"
"	Grambell, James "	"	"

Hudson River Bluestone — Ulster County — (*Continued*).

Post office.	NAME.		Location of Quarry.	
			Town.	County.
Brodhead	Hungerford, Alonzo.	*H. B.*	Olive	Ulster
"	Lyons, L.	"	"	"
"	Winn, Marshall	"	"	"
Glenford	Ballard, Sherman.	*R. & T.*	"	"
"	Brower, Edward.	"	"	"
"	Burlin, Wm.	"	"	"
"	Burton, H.	"	"	"
"	Castle, Wm.	"	"	"
"	Hicks & Cudney.	"	"	"
"	Hyatt, Clancy.	"	"	"
"	Johnson, Henry.	"	"	"
"	Krom, Wm.	"	"	"
"	Krum, Walter.	"	"	"
"	Lasher, Chas.	"	"	"
"	Martin, David.	"	"	"
"	Moore, John.	"	"	"
"	North, B.	"	"	"
"	Phillips, Rudolph.	"	"	"
"	Russell, John	"	"	"
"	Vallely, W. H.	"	"	"
"	Winnie, C.	"	"	"
"	Winters, Peter.	"	"	"
Hurley	Ostrander, Samuel.	*H. B.*	Hurley	"

Kingston	Beekman, Thomas.	"	Kingston	"
"	Britt, Deyo.	"	"	"
"	Burk, Bernard.	"	"	"
"	Thompson, Richard.	"	"	"
Lomontville	Bonkyonk, John.	"	Marbletown	"
"	Broadhead, L.	"	"	"
"	Broadhead, Wm.	"	"	"
"	Clearwater, James.	"	"	"
"	Clearwater, John.	"	"	"
"	Degraff, Charles.	"	"	"
"	Degraff, Edward.	"	"	"
"	Degraff, John H.	"	"	"
"	Degraff, John J.	"	"	"
"	Degraff, Matthew.	"	"	"
"	Degraff, Wm.	"	"	"
"	Dewitt, Jacob.	"	"	"
"	Dewitt, Wm	"	"	"
"	Duffy, Peter.	"	"	"
"	Dunn, John	"	"	"
"	Dunn, Patrick.	"	"	"
"	Elliott, Robert.	"	"	"
"	Emrich, Leir.	"	"	"
"	Guinn, E.	"	"	"
"	Gutches, William.	"	"	"
"	Johnson, Garret.	"	"	"
"	Jones, Spencer.	"	"	"
"	Mack, James.	"	"	"
"	Mack, Patrick.	"	"	"
"	Miller, Henry.	"	"	"
"	Pratt, Charles.	"	"	"
"	Robinson, Lewis.	"	"	"

Hudson River Bluestone — Ulster County — (*Continued*).

Post-office.	Name.	Location of Quarry.	
		Town.	County.
Lomontville	Rose, Andrew. *H. B.*	Marbletown	Ulster.
"	Sampson, A. "	"	"
"	Sampson, John. "	"	"
"	Sampson, Samuel D. "	"	"
"	Sampson, Thomas. "	"	"
"	Sampson, Thomas N. "	"	"
"	Sampson, William. "	"	"
"	Schryver, Edward. "	"	"
"	Schryver, Isaac. "	"	"
"	Terwilliger, T. "	"	"
"	West, Norman. "	"	"
"	Winchell, F. "	"	"
"	Winchell, Jno. "	"	"
"	Winchell, Jno. J. "	"	"
Marbletown	Bush, F. H. *R. & T.*	"	"
"	Clearwater, Jacob. "	"	"
"	Elliott, Robt. "	"	"
"	Eunist, Levi. "	"	"
"	Goutcheus, Wm. "	"	"
"	DeGraff, Wm. "	"	"
"	Jones, Squire. "	"	"
"	Mack, Patrick. "	"	"
"	Miller, Henry. "	"	"

"	Sampson Samuel.	"	"	"
"	Smith, Chas.	*H. B*	"	"
"	Terwillegher, C.	"	"	"
"	West, Norman.	"	"	"
"	Winchell, John J.	"	"	"
Mount Pleasant	Eighmey, I. B.	"	Shandaken	"
Olive	Chase, Charles.	"	Olive	"
"	Flower, A.	"	"	"
"	Flower, Wm.	"	"	"
"	Hogan, George.	"	"	"
"	Hogan, Luke.	"	"	"
"	Hughes, George.	"	"	"
"	Hughes, Oliver.	"	"	"
"	Pearson, Sidney.	"	"	"
"	Phillips, C.	"	"	"
"	Phillips, Frank.	"	"	"
"	Phillips, R. & Co.	"	"	"
Phœnicia	McGrath, John L.	"	Shandaken	"
"	Simpson, A. J.	"	"	"
Plattekill	Althiser, E.	"	Plattekill	"
"	Federkill, John.	"	"	"
"	Feter, Elijah.	"	"	"
"	Fratzer, F	"	"	"
"	Gallager, Philip.	"	"	"
"	Hart, Charles.	"	"	"
"	Hart, Henry.	"	"	"
"	Hickory, John.	"	"	"
"	Hiller, C.	"	"	"
"	Hollelight, A.	"	"	"
"	Lediger, Henry.	"	"	"
"	Longendyke & Co.	"	"	"

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry. Town.	Location of Quarry. County.
Plattekill	Low, Wesley.	*H. B*	Plattekill	Ulster.
"	Mehem, F. L.	"	"	"
"	Riece, Andrew.	"	"	"
"	Shaffer, Philip.	"	"	"
"	Sheffell, F. & Co.	"	"	"
"	Stauble, Charles.	"	"	"
"	Starker, M.	"	"	"
"	Stiger, Fred.	"	"	"
"	Teetsell, John.	"	"	"
"	Vedder, Charles.	"	"	"
"	Youngs, C.	"	"	"
Quarryville	Carnwright, Alphonso.	*U. B. S CO.*	Saugerties	"
"	Coughlan, John.	"	"	"
"	Farming, John.	"	"	"
"	Fiero, Myron & Co.	"	"	"
"	Fitzpatrick, Daniel.	"	"	"
"	Foley, Kearn.	"	"	"
"	Gray, Morgan.	"	"	"
"	Harvey, Cornelius & Co.	"	"	"
"	Kelley, Patrick K.	"	"	"
"	Mack, Peter.	"	"	"
"	McLaughlin, Charles.	"	"	"
"	Miller, Abram & Co.	"	"	"

"	Mower, John S.	"	"	"
"	O'Bryon, Samuel.	"	"	"
"	O'Rourke, John.	"	"	"
"	Quick, John A.	"	"	"
Sawkill	Bonsteel, Wm.	*H. B*	Kingston	"
"	Brink, Edward.	"	"	"
"	Brink, George.	"	"	"
"	Brophy, James.	"	"	"
"	Brophy, Wm.	"	"	"
"	Brown, F. Isaac.	"	"	"
"	Brown. Michael.	"	"	"
"	Burkins, Charles.	"	"	"
"	Burns, Bernard	"	"	"
"	Burns, Patrick.	"	"	"
"	Butler, Patrick.	"	"	"
"	Canine, Hiram.	"	"	"
"	Canty, Jno.	"	"	"
"	Canty, Matthew.	"	"	"
"	Canty, Thomas.	"	"	"
"	Carle, Alonzo.	*H. B. & R. & T.*	"	"
"	Carle, Henry.	*H. B*	"	"
"	Carney, Edward.	"	"	"
"	Cartwright, U. S.	"	"	"
"	Carr, James.	"	"	"
"	Carr, Richard.	"	"	"
"	Carroll, Henry.	"	"	"
"	Carroll, Jno.	"	"	"
"	Charleton, William.	*H. B & R. & T.*	"	"
"	Coudrey, Wm.	*H. B*	"	"
"	Crystal, Michael.	"	"	"
"	Donaldson, Hugh.	"	"	"

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry. Town.	Location of Quarry. County.
Sawkill	Draffen, Geo.	*R. & T*	Kingston	Ulster.
"	Draffen, Jno.	*H B*	"	"
"	Felter, Albert.	*H. B. & R. & T*	"	"
"	Fleming, R.	*H. B*	"	"
"	Gleason, Wm.	"	"	"
"	Glenon, Larry.	"	"	"
"	Haggerty, John.	"	"	"
"	Haggerty, Patrick.	"	"	"
"	Hanley, Dennis.	"	"	"
"	Hayes, Thos.	"	"	"
"	Henderson, Thos.	"	"	"
"	Hickey, Owen.	"	"	"
"	Hulsair, Victor.	"	"	"
"	Joy, Peter.	"	"	"
"	Kearney, Edward.	"	"	"
"	Kerr, James.	"	"	"
"	Leahey, James.	"	"	"
"	Leahey, Michael.	"	"	"
"	Leahey, O'Brien.	"	"	"
"	Leahey, Thomas.	"	"	"
"	Lynch, Michael.	"	"	"
"	Madigan, Chas.	"	"	"
"	Madigan, Edward.	"	"	"

"	Malone, James.	"	"	"
"	Maning, Patrick.	"	"	"
"	Masten, Samuel.	"	"	"
"	Mickens, Wm.	"	"	"
"	McCaffrey, Chas.	"	"	"
"	McCarty, John.	"	"	"
"	McDonald, L.	"	"	"
"	McGurrie, Christopher.	"	"	"
"	Murphy, John.	"	"	"
"	Murray, James.	"	"	"
"	Neenan, David.	"	"	"
"	Peppard, Michael.	"	"	"
"	Purdy, Daniel.	"	"	"
"	Rack, Wm.	"	"	"
"	Roach, Timothy.	"	"	"
"	Ryan, James.	"	"	"
"	Ryan, William.	"	"	"
"	Sheehan, Daniel.	"	"	"
"	Sheehan, Patrick.	"	"	"
"	Sheeley, Charles,	*H. B., R. & T.*	"	"
"	Stall, Morgan,	*H. B.*	"	"
"	Starr, John.	"	"	"
"	Sweeney, Chas.	"	"	"
"	Sweeney, Michael.	"	"	"
"	Walsh, Wm. & Co.	"	"	"
"	Watson, Adam.	"	"	"
Stone Ridge	Ballard Dewitt.	"	Marbletown	"
"	Barley, Edward.	"	"	"
"	Beatty, John.	"	"	"
"	Beatty, Marshall.	"	"	"
"	Bodily, David.	"	"	"

Hudson River Bluestone — Ulster County — (*Continued*).

Post-office.	NAME.		Location of Quarry.	
			Town.	County.
Stone Ridge	Boice, Benj.	*H. B.*	Marbletown	Ulster.
"	Burley, Benj.	"	"	"
"	Buryer, James.	"	"	"
"	Bush, Benj.	"	"	"
"	Bush, C. A.	"	"	"
"	Bush, Geo.	"	"	"
"	Bush, Henry.	"	"	"
"	Bush, Joseph.	"	"	"
"	Bush, Luther.	"	"	"
"	Bush, Thos.	"	"	"
"	Carson, Andrew.	"	"	"
"	Christanna, W.	"	"	"
"	Du Bois, William.	"	"	"
"	Freer, James.	"	"	"
"	Grimm, Jno.	"	"	"
"	Jones, Alfred.	"	"	"
"	Krum, E.	"	"	"
"	Krum, Geo.	"	"	"
"	Krum, Henry.	"	"	"
"	Krum, R.	"	"	"
"	Krum. S	"	"	"
"	Krum, Wm. & Co.	"	"	"
"	Lockwood, M.	"	"	"

“	Morey, Wm. A.	“	“	“
“	Osterhoudt, M.	“	“	“
“	Osterhoudt, Wm.	“	“	“
“	Ostrander, H.	“	“	“
“	Ostrander, Morris.	“	“	“
“	Palen, E.	“	“	“
“	Palen, J.	“	“	“
“	Palen, Lewis,	“	“	“
“	Palen, Theo.	“	“	“
“	Raymer, P.	“	“	“
“	Roosa, Geo.	“	“	“
“	Rosa, Aman	“	“	“
“	Rose, William.	“	“	“
“	Snidiger, Charles.	“	“	“
“	Snyder, Fred.	“	“	“
“	Strobridge, Geo.	“	“	“
“	Terwilliger, Jno.	“	“	“
“	Turner, C. C.	“	“	“
“	VanDermark, Gilbert	“	“	“
“	Van Dermark, L.	“	“	“
“	Van Hovenbergh, C.	“	“	“
“	Van Luerven, S.	“	“	“
“	Wager, Albert.	“	“	“
“	Wales, Wm. & Co.	“	“	“
“	Warner, Geo.	“	“	“
“	Whittaker, Wm. H.	“	“	“
“	Winchell, C.	“	“	“
“	Winchell, Geo.	“	“	“
“	Winchell, Wm.	“	“	“
“	Winnie, Geo.	“	“	“
“	Wood, Du Bois.	“	“	“

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry. Town.	Location of Quarry. County.
Stone Ridge	Wood, James.	*H. B.*	Marbletown	Ulster.
"	Woolsey, J. C.	"	"	"
Stony Hollow	Brophy, Michael.	"	Hurley	"
"	Burk, James.	"	"	"
"	Cassidy, Owen.	"	"	"
"	Cowley, Daniel.	"	"	"
"	Cunningham, C.	"	"	"
"	Doran, James.	"	"	"
"	Halloran, Daniel.	"	"	"
"	Hyland, James.	"	"	"
"	Muller, Thos.	"	"	"
"	Mulligan, Andrew.	"	"	"
"	Murphy, Michael.	"	"	"
"	Murtha, Michael.	"	"	"
"	Urall, James.	"	"	"
"	Urall, Patrick.	"	"	"
West Hurley	Ackerman, Julius.	*H. B. & R. T*	"	"
"	Angevine, George.	*H B.*	"	"
"	Angevine, Jacob.	"	"	"
"	Bahan, Patrick.	"	"	"
"	Bahan, William.	"	"	"
"	Baker, John G.	"	"	"
"	Baker, Orison.	"	"	"

"	Ballard, Jesse.	"	"	"
"	Ballard, Sherman.	"	"	"
"	Ballard, Wm. H.	"	"	"
"	Barber, Wm. H.	"	"	"
"	Berrian, A. & Co.,	*R. & T.*	"	"
"	Berryam, Henry.	*H. B*	"	"
"	Boice, Hewitt.	"	"	"
"	Boylon, F.	"	"	"
"	Brooks, John.	"	"	"
"	Bruce, David.	*H. B. & R. & T.*	"	"
"	Burling, John.	*H. B*	"	"
"	Cahill, James.	"	"	"
"	Carey, James.	"	"	"
"	Cassidy, Owen.	*R. & T.*	"	"
"	Chambers, Thomas.	*H. B*	"	"
"	Clancie, Wm.	"	"	"
"	Clark, Thomas.	*R. & T. & H. B.*	"	"
"	Cleary, Wm.	*H. B.*	"	"
"	Colpaugh, F.	"	"	"
"	Colvin, James.	"	"	"
"	Conlin, Thomas.	"	"	"
"	Connear, Robert.	"	"	"
"	Conners, Charles.*	"	"	"
"	Conners, John.	"	"	"
"	Conners, Joseph.	"	"	"
"	Conners, Samuel.	"	"	"
"	Conners, Thomas.	"	"	"
"	Conroy, Edward.	"	"	"
"	Conroy, Thomas.	"	"	"
"	Cotter, 'ohn.	"	"	"
"	Cotter, Wm.	"	"	"
"	Cowley, James.	"	"	"

Hudson River Bluestone — Ulster County — (*Continued*).

Post-office.	Name.		Location of Quarry. Town.	County.
West Hurley	Crosier, Hugh.	*H. B.*	Hurley	Ulster.
"	Cudney, Wm.	"	"	"
"	Cullen, James.	"	"	"
"	Cusack, Patrick.	"	"	"
"	Daley, Chas.	"	"	"
"	Davis, F.	"	"	"
"	Davis, James H.	"	"	"
"	De Vine, James.	"	"	"
"	Dimble, James.	"	"	"
"	Dolan, John.	"	"	"
"	Dolan, Patrick.	"	"	"
"	Douglas, G.	*R. & T.*	"	"
"	Douglas, L.	*H. B.*	"	"
"	Doyle, Jno.	"	"	"
"	Doyle, Timothy.	"	"	"
"	Du Bois, Robt.	"	"	"
"	Duel, C.	"	"	"
"	Duffy, Owen.	*H. B & R. & T.*	"	"
"	Duimond, Abram.	*H. B.*	"	"
"	Dummond Bros.	"	"	"
"	Durney, Patrick.	"	"	"
"	Duyer, William.	"	"	"
"	Eckert, James.	"	"	"

"	Eckert, Martin.	"	"	"
"	Elliot, Jno.	"	"	"
"	Ellsworth, Peter.	"	"	"
"	Eluyn, Geo.	"	"	"
"	Emrich, Chas.	"	"	"
"	Emrich, Isaac.	"	"	"
"	Emrich, James.	"	"	"
"	Everett & Co.	"	"	"
"	Fanning, Jno.	"	"	"
"	Farrell, Charles.	"	"	"
"	Finegan, Jno.	"	"	"
"	Finnigan, James.	"	"	"
"	Fitzgerald, M.	"	"	"
"	Fitzpatrick, Daniel.	"	"	"
"	Ford, Wm.	*R. & T. & H. B.*	"	"
"	Foster, Jno.	*H. B*	"	"
"	Gadd, Thos.	"	"	"
"	Goodwin, Jno.	"	"	"
"	Gorman, Thos.	"	"	"
"	Grant, Thomas.	"	"	"
"	Green, Alonzo.	*H. B. & R. & T.*	"	"
"	Green, James O.	*H. B*	"	"
"	Green, Wm.	"	"	"
"	Hale, Fred	"	"	"
"	Handrahan, Wm.	"	"	"
"	Hasbrook & Co.	"	"	"
"	Hendricks, George.	"	"	"
"	Hoffman, Barney.	"	"	"
"	Howard, James.	*H B. & R & T*	"	"
"	Hyatt, David.	*H. B.*	"	"
"	Hyland, James.	*R & T.*	"	"

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry.	
			Town.	County
West Hurley	Hyland, William.	*H. B*	Hurley	Ulster.
"	Hysen, James.	"	"	"
"	James & Co.	"	"	"
"	Jones, Charles.	"	"	"
"	Jones, Nathan.	"	"	"
"	Kelley, Crosby.	"	"	"
"	Kelley, Edward.	*H. B. & R. & T.*	"	"
"	Kelley, James.	*H. B.*	"	"
"	Kelley, Lawrence.	"	"	"
"	Kelley, Michael.	"	"	"
"	Kelley, Thomas.	"	"	"
"	Kilpatrick, John.	"	"	"
"	Kronser, Henry.	"	"	"
"	Lamb, Edward.	"	"	"
"	Lamb, James.	"	"	"
"	Landon, William.	"	"	"
"	Larkin, Thomas.	"	"	"
"	Leahey, James.	*R. & T*	"	"
"	Leahey, Thomas.	"	"	"
"	Lee, Walter.	*H. B.*	"	"
"	Lewis, Richard.	"	"	"
"	Linedes, Julius.	"	"	"
"	Long, John.	"	"	"

"	Madden, Michael.	"	"	"
"	Mahar, Peter.	"	"	"
"	Markle, Fred.	"	"	"
"	Markle, John.	"	"	"
"	Martin, David.	"	"	"
"	Martin, Jerry.	"	"	"
"	Mellon, Thos.	"	"	"
"	Miller, James.	"	"	"
"	Moran, Jno.	"	"	"
"	Moran & Smith.	"	"	"
"	McAuliffe, Thos.	"	"	"
"	McCalvey, Virgil.	"	"	"
"	McCann, M.	"	"	"
"	McCann, O.	"	"	"
"	McCarty, Jno.	*R & T*	"	"
"	McConnell, Jno.	*H. B*	"	"
"	McCullen, Jno.	"	"	"
"	McKeirnan, Edward.	"	"	"
"	McMahon, Patrick.	"	"	"
"	McMullen, C.	*H. B & R. & T*	"	"
"	McMullen, F.	*H B*	"	"
"	McMullen, Jacob.	"	"	"
"	McSpirit, H.	"	"	"
"	McWilliams, Jno.	"	"	"
"	Near, Hiram.	"	"	"
"	Neenan, Jno.	*R. & T*	"	"
"	Newberry, S.	*H. B*	"	"
"	O'Connell, Dennis.	"	"	"
"	O'Neill, James.	"	"	"
"	O'Neill, Jno.	"	"	"
"	O'Reardon, C.	*R. & T*	"	"

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry. Town.	Location of Quarry. County.
West Hurley	Osborn, Jno.	*H. B*	Hurley	Ulster.
"	Overbaugh, Benj.	"	"	"
"	Pierh, Robt.	"	"	"
"	Pierh, Thos.	"	"	"
"	Plass, Isaac.	*H. B. & R. & T.*	"	"
"	Plutzader, Jacob.	*H. B*	"	"
"	Purcell, Jno.	"	"	"
"	Quick, C.	"	"	"
"	Quick, William.	"	"	"
"	Rack, Wm.	*R. & T.*	"	"
"	Rice, Edward.	*H. B.*	"	"
"	Rice, Pat.	"	"	"
"	Riche, James & Co.	"	"	"
"	Rowe, Geo.	"	"	"
"	Rowe, Nicholas.	*H. B. & R. & T.*	"	"
"	Ryan, James.	*R. & T*	"	"
"	Saulpaugh, Daniel.	*H. B*	"	"
"	Schryver, John.	"	"	"
"	Scoville, Clinton.	"	"	"
"	Scribner, Geo.	*H. B. & R. & T.*	"	"
"	Scully, Joseph.	*H. B.*	"	"
"	Scully, Thomas.	"	"	"
"	Shader, Edward.	"	"	"

"	Shader, James.	"	"	"
"	Sheehan, John.	*R. & T.*	"	"
"	Sheehan, Robt. & Co.	*H. B.*	"	"
"	Smedes, Julius,	*H. B. & R. & T*	"	"
"	Smedes, Richard,	*H. B.*	"	"
"	Smedes, Rufus.	"	"	"
"	Smedes, Wm. H.	"	"	"
"	Snyder, Martin.	"	"	"
"	Spring, Fred.	"	"	"
"	Spring, John.	"	"	"
"	Stewart, Wm.	"	"	"
"	Sweeney, And.	"	"	"
"	Tain, Daniel.	"	"	"
"	Taylor, Wm.	"	"	"
"	Tobin, Michael.	*H. B. & R. & T.*	"	"
"	Toole Bros.	*H. B.*	"	"
"	Van Steenburgh, Isaac.	"	"	"
"	Van Steenburgh, Nathan.	"	"	"
"	Van Steenburgh, P. E.	"	"	"
"	Vaughn, John.	*R. & T.*	"	"
"	Van Velser, O.	*H. B*	"	"
"	Ward, Benj.	*H. B. & R. & T.*	"	"
"	Ward, George.	*H. B.*	"	"
"	Warren, Wm.	"	"	"
"	White, Michael.	"	"	"
"	White, Patrick.	"	"	"
"	Wolven, E.	"	"	"
"	Wolven, J. C.	"	"	"
"	Wolven, N.	"	"	"
"	Wolven, Richard.	"	"	"
West Saugerties	Carn, Jacob.	*U. B. S. CO*	Saugerties	"

HUDSON RIVER BLUESTONE - ULSTER COUNTY — (*Continued*).

Post-office.	NAME.		Location of Quarry.	
			Town.	County.
West Saugerties	Hommel, Abram.	*U. B. S. CO.*	Saugerties	Ulster.
"	Meyer, Wm. & Co.	"	"	"
"	Schoonmaker, Nelson & Co.	"	"	"
"	Snyder, Abram.	"	"	"
"	Vogel, Simon.	"	"	"
West Shokan	Boice, Lemuel.	*H. B.*	Olive	"
Wilbur	Osterhoudt, J		Kingston	"
"	Sweeney Bros		"	"
Woodstock	Bonsteel, Elliot	*H. B.*	Woodstock	"
"	Bonsteel, John.	"	"	"
"	Bonsteel, Luke.	"	"	"
"	Broner, Aaron.	"	"	"
"	Broner, Edward.	"	"	"
"	Broner, Howard.	"	"	"
"	Broner, Lewis.	"	"	"
"	Broner, Walter.	"	"	"
"	Burland, John.	"	"	"
"	Cashdollar, Wilbur.	"	"	"
"	Castle, John.	"	"	"
"	Degraff, O.	"	"	"
"	De Valley, Wm.	"	"	"
"	Elwyn, Larry.	"	"	"
"	Gray, Wallace.	"	"	"
"	Herrick, J L.	*H. B. & R. & T.*	"	"
"	Herrick, Judson.	*H. B.*	"	"

“	Johnson, Geo.	“	“	“
“	Johnson, Henry.	“	“	“
“	Jones, John L.	“	“	“
“	Kellyhouse, E.	“	“	“
“	Kittle, Hiram.	“	“	“
“	Lasher, Addison.	“	“	“
“	Lasher, Albert.	“	“	“
“	Lasher, C.	“	“	“
“	Lenox, Sherman.	“	“	“
“	Longyear, E.	“	“	“
“	Moner, Noah L.	“	“	“
“	Moore, Horace.	“	“	“
“	Ricks, Charles.	“	“	“
“	Russell, Geo.	“	“	“
“	Russell, H. & Co.	“	“	“
“	Russell, John.	“	“	“
“	Russell, Wm.	“	“	“
“	Schoonmaker, F.	“	“	“
“	Schoonmaker, Sanford.	“	“	“
“	Shultis, A.	“	“	“
“	Shultis, Hiram.	“	“	“
“	Shultis, William.	“	“	“
“	Smith, Charles.	“	“	“
“	Smith, Granville.	“	“	“
“	Smith, H.	“	“	“
“	Smith, Simon & Co.	*H. B. & R. & T.*	“	“
“	Sparling, F.	*H. B.*	“	“
“	Stoutenburgh L.	“	“	“
“	Stratton, Charles.	“	“	“
“	Van DeBogart, Rufus.	“	“	“
“	Van Etten, A. G.	*H. B. & R. & T.*	“	“

HUDSON RIVER BLUESTONE — ULSTER COUNTY — (*Concluded*).

Post-office.	NAME.		LOCATION OF QUARRY.	
			Town.	County.
Woodstock	Van Etten, Stephen.	*H. B*	Woodstock	Ulster.
"	Wallace, Wm.	"	"	"
"	Winters, Peter.	"	"	"
"	Yeary, Charles.	"	"	"
"	Yeary, Philip H.	"	"	"
"	Yeary, Stephen.	"	"	"

SLATE.

* Parties producing in 1894.   † Parties producing previous to 1894 now idle.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Granville	Reese, Owens & Co.	Granville	Washington.
"	Roberts, Eban J.	"	"
"	Williams, Wm. F. & Co	"	"
Hebron	Douglas, Mr	Hebron	"
Middle Granville	Eagle Red Slate Co. (Robert B. Pritchard, manager)*	Granville	"
"	Empire Red Slate Co.†	"	"
"	New Boston Red Slate Co. (A. T. Hughes, agent)*	Half mile from Middle Granville	"
"	New England Slate Co.		"
"	Nixon, L. G*	Granville	"
"	Pen Rhyn Slate Co.*	"	"
"	Williams, Hugh†	"	"
North Granville	Herbert, I. S.†	Whitehall	"
Salem	Kays, Hugh	Salem	"
"	Williams, John M., Valley View Slate Quarry.†	"	"
Shushan	Dobbin, Wm. A.†	Jackson	"
Troy	Baker Red Slate Co., No. 10 Hall building †	Granville	"
Whitehall	Hall, R. A.*	"	"

LIMESTONE AND MARBLE.

* Parties producing in 1894. † Parties producing previous to 1894 now idle. L. S: Limestone. M: Marble.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Amsterdam.	Austin, C. D	Amsterdam	Montgomery.
"	Hewitt, D. C.* *L. S.*	"	"
"	Van Derveer, T. B.* "	"	"
Auburn	Bennett, J. & Son.* "	Auburn	Cayuga.
"	Goodrich, L. S. & Son	"	"
Brasie Corners	Hall, R. G.* *L. S.*	Macomb	St. Lawrence.
Buffalo, 314 Broadway	Armbruster, Joseph	Buffalo	Erie.
" 110 Franklin street	Buffalo Cement Co. Lim.	"	"
" 480 Hamburg street	Consumer's Lime Co.* *L. S.*	Clarence	"
" 215 Oak street	Fogelsonger, D. R. & H	Amherst	"
" 187 LeRoy avenue	Gesl, John, Jr	Buffalo	"
" 2543 Main street	Kabel, Martin	"	"
" Cor. Huron and Oak sts.	Kehr, A. P. & Co.† *L. S.*	Clarence	"
" 124 Broadway	Williamsville Lime Co	Amherst	"
Brownsville	....	Brownsville	Jefferson.
Burlington, Vt	Burlington Mfg. Co.† *M*	Port Henry	Essex.
Canajoharie	Rapp, G.* *L. S.*	Canajoharie	Montgomery.
"	Shaper, A. E. "	"	"
Canton	Canton, Marble Co. Lim.* *M*	Canton	St. Lawrence.
Cassville	....	Cassville	Oneida.
Chaumont	Adams Bros	Chaumont	Jefferson.
"	Duford & Sons	"	"

Cherry Valley	....	Cherry Valley	Otsego.
Clarendon	Murphy, M	Clarendon	Orleans.
Clayton	Denney, Leander	Clayton	Jefferson.
Cobleskill	Brandenstein, John.* *L. S.*	Cobleskill	Schoharie.
"	Reilly, Wm.* "	"	"
Crown Point	....	Crown Point	Essex.
Dolgeville	Dodge, Alfred.* *L. S.*	Oppenheim	Fulton.
Dover Plains	Ketcham, Geo. W	Dover Plains	Dutchess.
"	Preston Quarries	"	"
Fayetteville	Ransier, Huestis B.* *L. S.*	Manlius	Onondaga.
Fort Edward	Harris, John F.* *L. S.*	Whitehall	Washington.
Fort Plain	....	Fort Plain	Montgomery.
Franklin Iron Works	Juhl, M.† *L. S.*	Augusta	Oneida.
Glens Falls	Glens Falls Co.* *L. S. & M.*	Queensbury	Warren.
"	Glens Falls Portland Cement Co	"	"
"	Jointa Lime Co.* *L. S*	"	"
"	Reynolds & Riordan.* *L. S.*	"	"
Gouverneur	Empire State Marble Co *M*	Gouverneur	St. Lawrence.
"	Gouverneur Marble Co.* *M*	"	"
"	Northern New York Marble Co.* *M.*	"	"
"	St. Lawrence Marble Co.* *M*	"	"
"	Whitney Marble Co *M*	"	"
Greenwich	Bennett, H. C.* *L. S.*	Greenwich	Washington.
Harrisville	Brady, Mary.† "	Diana	Lewis.
Hastings	....	Hastings	Westchester.
Holland Patent	Hillidge, James G.* *L. S.*	Trenton	Oneida.
Hoosick Falls	Carey, Wm.* "	Hoosick	Rensselaer.
"	Dolan, Jno.* "	"	"
"	McCaffery, Cornelius	"	"
Howe's Cave	Howe's Cave Association* *L. S*	Howe's Cave	Schoharie.
Hudson	Jones, F. W. *M*	Hudson	Columbia.

Limestone and Marble — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Jamesville	Alvord, E. B. & Co.* *L. S.*	DeWitt	Onondaga.
"	Burke & Burns	"	"
Johnson	House, S. M.* *L. S*	Wawayanda	Orange.
Jonesburg	Jones, Fred W.* *L. S.*	Greenport	Columbia.
Katsbaan	Valk & Beers.* "	Saugerties	Ulster.
Kingston	Donavan, D. E.	Kingston	"
"	Noone, Luke.† *L. S.*	"	"
"	O'Reilly, J	"	"
Le Roy	Holmes, Geo. D	Le Roy	Genesee.
"	Howell, Livingston D.* *L. S.*	"	"
"	Morris & Strobel.* *L. S.*	"	"
"	Pangrazio Bros.* "	"	"
"	Raymond & McGuire	"	"
Leyden	Auer, Melchior.* *L. S.*	Leyden	Lewis.
Little Falls	Jones, Hadley.† "	Manheim	Herkimer.
Lockport	Buffalo Stone Co	Lockport	Niagara.
"	Heary, M. F.* *L. S.*	"	"
"	Lockner, Wm. E.* *L. S.*	"	"
"	Lockport Stone Co.† "	"	"
"	Stainthrope, C. N. & Co	"	"
"	Tuohey, P. H.* *L. S.*	"	"
"	Watson, T. G.* "	"	"
"	Whitmore, Chas.† "	"	"

"	Wilson, John H.*	"	"	"
Lowville	Babcock, Wm. L.*	"	Lowville	Lewis.
"	Carter, L. H.*	"	"	"
"	Gowdy, Hiram		"	"
"	Lyman, M. M.*	*L. S.*	"	"
"	Waters, John M.*	"	"	"
Manlius	Loomis, Mr		Manlius	Onondaga.
Mapes Corners	Durland, Wilmot		Goshen	Orange.
Mendon			Mendon	Monroe.
Middle Falls	Bates, H. B.*	*L. S.*	Greenwich	Washington.
"	Grouty, Jas. M.*	"	"	"
Middleville	Mosher, W. W.*	"	Newport	Herkimer.
Newburgh	Brown Lime Co.*	"	Newburgh	Orange.
Newark, N. J	Sayre, James R., Jr., & Co.†	*L. S.*	Kingston	Ulster.
New Hamburg			New Hamburg	Dutchess.
New Lebanon			New Lebanon	Columbia.
Newport	O'Connor, Jno.*	*L. S.*	Newport	Herkimer.
"	Reynolds, Mr		"	"
"	Sherman, Waldo		"	"
New York city (157 Broadway)	Snowflake Marble Co.*	*M.*	Pleasantville	Westchester.
North Litchfield	Dixon & Lewis		Litchfield	Herkimer.
North Western	Van Dyke, Jno. H		Western	Oneida.
Norwich Corners	Ketchall, James, & Co		Litchfield	Herkimer.
Norwood (Box 126)	Hale, Geo. W.*	*L. S.*	Potsdam	St. Lawrence.
"	Murray, Robt		Norfolk	"
Ogdensburg	Howard, John F.*	*L. S.*	Oswegatchie	"
"	Nevin, Jno. H.*	"	"	"
Onondaga Castle	Kelley, John, Jr.*	"	Onondaga	Onondaga.
"	McElroy, P		"	"
Palatine Bridge	Frey, S. L. & A. B		Palatine	Montgomery.
"	Mohawk Valley Stone Co.*	*L. S*	"	"

LIMESTONE AND MARBLE — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Palatine Bridge	Sharpes & Johnson	Palatine	Montgomery.
Perryville	Britt, O. F.† L. S	Perryville	Madison.
"	Hodge, F. W	"	"
Phelps	Johnson, Wm. H.* *L. S*	Phelps	Ontario.
Plattsburg	Behan, Hugh.* "	Plattsburg	Clinton.
" (Box 504)	Robinson, Thomas.* "	"	"
Pleasantville Station	Cornell Lime Co.* *M.*	Mt. Pleasant	Westchester.
Poughkeepsie	Hufcut, H. D.† L. S.	Dover	Dutchess.
Prospect	Jones, H. & L. N.	One mile south of Prospect village	Oneida.
"	Thomas, Evan T.* *L. S.*	Trenton	"
Ravena	De Friest, W. W. D. H.* "	Coeymans	Albany.
"	Hotaling, David.† "	"	"
"	McCullock, Conrad.* "	"	"
"	Hughes, Wm * "	"	"
Rochester	Brown, Henry S.	Rochester	Monroe.
"	Foery & Kastner.* *L. S.*	"	"
"	Lauer & Hagaman.* "	"	"
"	Nellis, J. H.* "	"	"
"	Pike, R. E.	"	"
"	Smith, B. P.* *L. S*	Union Springs	Cayuga.
"	Whitmore, Rauber & Vicinus.* *L. S.*	Rochester	Monroe.
Rondout	Gross, F. W.† *L. S.*	Kingston	Ulster.

"	Newark Lime and Cement Co	Whiteport	"
Sandy Hill	Drake & Stratton Co. (Limited).* *L. S.*	Queensbury	Warren.
"	Sandy Hill Quarry	Sandy Hill	Washington.
"	Sturtevant, D.* *L. S*	South Glens Falls	Saratoga.
Saratoga Springs	Gorman, Michael	Milton	"
"	Lee, James A	"	"
"	Slade, Charles G	"	"
"	Wager, Isaac F.* *L. S*	"	"
Sauquoit	Thurston, W. W	Paris	Oneida.
Scarsdale	Bates Quarry	Scarsdale	Westchester.
Schoharie	Becker, Clinton L.* *L. S*	Schoharie	Schoharie.
"	Becker, David S	"	"
"	Brown, Albert.† *L. S.*	"	"
Seneca Falls	Fisher, John.* "	Fayette	Seneca.
Sharon Springs	Smith, Edwin J	Sharon	Schoharie.
"	Smith, Jefferson.† *L. S.*	"	"
"	Smith, W. T.* "	"	"
Smith's Landing	Massino, Wm.* "	Catskill	Greene.
South Bethlehem	Callanan, P. "	Bethlehem	Albany.
South Sodus	Thornton, Walter	Sodus	Wayne.
Split Rock	Connors, James.* *L. S*	Onondaga	Onondaga.
"	Crowley, Cornelius.* "	"	"
"	Hughes Bros	"	"
Springfield Center	McCabe, Mr	Springfield	Otsego.
" "	McDonough, Wm.* *L. S*	"	"
Syracuse	Hughes Bros.* "	Onondaga	Onondaga.
Three Mile Bay	Barron, Jno. J.* "	Lyme	Jefferson.
Thurman	Pelletier, Jno.† *M.*	Thurman	Warren.
Ticonderoga	Joubert, Israel.* *L. S.*	Bolton	"
Towners	Penny, P. D.† "	Patterson	Putnam.
Tremont	Hillman, Caleb. *M*	Tremont	New York.

LIMESTONE AND MARBLE — (*Concluded*).

Post-office.	NAME.	Location of Quarry. Town.	County.
Tribes Hill	Hurst, Henry & Son	Mohawk	Montgomery.
"	Shanahan, James.† *L. S.*	"	"
Troy	Cheney, W. E. & Son	Smith's Basin	Washington.
Tuckahoe	N. Y. Quarry Co.† *M.*	East Chester	Westchester.
"	Norcross Bros.* "	"	"
"	Tuckahoe Marble Co. "	"	"
Union Springs	Mosher, Daniel		
"	Smith & Wood.* *L. S.*	Springport	Cayuga.
Utica	Callahan, Ed.* "	Trenton	Oneida.
" 44 Washington st	George & Griffith.* "	"	"
"	Shaleto & Hoff	"	"
Verplank	Bleackley, Clarence L	Cortlandt	Westchester.
Waterloo	Emmet, John	Fayette	Seneca.
"	Thomas, Loren.* *L. S.*	"	"
Warwick	Burt, Thomas.* "	Warwick	Orange.
Watertown	City of Watertown quarry	?	Jefferson.
"	Cory & Fish	?	"
"	Gould & Enos quarry	?	"
"	Hunting, S. E.† *L. S.*	Pamelia	"
"	Phillips, Patrick	?	"
"	Williams, E	?	"
"	Williams, S	?	"
Waterville		Waterville	Oneida.

West Troy	Mark, George	Watervliet	Albany.
Whitehall	McLaughlin, Jno. *L. S*	Whitehall	Washington.
Wilbur	Sears, Alfred	Kingston	Ulster.
Williamsville	Young, J. S. & F. H	Williamsville	Erie.
Willsboro Point	Clark, Solomon W	Willsboro	Essex.
"	Frisbie, A. W.† *L. S*	"	"
Wolcott	Walker, Chas. J.† "	Butler	Wayne.

Clay.

The clay industries of New York have been exhaustively described in Bulletin No. 12 of the New York State Museum published this year and the reader is referred to that publication for a complete discussion of the subject.

The following brief extract from the above-mentioned bulletin will convey an idea of the condition of these industries.

The increasing value of clay for the manufacture of brick, tile, terra cotta, pottery, etc., and the ever growing demand for these products have given rise to an industry which is rapidly assuming vast proportions, and will in the near future become one of the most extensive and important in the country. Scattered over New York are extensive deposits of clay, many of them capable of being used for the manufacture of terra cotta, roofing tile and the coarser grades of pottery. To add to their value the most extensive beds of clay are situated in close proximity to the waterways and railroads which lead to the principal cities of the State. The commoner kinds of clay products, such as building brick, are marketed within the State, but the higher grades, such as terra cotta and roofing tile, have found good markets outside of New York.

The following table gives the receipts derived from the various branches of the clay industry during the year of 1892:

Building, front and paving brick	$8,500,000
Terra cotta	100,000
Sewer pipe	260,000
Fire brick*	50,000
Stoneware clay	10,000
	$8,920,000

* This does not include those manufactured in the State from clays obtained in other States.

As will be seen from the above statement bricks are the chief source of income. That the other branches of the clay industry are not further advanced is probably due in a large measure to the fact that the clay deposits of the State have been so little exploited or otherwise examined. Though many of the deposits have been opened up and are still being worked, there are numerous others scattered over the State which are still untouched. Few of the clays are found to be of sufficiently refractory character to be used for making fire brick, gas retorts, or other products which in use are subjected to a higher degree of heat; but for the manufacture of coarse pottery, terra cotta, paving brick, etc., many of the clays are eminently suited.

. Within the last seven or eight years the manufacturers in New York have turned their attention toward the extensive beds of argillaceous shale which the State contains, and which on trial nave given very satisfactory results. Several large firms are using them for the manufacture of sewer pipe, terra cotta paving brick and roofing tile. The shale formations at present used are the Salina, Hamilton and Chemung. The Hudson River shales are no doubt sufficiently argillaceous over many areas to be used for the manufacture of clay products, and the same may be said of the Niagara shale, which weathers to a red clay. A sample of this latter shale from Niagara Falls was first ground and then molded in a stiff mud machine and found to burn to a white brick, which was unaffected by a temperature of 2,500 degrees.

That the clays and shales of New York are comparatively undeveloped is, no doubt, largely due to the lack of knowledge of their extent and character. There seems, however, to be no reasonable doubt that they will in future become a valuable source of revenue.

GEOLOGY AND GEOGRAPHY OF THE CLAY DEPOSITS.

Deposits of clay occur in nearly every county of New York. They belong to three geological periods, namely:

'Quaternary, Tertiary and Cretaceous.

The clays of the first age are by far the most common. Those of the second are somewhat indefinite in extent, but they probably include a large number of the Long Island deposits. Of the third class there are undoubted representatives on Long Island and Staten Island, as well as some additional ones on Long Island, which are questionable.

The clays of the mainland are all Quaternary so far as known. The problems of the Quaternary formations in New York are by no means solved, and it is not always possible to decide on the causes leading to the deposition of any particular body of clay by a single visit to the locality.

A great majority of the deposits are local and basin-shaped, lying in the bottoms of valleys which are often broad and fertile. They vary in depth from four to 20 or even 50 feet; as a rule they are underlain by modified drift or by bed rock. The clay is generally of a blue color, the upper few feet being weathered mostly to red or yellow. Stratification is rarely present, but streaks of marl are common. In some of the beds small pebbles, usually of limestone, are found, and these have to be separated by special machinery in the process of manufacture. In many instances the clay is covered by a foot or more of peat.

The basin-shaped deposits are no doubt the sites of former ponds or lakes, formed in many instances by the damming up of valleys, which have been filled later with the sediment of the streams from the retreating ice sheet. The valleys in which these deposits lie are usually broad and shallow. The broad flat valley in which the Genesee river flows from Mt. Morris to Rochester is a good example. The waters of the river were backed up by the ice for a time, during which the valley was converted into a shallow lake in which a large amount of aluminous mud was deposited. This material has been employed for common brick.

There are a number of these deposits which are of sufficient interest, geologically as well as commercially, to be mentioned in some detail.

At Dunkirk is a bed of clay having a depth of over 20 feet. The upper six feet are yellow and of a sandy nature, while the lower two-thirds is blue and of much better quality. It is mentioned by Prof. Hall* in his report, and is an instructive example of the manner in which the clay changes in color, downward.

* Geology of New York, 4th District, 1843, p. 362.

Around Buffalo is an extensive series of flats underlain by a red clay. A thin layer of sand suitable for tempering overlies the clay in spots, and limestone pebbles are scattered through it. Similar deposits occur at several localities to the north of the Ridge road and around Niagara Falls, also at Tonawanda and La Salle, to the north of Buffalo, as well as south of it along the shore of Lake Erie. No doubt much of this clay was deposited during the former extension of the Great Lakes.

Prof. Hall mentions deposits of clay at the following localities: at Linden one mile south of Yates Center;* along the shore of Lake Ontario east of Lewiston; on Cashaqua creek † deposits of tenacious clay due to the crumbling of the argillaceous green shales; in Niagara county ‡ beds of clay are said to occur in every town, but they often contain a considerable amount of lime.

A bed of blue and red clay is being worked at Brighton near Rochester. This deposit lies near the head of Irondequoit bay and was deposited by some stream flowing into it. To the southeast of Rochester is a large esker which extends in a northeast direction nearly to Brighton. Mr. Upham, who has described this esker, considers that it was formed by a river which flowed between walls of ice and deposited the bed of clay above mentioned.*

Clays are also found at several points in the valley of the Oswego river from Syracuse to Oswego, an important one being at Three Rivers.

An extensive bed of red and gray clay, 20 acres in extent and horizontally stratified, occurs at Watertown. The deposit is 20 feet thick and rests on Trenton limestone.

Another deposit of considerable size is being worked at Ogdensburg. The clay is blue and has a depth of 60 feet.

In the southern portion of the State we find clays in abundance, in all the valleys, and lowlands. The extensive marshes near Randolph and Conewango are said to be underlain by clay throughout their entire extent.

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* Geology of New York, 4th District, 1843, p. 437.

† Ibid., p. 227.

‡ Ibid., p. 444.

At Levant, four miles east of Jamestown, Chautauqua county, is an interesting bed of blue clay underlying an area of several acres. It is probably of post-glacial age, and the section as determined by an artesian well-boring is:

Yellow sand	4		feet
Quicksand	...	4	inches
Yellow clay	5		feet
Blue clay	70		"
Hardpan	...		"
Total thickness	79	4	"

The owner of the clay bed states that leaves are often found between the layers of the clay at a depth of 15 or 20 feet.

At Breesport near Elmira is a bank of blue clay rising from the valley to a height of 50 feet. It was evidently formed when the valley was dammed up, and has subsequently been much eroded so that all that now remains is a narrow terrace along the side of the valley. A similar deposit is found at Newfield south of Ithaca. A moraine crosses the valley a mile or two south of it. Deposits of clay suitable for brick and tile occur extensively in the lowlands bordering the Mohawk river from Rome to Schenectady. The beds vary in thickness from six to 15 feet and are mostly of a red, blue, or gray color.

Among the most extensive and important clay formations occurring in New York are those of the Hudson valley. Here are deposits of two types. (1) Estuary deposits of fine stratified sand, yellow and blue clay, and (2) cross-bedded delta deposits, the materials of which are much coarser. The estuary deposits indicate a period of depression, and deposition in quiet water. The clay is chiefly blue, but where the overlying sand is wanting or is of slight thickness, it is weathered to yellow, this weathering often extending to a depth of 15 feet below the surface, and to a still greater depth along the line of fissures. The depth of oxidation is of course influenced by the nature of the clay; the upper portion weathering easily on account of its more sandy nature and hence looser texture.

Horizontal stratification is usually present, and the layers of clay are separated by extremely thin laminæ of sand. At some localities the layers of the clay are very thin and alternate with equally thin layers of sandy clay. This condition is found at Haverstraw, Croton, Dutchess Junction, Stony Point, Fishkill, Cornwall, New Windsor, Catskill and Port Ewen. At all of the above-mentioned localities except the last two, the clay is overlain by the delta deposits of rivers tributary to the Hudson, and the alternation of layers may be due to variations in the flow of the rivers emptying at those points, the sandy layers being deposited during period of floods. Isolated ice-scratched bowlders are not uncommonly found in the clay.

There is often a sharp line of division between the yellow weathered portion and the blue or unweathered part of the clay. The line of separation between the clay and overlying sand is also quite distinct in most cases. Of the blue and the yellow clay the former is the more plastic, but both effervesce readily with acid, due to the presence of three to six per cent. of carbonate of lime, and are therefore, properly speaking, marly clays. The clay is underlain by a bed of gravel, sand, hardpan, bowlder, till or bed rock. From Albany to Catskill the underlying material is a dark gray or black sand with pebbles of shale and quartz. The sand grains are chiefly of pulverized shale, the rest being silicious and calcareous with a few grains of feldspar and garnet. This sand can often be used for tempering, but at Catskill contains too much lime for this purpose,

From Catskill northward the clay is in most cases covered by but a foot or two of loam. South of Catskill the character of the overlying material varies.

The Clays of the Champlain Valley.

The clays of the Champlain valley are estuary formations and of the same age as the Hudson river clays. They underlie terraces along the lake which have been elevated to a height of 400 feet above the lake surface. These terraces may be traced almost continuously from Whitehall, at the head of Lake Champlain, to the northern end of the lake and beyond it, but on account of the extensive erosion which has taken place, they are usually narrow, and it is only at sheltered points, like Port Kent and Beauport, that they are specially prominent. The section involved is yellowish brown sand, yellowish brown clay and stiff blue clay, the latter being rather calcareous. The upper clay is somewhat silicious, and its coloring is due to the weathering of the lower layer. This formation has a thickness of about 15 feet, but sometimes, as at Burlington, it reaches a thickness of 100 feet. Isolated bowlders are occasionally found in the clays. The clays are usually horizontally stratified, and contortions of the layers are extremely rare. Numerous marine Quaternary fossils have been found in the overlying sands; the skeleton of a whale has also been found in them.

Openings have been made in these deposits for the purpose of obtaining brick clays at Plattsburg and a few other localities.

Long Island Clays.

Clay beds are exposed along the north shore of the island and at several points along the main line of the Long Island railroad.

There is still some doubt as to the exact conditions under which the beds of clay and gravel which form the greater portion of Long Island were deposited, but it is probable that the clays represent shallow water marine deposits of Cretaceous and Tertiary age. The overlying sands and gravels have in most instances a cross-bedded structure, with a south dip, and were probably deposited by swift currents as stated by Dr. Merrill.

The age of the clays is still largely a matter of speculation, and will probably remain so in many cases unless palæontologic evidence is forthcoming. Those on Gardiner's Island are quite recent, as shown by the contained fossils, and the clay on Little Neck, near Northport, is Cretaceous. The age of the Glen Cove clay is probably Cretaceous.

Cretaceous leaves in fragments of ferruginous sandstone have been found along the north shore of Long Island from Great Neck to Montauk Point,* but they are usually much worn and scratched and have evidently been transported from some distant source. The clays at Center Island, West Neck, Fresh

* A. Hollick, Notes on Geology of North Shore of Long Island, Trans. N. Y. Acad. Sci., XIII.

Pond and Fisher Island are very similar in appearance and composition, are very probably of the same age, possibly Tertiary, but we lack palæontologic or stratigraphic evidence. At West Neck the clay underlies the yellow gravel, and the latter is covered by the drift, so that is Pre-pleistocene.

The clays of Staten Island are chiefly Cretaceous, as proven by the fossils found in them. The chief outcrops are at Kreischerville, Green Ridge and Arrochar. Besides the clay there are several "kaolin" deposits.

DIRECTORY OF CLAY MANUFACTURERS.

Abbreviations used.

* Parties producing in 1894.
† Parties producing previous to 1894.
B. B.: Building Brick
C. B : Common Brick.
D. T.: Drain Tile.
E. W.: Earthen Ware.
F. B.: Fire Brick.
F. P.: Flower Pots.
H. B.: Hollow Brick.
O. B.: Ornamental Brick.
Pa B.: Paving Brick.
P. B : Pressed Brick.
R. B.: Roofing Brick. Local name for H. B.
R. T.: Roofing Tile.
S. B : Stock Brick. Good quality of B. B.
S. P.: Sewer Pipe.
T. C : Terra Cotta.

Post-office.	NAME.	Location of Clay Deposit — Town.	Location of Clay Deposit — County.
Albany	Ammenheuser, Gottfried.* *E. W. & F. P.*	Albany	Albany.
"	Babcock, J.* *C. B.*	"	"
"	Hunter, Alfred.* "	"	"
"	Jackson Bros.* *C. B., P. B., O. B., D. T.*	"	"
"	Moore, James C.* *C. B.*	"	"
"	Poutre, Antoine.* "	"	"
"	Rigney, Mrs T.	East Greenbush	Rensselaer.
"	Smith, Ed. J.* *C. B*	Albany	Albany.
"	Stanwix & McCarty.* "	"	"
"	Winne, John.† "	Niskayuna	Schenectady.
Albion	Lafler, Charles L.	?	Orleans.
Alfred	Celadon Terra Cotta Co. (Limited).* *T. C., R. T.*	Alfred	Allegany.
"	Rock Cut Clay Co.* *C. B., P. B*	"	"
Allen's Hill	Abbey, B. G.* *D. T.*	Richmond	Ontario.
Amenia	The Amenia Brick Co.	Amenia	Dutchess.

Amsterdam	Grieme, Henry C.* *C. B.*	Amsterdam	Montgomery.
"	Hart, Frank.† "	Florida	"
Angola	Lyth, John & Son.* *D. T. & B. B.*	Evans	Erie.
Arlington	Flagler & Allen.* *C. B. & P. B.*	Poughkeepsie	Dutchess.
"	Rose, H. R. Sons.* *C. P. & Pa. B.*	"	"
Athens	Porter, J. R.* *C. B*	Athens	Greene.
"	Porter, J. W.	"	"
"	Porter, S. E.	"	"
"	Rider, W. W	"	"
"	Smith, John	"	"
Auburn	Harvey, Fred. W.* *C. B*	Auburn	Cayuga.
Baldwinsville	Mahoning, John	Baldwinsville	Onondaga.
"	Seneca River Brick Co	"	"
Barrytown-on-Hudson	Donaldson, Wm. G	Barrytown	Dutchess.
Bealsburg	Gay, Robt	Maplewood	Monroe.
Big Flats	Lowe, J. R	Big Flats	Chemung.
Binghamton	Ogden Brick Co.* *C. B*	Binghamton.	Broome.
"	Wells & Brigham.* "	Union	"
Breesport	Empire State Pressed Brick Co	Horseheads	Chemung.
"	Locy Bros	"	"
"	Townsend, P. M. C	"	"
Buchanan	Oldfield, C. W. & R. W.* *C. B.*	Cortland	Westchester.
Buffalo	Adams Brick & Terra Cotta Co.† *C. B.*	Cheektowaga	Erie.
"	Berrick, Chas. & Sons	?	"
"	Black Rock Sewer Pipe Co		
"	Brush Bros.* *C. B., P. B., O. B., S. B.*	Buffalo	Erie.
"	Brush & Schmidt.* *C. B., P. B., . B.*	Aurora	"
"	Buffalo Sewer Pipe Co.* *S. P.*	Tonawanda	"
"	Dietschler, Henry	?	"
"	Haake, Fred W.* *C. B. & S. B*	Buffalo (East)	"
"	Hebert & Schusler	?	"

DIRECTORY OF CLAY MANUFACTURERS — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit. Town.	Location of Clay Deposit. County.
Buffalo	Holmes, John	?	Erie.
"	Kirkover, Louis	?	"
"	Lancaster Brick Co.* *C. B. & H. B.*	Lancaster	"
"	Richards, J. P.* *C. B. & D. T.*	Cheektowaga	"
"	Savage, Thos.* *D. T.*	Buffalo	"
"	Schusler & Co	?	"
Cambridge	Bronwell, Isaac W.† *C. B.*	White Creek	Washington.
Camillus	Bates, Wm	?	Onondaga.
"	Brameley, P	?	"
Canandaigua	Canandaigua Pressed Brick Works	?	Ontario.
"	Gleason & Sidway*	Canandaigua	"
"	Willys & Hollis.* *C. B. & D. T.*	"	"
Canastota	Ballou, G. F.† *C. B*	Canastota	Madison.
Canton	O'Brien, Luke.* "	Canton	St. Lawrence.
Carthage	Griggs & Co	?	Jefferson.
"	Houghton, Hiram.* *C. B. & D T*	Wilna	"
"	Wrape & Peck.* *C. B*	"	"
Carthage Landing	Meade Bros.* "	Wappinger	Dutchess.
Catskill	Derbyshire Brick Co		
"	Ferrier & Golden.* *C. B*	Catskill	Greene.
"	Washburn, Geo. W. & Co.* "	"	"

Chittenango	Central, N. Y. Drain Tile and Br. Co. *D. T.* *	Sullivan	Madison.
"	Dibble, J. C	"	"
Coeymans	Brower, J. A. & L. K	Coeymans	Albany.
"	Corwin & McCullough.* *C. B*	"	"
"	Fevlit, Henry	"	"
"	Hardrick & Walsh	"	"
"	Niles & Slingerland	"	"
"	Slingerland, H. & Co.* *C. B*	"	"
"	Sutton & Sudderly.* "	"	"
Cohoes	Baeby, J	Cohoes	"
"	Murray & Burkboy	"	"
"	Newton, A. H	"	"
Cold Spring Harbor	Jones, Dr. Oliver.† *C. B*	Huntington	Suffolk.
Corning	Corning Brick and Terra Cotta Co*. *C. B., P. B., O. B., F. B., Pa. B., T. C.*	Corning	Steuben.
Cornwall-on-Hudson	Hedges, C. A. & A. P.* *C. B*	Cornwall	Orange.
Cortland	Phillips, H. M.* "	Cortland	Cortland.
Coxsackie	Cooper & Bell		
"	Fitzgerald Sons, James.* *C. B.*	Coxsacki	Greene.
"	Noble, F. W. & A		
Coxsackie Station	Walsh Bros. & Co.* *C. B*	Stockport	Columbia.
Crescent	Newton, John B.* "	Halfmoon	Saratoga.
Croton Landing	Frost, Orrin		
Croton-on-Hudson	Anchor Brick Co.* *C. B*	Cortland	Westchester.
"	Croton Brick Co.* "	"	"
"	Morton, John.* "	"	"
"	Nickerson, P. W. & Co	"	"
"	Underhill Brick Co.* *C. B., R. B., O. B*	"	"
Crugers	Avery, Thos	"	"
"	Bushnell, Henry	"	"

DIRECTORY OF CLAY MANUFACTURERS — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit.	
		Town.	County.
Crugers	Carman, C	Cortland	Westchester.
"	Fisher, Adam	"	"
"	Fisher, W. H	"	"
"	Manning, J. H	"	"
"	Martin, John	"	"
Deerfield	Geo. F. Weaver's Sons.* *C. B*	Utica	Oneida.
Dolgeville	Kyser, A. C	?	Herkimer.
Dunkirk	Hilton, John.* *C. B*	Dunkirk	Chautauqua.
Dutchess Junction	Bontecou, Geo. H.* "	Fishkill	Dutchess.
"	Budd, W. D.* "	"	"
"	Covert Bros	"	"
"	Fishkill Brick Works	"	"
"	Fowler, Mr	"	"
"	Timoney, F	"	"
East Bethany	Peck, Richard.* *D. T. & B. B*	Bethany	Genesee.
East Greenbush	Dunn, Geo	East Greenbush	Rensselaer.
East Kingston	Brigham Bros	Ulster	Ulster.
"	Herrick, Wm. & Son.* *C. B*	"	"
"	Kerr, Geo. H	"	"
"	Manchester, D. S	"	"
"	Overbaugh, D. C	"	"
"	Rose & Co	"	"

"	Shultz, Chas. A	"	"
"	Staple, A. S	"	"
"	Streeter & Hendricks.* *C. B*	"	"
"	Terry Bros.* "	"	"
"	Washburn, J. T. & W. F	"	"
East Williston	Post, W. J.* *C. B*	New Hempstead	Queens.
Ellenville	Brady & Ryan	?	Ulster.
Elmira	Elmira Brick Co	Horseheads	Chemung.
"	Elmira Sewer Pipe and Fire Brick Co.	"	"
"	Empire Brick Manufacturing Co.* *C. B.*	"	"
"	Hayes, H. O. & Son	?	"
"	Weyer, J. Philip & Son.* *C. B., P., B., O. B., Pa. B. & T. C*	Elmira	"
Evans	Bolton, Wm.* *C. B*	Evans	Erie.
Farmingdale	The Queens County Brick Manufacturing Co.* *C. B*	Oyster Bay	Queens.
Fishkill	Dinan, Thos.* "	Fishkill	Dutchess.
"	Dinan & Butler	"	"
"	McClure & Co	"	"
"	McClean, Alex.† *C. B*	Catskill	Greene.
"	Page & Sherman	Fishkill	Dutchess.
Fishkill Landing	Dow, Geo.* *C. B*	"	"
"	Lahey, Wm.	"	"
Fishkill-on-the-Hudson	Aldridge Bros. & Co.* *C. B*	"	"
"	Brockway Brick Co.* "	"	"
"	Dennings Point Brick Co.* "	"	"
"	Ginley, James.* "	"	"
"	Lahey, Wm.* "	"	"
"	Page, John.* "	"	"
Florida	Vernon, M. H.* *C. B*	Goshen	Orange.
Fonda	Davenport, Wm.* *D. T.*	Fonda	Montgomery.

DIRECTORY OF CLAY MANUFACTURERS — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit. Town.	Location of Clay Deposit. County.
Fort Edward	Smith, Andrew.* *C. B.*	Fort Edward	Washington.
Fort Salonga	Longbothum, Geo. S.† "	Huntington	Suffolk.
Fulton	Fulton Fire Brick Co	......	......
Garden City	Garden City Brick Co.* *C. B., P. B., O. B.*	Oyster Bay	Queens.
Geneva	Baldwin, A. A.† *C. B., P. B., Pa. B.*	Geneva	Ontario.
"	Delamorter, Wm. F.† *C. B*	"	"
"	Dixon & Whitewell	"	"
"	Dove, W. G.* *C. B*	"	"
"	Geneva Brick Co.† *C. B, P. B., O. B., Pa. B. & D. T*	Waterloo	Seneca.
Glasco	Finger, Wm	Saugerties	Ulster.
"	Lent, Robert.* *C. B.*	"	"
"	Maginnis, Wm. & Son.* "	"	"
"	Porter, Wellington	"	"
"	Van Duzen & Co	"	"
"	Washburn Bros. & Co.* *C. B.*	"	"
Glens Falls	Glens Falls Brick Co.* "	Queensbury	Warren.
"	Glens Falls Terra Cotta & Brick Co.* *T. C., C. B., P. B., O. B*	Glens Falls	"
Gloversville	Eureka Pressed Brick Co.* *C. B*	Johnstown	Fulton.
"	McDuffie, Henry.* "	"	"
"	McDuffie & Golden	......	......

"	Stoutner, Wm.* *C. B*	Johnstown	Fulton.
Goshen	Goshen Brick Co.		
"	Van Leuven, Isaac.* *C. B*	Goshen	Orange.
Gouverneur	Smith & Anthony.* "	Gouverneur	St. Lawrence.
"	Thompson, G. R.	"	"
Grand Island	Stengel, J. F.* *C. B*	Grand Island	Erie.
Grassy Point	Brophy, Patrick.* "	Haverstraw	Rockland.
"	Carroll & Co	"	"
"	Crowley, R. & J. R	"	"
"	Farley & Barnes	"	"
"	Grimes, Frank.* *P. B*	"	"
"	Heittinger & Co	"	"
"	Kelley & Burns	"	"
"	Malley, Thos.*. *C. B*	"	"
"	Morrisey & Co	"	"
"	Washburn, W. F. & Co	"	"
Greenport	Long Island Brick Co.* *C. B*	Southold	Suffolk.
Green Ridge	Atlantic Brick Co	?	Richmond.
"	Kiernan & Monahan	?	"
"	McCabe Bros.† *B. B*	Westfield	"
"	Wood & Keenan	?	"
Haverstraw	Allison, B. J. & Co.* *C. B*	Haverstraw	Rockland.
"	Allison & Wood.* "	"	"
"	Allison, Wood & Keenan	"	"
"	Archer, M. A. Estate	"	"
"	Barney & Farley	"	"
"	Brennan, P. & Co	"	"
"	Buckley, Dunn & Co	"	"
"	Byrnes & Palmer	"	"
"	Cahill & Carroll	"	"
"	Christie, Henry & Son	"	"

DIRECTORY OF CLAY MANUFACTURERS — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit.	
		Town.	County.
Haverstraw	Clark & Goldrick	Haverstraw	Rockland.
"	Denton, Fowler & Son.* *C. B.*	"	"
"	Dunn, John & Co	"	"
"	Dolan, Dunn & Butler	"	"
"	Dolan, Jos. & Co	"	"
"	Donnelly, A. & Son	"	"
"	Excelsior Brick Co.* *C. B*	"	"
"	Felter, John W.* "	"	"
"	Fowler & Son	"	"
"	Frederick, Theo	"	"
"	Goldrich, Philip.* *C. B & P. B.*	"	"
"	Heittinger & Co.* *C. B.*	"	"
"	Johnson & Myers	"	"
"	Levy, O'Brien & Co	"	"
"	Lynch, Patrick & Sons	"	"
"	Malley, T	"	"
"	Marks, C. A. & Bros	"	"
"	McGowan & McGowan	"	"
"	McGuire & Lynch.* *C. B*	"	"
"	McGuire, T. & Son.* "	"	"
"	Murray & Morrisey	"	"
"	Peck, T. G. & G. H.* *C. B.*	"	"
"	Renn, E. N. & Co.* "	"	"

"	Riley & Farley	"	"
"	Rowan & Scott.* *C. B*	"	"
"	Shankey, Kelly & Renn	"	"
"	Shankey, T. & Son.* *C. B*	"	"
"	Sherwood, G. S.* "	"	"
"	Snedecker Bros.* "	"	"
"	Theodore, F	"	"
"	Washburn, W. F. & Co* *C. B. Pa., B., S. P., D. T., T. C., R. T., B. B*	"	"
"	Wood & Allison.* *C. B*	"	"
Herkimer	Mabbett, John J.* "	German Flats.	Herkimer.
Hermon	Frank, Nathan T.* "	DeKalb.	St. Lawrence.
"	Tillapaugh, E A.* "	"	"
Homer	Hall, Horace W.* "	Homer	Cortland.
"	Woodruff & Brown	"	"
Hoosick Falls	Dolan, John.† *B. B*	Hoosick	Rensselaer.
Hornellsville	Hornellsville Brick and Terra Cotta Co.	Hornellsville	Steuben.
"	Preston Brick Co.* *C. B., O. B., Pa. B.*	"	"
"	Signor Brick Co.* *C. B*	"	"
Horseheads	Horseheads Brick Yard.* "	Horseheads	Chemung.
"	Townsend, P. M. C.† *C. B. D. T.*	"	"
Hudson	Arkison Bros	Hudson	Columbia.
"	Bartlett, F. W	"	"
"	Fitzgerald, James & Sons	"	"
Huntington	Brown Bros	?	Suffolk.
"	Talcott, C	"	"
Ingham Mills	Keyes, A	"	Herkimer.
Ithaca	Campbell & Wood.* *C. B., P. B., Pa. B.*	Newfield	Tompkins.
"	Wilcox, Seth	....	....
Jamestown	Jamestown Shale Paving Brick Co.* *C. B & Pa. B*	Jamestown	Chautauqua.

DIRECTORY OF CLAY MANUFACTURERS — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit. Town.	Location of Clay Deposit. County.
Jamestown	Morley, C. A.	Jamestown	Chautauqua.
Johnson Creek	Parker, J. A.	?	Niagara.
Johnstown.	Kilmer, Robert	"	Fulton.
Jones Point	De Groat, James A.	"	Rockland.
Kingston	Fredericks, Franklin	Ulster	Ulster.
"	Hutton, William	"	"
"	Main, Robert	"	"
"	Overbury, S. B	"	"
Kirkville	Central City Brick Co.* *C. B., P. B., O. B.*	Kirkville	Onondaga.
Kreischerville	Kreischer Bros., New York Anderson Pressed Brick Co.† *P. B. & O. B.*	Westfield	Richmond.
Lancaster	Buffalo Star Brick Co.* *C. B.*	Lancaster	Erie.
"	Parker, J. W	...	...
Lansingburg	Morrisey Thos. F.* *C. B.*	Lansingburg	Rensselaer.
LaSalle	Tompkins & Smith.* "	Niagara	Niagara.
Levant	McCusker M. J. & Son.* *C. B., P. B. & D. T.*	Ellicott	Chautauqua.
Little Valley	Rink John.* *C. B.*	Little Valley	Cattaraugus.
Lockport	Mossell, Aaron.* "	Lockport	Niagara.
Madrid	Watson, R. B.* "	Madrid	St. Lawrence.
Malden	Cooney & Farrell.† "	Malden	Ulster.
Malone	Dumas, Alex, & Wm.† "	Malone	Franklin.

Massena Springs	Gibson H. S.* "	Norfolk	St. Lawrence.
Matteawan	Mosier, Platt	?	Dutchess.
Mayfield	Thompson, Ed	"	Fulton.
Mechanicville	Mechanicville Brick Co.* *C. B. & Pa. B*	Half Moon	Saratoga.
Middleburg	Underwood, A	?	Schoharie.
Middle Falls	Pullman, H	"	Washington.
Middle Granville	Pepper, J. H.* *C. B.*	Granville	"
Middletown	Robertson & Ridgeway	?	Orange.
"	Smith & Wood	"	"
"	Wheeler, O. B	"	"
Mohawk	Coe, Samuel E.* *C. B.*	German Flats	Herkimer.
Montrose	Bellefenelle, Edward.* "	Cortland	Westchester.
"	Bushnell, James F.* "	"	"
"	Cannon, C	"	"
"	Hyatt, Chester W	"	"
"	Montrose Point Brick Co	"	"
"	Peck, E. H. & W. J	"	"
Newburgh	Bourne, Clayton.* *C. B*	Wappingers	Dutchess.
"	Brewer, Warren	New Windsor	Orange.
"	Brown, W. R	"	"
"	Carson, David.† *C. B*	"	"
"	Christie, Mrs. E. L	"	"
"	Davidson Bros	"	"
"	Gillies, James M.* *C. B*	"	"
"	Jover, J. J	"	"
"	Lahey, William.* *C. B*	"	"
"	Lang, E.* "	"	"
"	Newburgh Tile Works	"	"
"	Walsh, E. A	"	"
"	Whitbeck, J. A	"	"

Directory of Clay Manufacturers — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit. Town.	County.
New Paltz	Lowe, Fred	?	Ulster.
"	New Paltz Brick Co	"	"
New York	Hammond, W. K.* *C. B*	Huntington	Suffolk.
Niagara Falls	Niagara Brick Co.* "	Lewiston	Niagara.
Northport	Brodsky, Isaac.* "	Huntington	Suffolk.
"	Sammis, R.* "	"	"
Oakfield	Drake, George L.* *D. T.*	Oakfield	Genesee.
Ogdensburg	Paige Bros	Ogdensburg	St. Lawrence.
Olean	McMurray, J. C. & A	?	Cattaraugus.
Oneida	Hall, F. L	"	Madison.
Oneonta	Crandall & Marble	Oneonta	Otsego.
"	Denton, J. H. & Son	"	"
Oswego Falls	Edgarton, W. D.* *C. B*	Granby	Oswego.
"	Fletcher, A. B.* "	"	"
Owasco	Lester, Alfred.* *P. B. & D. T.*	Owasco	Cayuga.
Oyster Bay	Dunn, Dolan & Co.* *C. B*	Oyster Bay	Queens.
Peekskill	Bonner Brick Co.* "	Cortland	Westchester.
"	Carman, Charles	"	"
"	Cole & Bonner.* *C. B*	"	"
"	Travis, Cyrus.* "	"	"
Plattsburg	Gilliland & Day.* "	Plattsburg	Clinton.
	Vaughn, Chas. W.* "	"	"
Port Ewen	Kline, Jacob.* "	Esopus	Ulster.

"	Port Ewen Brick Co	"	"
Port Jefferson	Lillis, Johanna.* *C. B., P. B., F. B*	Brookhaven	Suffolk.
Poughkeepsie	Caire, Adam.* *F. P*	Poughkeepsie	Dutchess.
"	Fishkill Brick Works.* *C. B.*	Fishkill	"
Randolph	Turner, J	....	....
Raymondsville	Coats, Wm.* *C. B*	Norfolk	St. Lawrence.
Rochester	New York Hydraulic Pressed Brick Co.* *P. B. & O. B*	Canandaigua	Ontario.
"	Otis, Gorsline* *S. P*	Brighton	Monroe.
"	Rochester Brick and Tile Manufacturing Co.* *C. B., Pa. B., D. T., B B.*	"	"
"	Rochester German Brick and Tile Co.* *C. B*	" and Chili	"
"	Rochester Sewer Pipe Co	"	"
R man	Gotham, John	?	Jefferson.
"	Whitney, Mrs. E. D	"	"
Rome	Parry, Watkyn W.† *C. B*	Rome	Oneida.
Romulus	Yerkes, J. M. & Son.* *C. B. & D. T*	Romulus	Seneca.
Rondout	Cooney, John J	....	....
"	Course, Henry	?	Ulster.
"	Coykendall, S. D.* *C. B.*	Esopus	"
"	Everburgh, D. C.	Kingston	"
"	Staples, A. S.* *C. B*	"	"
"	Terry Bros.* "	"	"
Roseton	Jova Brick Works.* "	Roseton	Orange.
"	Rose, J. C	"	"
Sag Harbor	Sag Harbor Brick Co. (Limited).* *C. B.*	Southampton	Suffolk.
Sangerfield	Corse, H	Sangerfield	Oneida.
"	Haven, P. B. & Son.* *C. B*	"	"

Directory of Clay Manufacturers — (*Continued*).

Post-office.	NAME.	Location of Clay Deposit. Town.	County.
Saratoga Springs	Davidson, David.* *C. B. & Pa. B*	Greenfield	Saratoga.
"	Williams, Chauncey L.* *C. B., O. B. & Pa. B*	"	
Saugerties	Porter, Wellington	Saugerties	Ulster.
Schenectady	Case, Sherman A † *C. B.*	Glenville	Schenectady.
Seneca Castle	Childs, A. S.* *D. T.*	Seneca	Ontario.
Schodack Landing	Brousseau, Ed.	Stuyvesant	Columbia.
Skaneateles	Webber, F	?	Onondaga.
Southampton	Graham, Wm. T	"	Suffolk.
South Bay	Stephens, Clinton	"	"
Southold	Sanford, C. L.* *C. B*	Southold	"
South Plattsburg	McCarty, James.* "	Plattsburg	Clinton.
South Trenton	Garrett, Henry L.* "	Trenton	Oneida.
Spencer	Spencer Brick Co.* "	Spencer	Tioga.
Spring Brook	Northrup, E. B	?	Erie.
Springville	Churchill, A. C	?	"
Stanley	Preston, Wm.* *C. B. & D. T*	Gorham	Ontario.
St. Johnsville	Smith, J. S	St. Johnsville	Montgomery.
Stockport	Washburn & Barnes	?	Columbia.
Stony Point	Farley & Barnes	....	....
"	Marks & Meehan.* *C. B*	Stony Point	Rockland.
"	Reilly & Clark.* "	"	"
"	Reilly & Rose.* "	"	"

Storm King	Mosher Bros.† "	Fishkill	Dutchess.
Syracuse	Ballard, Robert	?	Onondaga.
"	Brophy, John * *C. B.*	Salina	"
"	Brown Brick Co	?	"
"	Callaway, E. H	?	"
"	Central City Brick Co.* *P. B. & O. B.*	Manlius	"
"	Central New York Drain Tile and Brick Co.* *D. T.*	Chittenango	Madison.
"	Kennedy, Frank	?	Onondaga.
"	Merrick, C. & L.* *C. B., P. B., B. B. H. B.*	Dewitt	"
"	New York Brick and Paving Co.* *C. B. & Pa. B.*	Clay	"
"	Nolan, Timothy	?	"
"	Peck, Geo. W. & Son	?	"
"	Preston, Patrick	?	"
"	Syracuse Pressed Brick Co.* *C. B. & P. B.*	Onondaga	"
Thiells	Felter & Mather	Haverstraw	Rockland.
Throopsville	Laden, John	?	Cayuga.
Tomkins Cove	McGuire, T. C.* C. B	Haverstraw	Rockland.
"	Rodemond, R. & Co	"	"
Tonawanda	Riesterer, M. & Son.* *C. B.*	Tonawanda	Erie.
Troy	Dennis, John	....	....
"	Ferguson, Alex.* *C. B., S. B., B. B.*	Troy	Rensselaer.
"	Ostrander Fire-Brick Co.* *F. B*	Westfield	Richmond.
"	Painton, C. R	....	....
"	Roberts, J	....	....
Utica	Callahan & Doyle.* *C. B., P. B. & O. B.*	Marcy	Oneida.
"	Central New York Pottery	?	"

DIRECTORY OF CLAY MANUFACTURERS — (*Concluded*).

Post-office.	NAME.	Location of Clay Deposit. Town.	Location of Clay Deposit. County.
Utica	Utica Brick Works	?	Oneida.
"	White, N. A. & Co	?	"
"	Wiley, Wm	?	"
Verplank	Avery & Mackey	Verplank	Westchester.
"	King & Lynch.* *C. B.*	"	"
"	Mackey, Robert	"	"
"	Mackey, Wm	"	"
"	McGuire, B. G	"	"
"	O'Brien, Philip	"	"
"	O'Brien, McConnon & Vaughey.* *C B*	Fishkill	Dutchess.
Warners	Onondaga Vitrified Brick Co.* *C. B., P. B., Pa. B., D. T., B. B*	Van Buren	Onondaga.
Warsaw	Cheeney, J	?	Wyoming.
Waterloo	Whartenby, Alex.* *D. T*	Waterloo and Fayette	Seneca.
"	Whiteside, M	"	"
Watertown	Watertown Pressed Brick Co.* *C. B., P. B, O. B*	Pamelia	Jefferson.
West Bloomfield	Webb, Geo. N.* *D. T*	West Bloomfield	Ontario.
West Haverstraw	Hurley, John F.* *C. B*	Stony Point	Rockland.
West Troy	Tupper, H. D.* "	Watervliet	Albany.
"	Wiswall, E. S	"	"
Whitehall	Adams, Jeremiah.* *C. B*	Whitehall	Washington.
"	Culbertson, D. & Co	"	"

Lime and Cement.

Lime is produced throughout the State on the outcrops of the Calciferous, Trenton, Niagara and Helderberg limestones. Some of the chief localities are Glens Falls, Howe's Cave, Rochester, Buffalo, Sing Sing, Pleasantville and Tuckahoe. Hydraulic cement or water lime is chiefly produced from beds of hydraulic limestone in the Water lime group at the base of the lower Helderberg. Rondout and Rosendale, Howe's Cave and the vicinity of Syracuse are important commercially in this product. At Akron and Buffalo much water lime is made, but from a lower formation, probably the Salina Group.

Portland cement is made from marl and clay at Warner's near Syracuse, and at Wayland, Steuben county; from lime and clay near Glens Falls and at other points.

Limestone for Flux.

In the present depressed condition of the manufacture of iron in New York, the production of limestone for flux is but a small industry.

DIRECTORY OF PRODUCERS OF LIME AND CEMENT.

* Parties producing in 1894. † Parties producing previous to 1894, now idle. L, Lime. C. Cement.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Accord	Baker, A. G	Rochester	Ulster.
"	Baker, John A	"	"
"	Baker, Simon	"	"
"	Christiana, Nelson	"	"
"	Gordon, Eugene	"	"
"	Myers, A	"	"
Akron	Akron Cement Co	Newstead	Erie.
"	Jebs Cement Works	"	"
"	Newman, H. L. & W. C.* *C*	"	"
" (General office, Buffalo.)	The Cummings Cement Co. *C*	"	"
Albion	Johnson, B	Barre	Orleans.
"	Staines, Charles	"	"
"	Staines, Henry	"	"
"	Staines, Thomas F.* *L*	"	"
Amsterdam	Hewitt, D. C.* *L*	Amsterdam	Montgomery.
"	Wilber, C	"	"
Batavia	Heintz, John & Sons	Batavia	Genesee.
"	Merrill, John.* *L*	"	"
Bellona	Alexander, John	Benton	Yates.
"	Scott, D. M	"	"
Bigelow	Williams, Chas. & Co.* *L*	De Kalb	St. Lawrence.
Boonville	Lee, Albert J.* *L*	Boonville	Oneida.

Brasie Corners	Fleming, Walter.* L	Macomb	St. Lawrence.
"	Hall, Robert G.* L	"	"
"	Tully, Richard	"	"
Buffalo, 200 Main street	The Cummings Cement Co.* C	Newstead	Erie.
" 480 Hamburg street	Straub, Peter G.* L	Clarence	"
Canajoharie	Allen, Wm. L	Canajoharie	Montgomery.
Canandaigua	Brown, G.* L	Canandaigua	Ontario.
"	Wells, John.* L	"	"
Catskill	Palmer, H. P.* L	Catskill	Greene.
Chaumont	Capley Bros.* L	Lyme	Jefferson.
Chazy	Chazy Marble Lime Co. (C. H. Jones, general manager).* L	Chazy	Clinton.
"	Goss, L. M.* L	"	"
Cherry Valley	Bastian, Wm.* L	Cherry Valley	Otsego.
"	Eldridge, O. H.* L	"	"
Chittenango Falls	Keeler, Chas.† L. & C	Fenner	Madison.
Climax	Day, John	Coxsackie	Greene.
Cobleskill	Baard, Frank.* L	Cobleskill	Schoharie.
Collinsville	Jones, Hugh D.* L	West Turin	Lewis.
"	Williams, B. B.* L	"	"
Columbia	Manning, A	Columbia	Herkimer.
Coxsackie	Day, Ambrose.* L	Coxsackie	Greene.
Cranberry Creek	Kegg, Willard.* L	Northampton	Fulton.
Crary's Mills	Church, Ashley.* L	Potsdam	St. Lawrence.
East Penfield	Hanson, W	Penfield	Monroe.
East Pitcairn	Van Patten, F. A.* L	Pitcairn	St. Lawrence.
Ellenville	Sheley, C. N.* L	Wawarsing	Ulster.
Fayetteville	Bangs & Gaynor.* C	Manlius	Onondaga.
"	Sheedy, Thos. W.* C	"	"
Glens Falls	Glens Falls Co.* L	Queensbury	Warren.
"	Jointa Lime Co.* L	"	"

DIRECTORY OF PRODUCERS OF LIME AND CEMENT — (*Continued*).

Post-office.	NAME.	Location of Quarry. Town.	County.
Glens Fallls	Morgan Lime Co.* *L.*	Moreau	Saratoga.
"	Sherman Lime Co.* *L.*	Queensbury	Warren.
"	Glens Falls Portland Cement Co	"	"
Gloversville	Mayfield Lime Co.* *L.*	Mayfield	Fulton.
Gouverneur	Abbot, J. B.* *L.*	Gouverneur	St. Lawrence.
"	Potter, Chas. A.* *L.*	Fowler	"
"	Wright, H. J.* *L.*	"	"
Hailsboro	Patten, Chas	"	"
Harris Hill	Fiegle, August.* *L.*	Clarence	Erie.
Harrisville	Brady, Mary.† *L*	Diana	Lewis.
Hayts Corners	Yarnell, E. J.† *L.*	Romulus	Seneca.
Hart Lot	Carrigan, P C.*	Skaneateles	Onondaga.
Hickory	Ingram, Vilas.* *L.*	Macomb	St. Lawrence.
"	Perin, William.* *L.*	"	"
Howe's Cave	Howe's Cave Association.* *L. & C.*	Cobleskill	Schoharie.
"	Howe's Cave Lime and Cement Co.* *L. & C.*	Howe's Cave	"
Ingham Mills	Butler, Sherman	Manheim	Herkimer.
Jamesville	Alvord, E. B. & Co.* *L. & C.*	De Witt and Lafayette.	Onondaga.
"	Dunlap, R. & Co	De Witt	"
Joy	Horn & Burcroff	Sodus	Wayne.
Kattsbaan	Fiero, William.* *L.*	Saugerties	Ulster.
Kerhonkson	Gordon, E. H.* *L.*	Rochester	"

Le Roy	Heinlich, John.* *L.*	Le Roy	Genesee.
Lincoln	Shorte, Fred.	Walworth	Wayne.
Lowville	Waters, John M.* *L.*	Lowville	Lewis.
Manlius	Behan's, James, Estate.* *L. & C.*	Manlius	Onondaga.
"	Brown Cement Co	"	"
Marbletown	Davenport, Solomon	Marbletown	Ulster.
Marcellus	Malley, William	Marcellus	Onondaga.
Marcellus Falls	Sherman, J. N.* *C.*	"	"
Mayfield	Dennie Bros	Mayfield	Fulton.
"	Warner, S. B.* *L.*	"	"
Mettacahonts	Gray, Steph n.*	Rochester	Ulster.
Middle Falls	Bates, H. B.* *L.*	Greenwich	Washington.
"	Cepperly & Hegeman	"	"
"	Cipperly, Jno	"	"
Millgrove	Shoff, B. O.	Alden	Erie.
Mohawk, Box 21	Humphrey, Jay W.* *L.*	Columbia	Herkimer.
Monroe	Cross, Jno	Monroe	Orange.
Munnsville	Bassett, W. H.* *L.*	Stockbridge	Madison.
Napanoch	Young & Humphrey	Wawarsing	Ulster.
Natural Bridge	Ashcraft, F. E.† *L.*	Diana	Lewis.
"	Hall, E. & W.* "	Wilna	Jefferson.
"	Loveless, E. J	"	"
Newburgh	The Brown Lime Co.* *L.*	Newburgh	Orange.
Newcomb	Anderson & Maynehan.* "	Newcomb	Essex.
New York	Duryee Portland Cement Co.† *C.*	Montezuma	Cayuga.
"	Newark & Rosendale Lime and Cement Co.* *L. & C.*	Whiteport	Ulster.
"	O'Connell & Hillery*. *L.*	Tuckahoe	Westchester.
Niagara Falls	Messing, Bernard.* "	Niagara	Niagara.
North Litchfield	Davies, Albert R.* "	Litchfield	Herkimer.
"	Dickson, Chas.† "	"	"

DIRECTORY OF PRODUCERS OF LIME AND CEMENT — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
North Litchfield	Holland, Geo. E.* *L.*	Litchfield	Herkimer.
"	Salisbury, John E.* "	"	"
North Tonawanda	Calkins & Co	Tonawanda	Erie.
North Western	Vale, Jno. D.* *L.*	Western	Oneida.
Norwich Corners	Thurston, W. W	Litchfield	Herkimer.
Ogdensburg	Howard, John F.* *L.*	Oswegatchie	St. Lawrence.
Oriskany Falls	Putnam & Clark	Augusta	Oneida.
Perryville	Hodge, Fred	Sullivan	Madison.
"	Worlock, Cyrus.* *L. & C.*	"	"
Pine Island	Brown, B. T.† *L.*	Warwick	Orange.
"	Elston, Chas	"	"
Plattsburg	Pray, G. W.†	Peru	Clinton.
Pleasant Valley	Russell, Evert.* *L.*	Pleasant Valley	Dutchess.
Prospect	Talcott, Chas. L.* *L.*	Russia	Herkimer.
"	Thomas, E. T. (agent).* *L.*	Trenton	Oneida
Ravena	Day, Abraham	Coeymans	Albany.
Redwood	McDonald, Felix	Alexandria	Jefferson.
"	McDonald, John	"	"
Rochester	Hurd Lime Kiln	Rochester	Monroe.
"	May, Mr	"	"
"	Nellis, J. H.* *L.*	"	"
"	Neuman, R. G.* *L.*	Gates	"
"	Snow, John, estate	"	"

Rockton	Austin, C. D	Amsterdam	Montgomery.
Rondout	Lawrence Cement Co.* *C.*	Kingston	Ulster.
"	New York & Rosendale Cement Co.* *C.*	Rosendale	"
Rossie	O'Brien, John.* *L.*	Rossie	St. Lawrence.
Saratoga Springs	Leonard, Patrick	Milton	Saratoga.
"	Wing's, Prince, estate.* *L.*	"	"
Schoharie	Brown, Albert.† *C.*	Schoharie	Schoharie.
Seneca Falls	Fisher, John.* *L.*	Fayette	Seneca.
Sharon Springs	Smith, Henry S.* *L*	Sharon	Schoharie.
Shelby	Simonds, E. B.† *L.*	Shelby	Orleans.
Sing Sing	Sing Sing Lime Co	Ossining	Westchester.
Smith's Basin	Keenan Lime Co.* *L.*	Kingsbury	Washington.
"	Nichols, D. & Son.* *L.*	Hartford	"
Sodus	Horton, Mr	Sodus	Wayne.
Sodus Center	Mather, E. B. & Co.* *L.*	"	"
"	Munn, Gardner A.* *L.*	"	"
South Greenfield	Wing, Elihu.* *L.*	Milton	Saratoga.
St. Johnsville	Smith, Albert H.* *L.*	St. Johnsville	Montgomery.
Stone Ridge	Bastere, John	Marbletown	Ulster
"	Davenport, Solomon	"	"
"	Sahler, James D	"	"
Syracuse	Alvord, A. E.* *L. & C.*	Manlius	Onondaga.
"	Britton & Clark.* *L.*	Onondaga	"
"	Solvay Process Co.* *L.*	"	"
Thurso	Miller, Tob & Son	Clayton	Jefferson.
Troy	Cheney, W. E. & Son.* *L.*	Smith's Basin	Washington.
Union Springs	Shalebo, J. L.†	Springport	Cayuga.
Upper Jay	Fuller, H. C	Jay	Essex.
Valley Mills	Dexter, C. W	Stockbridge	Madison.
Walworth	Hall, W. L	Walworth	Wayne.
"	Mann, Owen.* *L.*	"	"

DIRECTORY OF PRODUCERS OF LIME AND CEMENT — (*Continued*).

Post-office.	NAME.	Location of Quarry.	
		Town.	County,
Walworth	Read, John.* *L*	Walworth	Wayne.
Warners	Empire Portland Cement Co.* *C*	Camillus	Onondaga.
Watertown	Cory, Henry S.* *L*	LeRay	Jefferson.
Wawarsing	Hornbeck, Chas. H.	Wawarsing	Ulster.
Webster	Hanson, Wm.	Webster	Monroe.
West Walworth	Wooster, Hiram O	Walworth	Wayne.
West Winfield	Bradley, A. P.* *L*	Winfield	Herkimer.
Whitfield	Barley, Albert.* *L*	Rochester	Ulster.
"	Dixon, Benj. C.* *L*	"	"
Wolcott	Post, Alonzo.† *L*	Butler	Wayne.
"	Walker, Chas. J.† *L*	"	"
Wolcottsville	Luckman, Wm. J.* *L*	Royalton	Niagara.

Millstones.

Millstones for grinding paint, feed, cement and other purposes are quarried from the Oneida conglomerate in Ulster county in the townships of Rochester and Wawarsing. The demand is said to be increasing yearly and during 1894 is said to have amounted to about $100,000.

The following is a list of the parties now quarrying millstones in this region:

DIRECTORY OF PRODUCERS OF MILLSTONES.

* Parties producing in 1894.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Accord	Brodhead & Roosa *	Rochester	Ulster.
"	Rose, W. H.*	"	"
Granite	Van Etten, James S.*	"	"
Kerhonkson	Davis, J. P.*	Wawarsing.	"
"	Van Dover, William	"	"
Kyserike	Harnden, T. C.*	Rochester	"
"	Krom, William H	"	"
"	Lawrence, Daniel	"	"
"	Lawrence, George	"	"

Marl.

This material is found in many places throughout the State. Dutchess, Columbia, Orange, Ulster, Greene and Albany counties have many small deposits; in central and western New York there are large deposits in Onondaga and Madison counties, particularly in the Cowaselon swamp; it is also found in Cayuga, Wayne, Seneca, Ontario, Monroe, Genesee and Niagara counties.

It is a deposit formed in standing water and consists chiefly of carbonate of lime. It is largely used as a fertilizer, but is also employed in the manufacture of Portland cement as at Warners, Onondaga county, by the Empire Portland Cement Co., at Montezuma and at Wayland, Steuben county, by Millen & Co.

Iron Ores.

The iron ores of New York have been carefully studied and described by Prof. J. C. Smock, who has published his results in Bulletin No. 7 of the New York State Museum and by Mr. Bayard F. Putnam who contributed an article on this subject to the volume on Mining Industries (No. XV) in the report of the Tenth Census. These two important papers taken together give a most complete review of the sources of iron in New York. Our knowledge of the Adirondack ores is supplemented by the work of Prof. J. F. Kemp, which is contained in Bulletin No. 13 of the New York State Museum, entitled the Geology of Moriah and Westport townships. The localities of all the principal mines are shown on the economic map. The following is a brief extract from Prof. Smock's bulletin.

IRON ORES OF NEW YORK.

By John C. Smock, revised by F. J. H. Merrill.

The ores of iron, which occur in beds and deposits of workable size in the State of New York, may be classified, according to their chemical composition, into oxides and carbonates of iron, and these classes may be subdivided, following the mineralogical characters, into the several species and varieties. The following tabular arrangement shows the natural grouping of species in these two great divisions:

Chemical Groups.		Mineralogical Species and Common Names.	
Oxides	Anhydrous Ferric Oxide. Sesquioxide of iron.	Hematite	Red Hematite. Specular Ore. Clinton Ore.— Fossil ore. Red Ochre.
	Ferric and Ferrous Oxides. Proto-sesquioxide of iron.	Magnetite	Magnetic Iron Ore. Titaniferous Iron Ore.
	Hydrated Ferric Oxide. Sesquioxide of iron.	Limonite	Brown Hematite. Brown Ochre. Bog Iron Ore.
Carbonates	Ferrous Carbonate. Carbonate of Iron.	Siderite Spathic Iron ore	Carbonate Ore. Clay Iron Stone. "White Horse."

A general law of occurrence of iron ores is that certain ore species occur in, or are characteristic of, definite geological horizons. For example, the magnetic iron ores are found in the crystalline rock areas of the Precambrian; the red hematite appears to mark the Huronian; the fossil ore, the limonite or brown hematite are found in the Palæozoic rocks; and the carbonate and the bog iron ore in the more recent formations of Tertiary and Post Tertiary ages. There are, as might be expected, many exceptions; but in the greater number of these apparently exceptional cases, the surface alteration, due to weathering or other atmospheric agencies, explains the occurrence.

This relation between the geological formation and the mineralogical species or *kinds* of iron ore indicates the areas in which they may occur, and determines roughly their limits. Hence, a geological map of the State shows approximately correct boundaries of the several iron-ore districts, and is, as it were, an iron mines map. The geology of a county or district gives the clue in searching for ore; and its importance can not be too strongly stated, both as a guide, suggesting exploration, and warning against unnecessary and fruitless surveys and wasteful outlays of time and money. Thus, for example, the magnetites belong in the crystalline rock districts, and the search for them in the later, sedimentary rocks of the adjacent territory would be a hopeless task; or, again, the exploration of the Highlands or Adirondacks, for carbonate ores, would be equally unscientific and destitute of good results.

The geological formations, which are characterized as definite ore horizons, become the basis of a natural arrangement of the ore districts of the State. They are well marked geographically also.

Following this geologico-geographical arrangement, the groups and iron-ore districts are:

I. The Highlands of the Hudson.— Magnetic Iron Ores.
II. The Adirondack Region, Including the Lake Champlain Mine.— Magnetic Iron Ores.
III. The Hematites of Jefferson and St. Lawrence Counties.
IV. The Clinton or Fossil Ores.
V. The Limonites of Dutchess and Columbia Counties.
VI. The Limonites of Staten Island.
VII. The Carbonate Ores of the Hudson River.

A few isolated mines can not be thus classified, as the hematite near Canterbury, Orange county, Ackerman's mine near Unionville, Westchester county, the Napanock and Wawarsing mines, in Ulster county, the hematite of Mt. Defiance in Ticonderoga, and the bog iron ores, which are scattered in all of the great divisions of the State. The iron sands of the shores of Long Island are left out, as not properly a natural source of iron.

I. The Highlands of the Hudson. — Magnetic Iron Ores.

Magnetite is one of the common minerals in the crystalline rock region of the Highlands. It occurs as an accessory constituent in the granitic and gneissic strata; and by itself, forms beds of considerable extent and thickness. Accordingly as it is more or less free from foreign minerals it is rich or lean, varying from the pure magnetic iron ore to rock with traces only of iron in its mineralogical composition. The beds of ore show lamination and are faulted, folded and contorted as the inclosing strata of rock, and have the same general strike and dip in common with the latter. They are generally of irregular form, in places widening into thick deposits or lenticular shaped masses, in others contracted in thin sheets, which are not mined profitably. The ore is found in some cases to separate into thin layers, and masses of rock ("horses") are met with entirely surrounded by the ore. The phases of variation are as many almost as there are mines, where they can be studied. In the larger and older mines the ore has been followed for thousands of feet in the line of strike or on the course of the ore, and for hundreds of feet in depth (on the line of dip) without reaching its limits. Owing to the unprofitable nature of working so thin ore beds, they are often not followed to the end, and the real extent of few of these ore deposits is known. In general, it may be stated that in this region the ore beds stand nearly on edge and have a northeast and southwest strike and a descent or dip at a steep angle to the southeast. In consequence of their highly inclined position and their irregular shape these ore bodies are called "veins," less frequently "chimneys" and "shoots" of ore.

The magnetic iron ore has not been found distributed uniformly throughout the Highlands. There appear to be certain ore *ranges* or belts in which the larger and more productive mines are opened. There are mine groups also, as the Sterling Iron and Railway Company's mines, the Greenwood mines, in Orange county; the Todd-Croft and Sunk mines, and the Croton-Brewster ranges in Putnam county. The boundaries of these ore-bearing belts and the intermediate barren territory have not been determined, since the exploration has been largely made by individual effort and without any general plan covering the whole area. It is probable that a geological survey of the Highlands would enable us to trace the limits of an iron-bearing group, as has been indicated by the surveys of the New Jersey Highlands.*

* See "Ann. Report of the State Geologist for the year 1886." Trenton, 1887, pp. 82–85.

Mines have been opened in Orange, Rockland, Westchester and Putnam counties in this iron ore district and from the New Jersey line at the southwest to the Connecticut boundary on the east. Their locations are shown on the map which accompanies this report. Some of the largest and most productive mines in Orange county have been worked more than a century.* This county was famous for its iron manufacture during the Revolutionary war.† The greatest development of the iron mines in Putnam county has been since the opening of the Tilly Foster and Mahopac mines or during the last twenty-five years. The distance from public lines of transportation, the increased cost of working the smaller "veins" at greater depths, the low prices for iron ore and the competition with the richer ores of other parts of our country have necessitated the suspension of work in some of the mines and led to the permanent abandonment of those most unfavorably situated. Of the 40 separate mines which have been ore producers, 10 only were in operation during a part or the whole of the year 1888. Their aggregate output for that year amounted to 114,000 gross tons. The ores of the Highlands district are the hard, crystalline magnetites. They are generally rich, free from titanium, but contain a slight excess of phosphorus above the limit for the manufacture of Bessemer iron, excepting the Mahopac and Tilly Foster mines, which have yielded a large amount of Bessemer ore, and a few small mines but which are no longer worked.

II. The Adirondack Region, Including the Lake Champlain Mines.— Magnetic Iron Ores.

The Adirondack region, the great mountain plateau of northern New York, is bounded by the valleys of Lake Champlain on the east, of the St. Lawrence river on the north and northwest, of Black river on the west, and the Mohawk on the south. It occupies nearly all of Warren, Hamilton and Essex counties, the western and southern parts of Clinton, the southern parts of Franklin and St. Lawrence, the eastern part of Jefferson and Lewis, the northern towns of Oneida, Herkimer, Hamilton and

* Ore was discovered on the Sterling tract as early as 1750; the Forest of Dean mine was opened about the same time.

† See "History of the Manufacture of Iron in all ages," by James M. Swank, Philadelphia, 1884, pp. 102–106.

Saratoga, and the northwest corner of Washington counties. Its area has been estimated to be at least 10,000 square miles. Dr. Emmons, in his survey of the Second Geological District, decribed the rock formation of this territory as gneisses and hypersthene rock principally; and the former he regarded as the prevailing rock, excepting in a large triangular area in Essex county, where the outcropping rocks are hypersthene.*

The so-called "hypersthene rocks" of Dr. Emmons consist of labradorite and pyroxene or labradorite with hypersthene and some pyroxene, and hence are often designated as a Labrador series. In an article on the "Laurentian Magnetic Iron Ore Deposits in Northern New York," Charles E. Hall has grouped the magnetites in three series, or horizons; the lowest, the Laurentian magnetites; second, the Laurentian sulphurous ores; and highest, the Labrador group with its titaniferous ores.†

Magnetite is one of the common minerals in the Adirondacks, and is widely distributed, both as a constituent or accessory mineral in rocks, and in beds of workable extent. Mines have been opened in all parts of the region, but the greatest development has been in the valley of Lake Champlain, and hence the ores are known in the market as Lake Champlain ores. In it are the famous Port Henry mines and others. The Chateaugay range can not be said to lie in the Champlain valley. Therefore the grouping by geological rather than by geographical lines alone, is more definite, and the larger district of the Adirondacks is better than any subdivisions according to our present knowledge. It is a notable fact that nearly all of the mines are on the borders, and that comparatively few ore localities have been found in the interior of it. A reference to the map of the State, with this report, shows the location of the mines and mine groups. The explanation of their distribution is the greater accessibility of the outer part of the region to lines of transportation and its more thorough exploration. Prospecting for iron ore in the forested and more distant interior is difficult, and besides, is not stimulated by any hope of adequate return, excepting in case of large deposits which, from their extent and character of ore, might warrant the construction of branch railway lines, as at Chateaugay, Clifton, Jay-

* EMMONS: Survey of the Second Geological District, Albany, 1842, pp. 27-33 and 75-78.

† Thirty-second Annual Report, N. Y. State Museum, pp. 133-140.

ville and Little River. Future explorations will, doubtless, discover many iron-ore beds, and result in the devolopment of other mining centers in what now appears as barren ore-territory. The construction of additional railways, affording facilities for reaching the markets, will do much to open and develop new mines.

The titaniferous nature of the magnetites, which have been found in the Labrador series, as for example, at Splitrock, in Westport, and at Adirondack, in the town of Newcomb, Essex county, has retarded mining in the localities where they occur.

The difficulty and expense of reducing the ores containing considerable titanium, and the failures in the way of practically separating the titanic minerals from the magnetite, have shut them out of the iron-ore market, and the mines having such ores only have been idle for years. That all the magnetic iron ore occurring in this geological horizon is alike titaniferous does not appear to be proven by the comparatively few ores analyzed from limited areas; and there is hope that ores sufficiently low in titanium for successful working may be found.*

The strike or course of the iron-ore beds in so large a district is affected by all the local variations in the positions of the inclosing strata. In general, the direction is northeast and southwest. The dip is also at all angles, varying from a horizontal to a vertical Much further study of the geological structure is needed to explain the features which the mines have exposed to view. The immense deposits at Port Henry mines, the many separate beds of the Crown Point mines, the dikes and faults at Palmer Hill, the parellel shoots of the Arnold Hill mine, the bends and faults at Chateaugay are interesting features for study.

The magnetite, as it occurs in the Adirondack region, varies much in the degree of crystallization, in texture and color. In the Port Henry mines it is, as a rule, rather coarsely crystalline and lustrous black. At Palmer Hill and at Arnold Hill martite a hematite crystallizing as magnetite, appears to replace the latter mineral. The titaniferous ores are noted for their hardness, dull black fracture surfaces and general fineness of grain. In the nature of the associated minerals also, there is much variation. The more commonly occurring rock constituents are found everywhere. Apatite, also, is a common associate, as in some

* Mr. James McNaughton of Albany, one of the owners of the McIntyre tract, reports (Sept. 1895) that he has succeeded in smelting the titaniferous ores hitherto regarded as useless.

of the ore at the Port Henry mines. In general, the iron ores of this region average high in the percentage of metallic iron, especially the non-Bessemer ores; and on account of their richness, the Port Henry magnetites are widely known and esteemed. Bessemer ores are obtained in quantity at Crown Point, in the western range at Mineville (Port Henry), at Chateaugay, and at other localities, given in the notes of mines, further on in this report.

The beginnings of iron-ore mining in the Lake Champlain valley were early in the present century. Some of the forges were in operation in 1801 and 1802, and they were run upon the ores in their vicinity.* But the output was small, in the aggregate a few thousands of tons. The rapid increase was after 1840. In 1868 the town of Moriah, Essex county, produced 230,000 tons. The tenth census reported 742,865 tons from all of the mines in the Adirondack region. In 1888 the output was 182,000 gross tons, of which 418,000 tons came from the Port Henry mines. In the course of the last 10 years a notable change has been in the suspension of work at the mines which supplied the ores for the forges, or bloomaries. All of the bloomaries are idle, excepting those belonging to the J. & J. Rogers Iron Company and the Chateaugay Ore and Iron Company. The mines away from railway or lake navigation lines have all been closed. The capacity of production in the few mines which are in operation has been increased greatly by their better equipment and improved facilities for sending their ores to market. Another characteristic of the region is the great size of some of the ore beds. The great sheet, as it were, opened in the Chateaugay slopes, the thick beds or shoots of ore at Mineville (Port Henry), the great outcrops at Adirondack and the ridge of lean ore at Little River, are almost inexhaustible, and, with the advent of practicable, concentrating processes, all of them can produce cheap ores and compete with other iron-ore districts of the country.

The following chapter by Prof. J. F. Kemp gives the latest information on the titaniferous magnetites near Lake Sandford and Lake Henderson:

These great ore-bodies have claims to general interest, not alone from their size and geological relations, but also because they

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* SWANK: "History of the Manufacture of Iron in All Ages," Philadelphia, 1888, p. 106.

were the basis of an iron industry that was begun about 1840 and continued until 1858. They are situated near and on both sides of Lakes Sandford and Henderson, at the headwaters of the Hudson river, in Newcomb township, Essex county. They lie well within the great Norian area of the Adirondacks, Mt. Marcy being nearly due east eight or ten miles, Mt. McIntyre six miles northeast and the Indian Pass due north. Santanoni lies west and other minor peaks are near. Crystalline limestone outcrops about five miles southwest on Lake Newcomb. The country rock at most of the ore-bodies is the coarsely crystalline, dark blue labradorite rock or "anorthosite," characteristic of the Adirondacks. At the Millpond opening, where the walls are well exposed, it is perfectly massive and shows none of the crushing that is so marked a feature of the usual outcrops. Elsewhere garnets are sometimes met and a very little hypersthene. At the Cheney opening the walls, called "sienite" by Emmons, are a gneissoid gabbro. The greatest ore-body of all is the Sandford. This is exposed in a hillside a mile west of Lake Sandford, where an open cut shows a breast of about 20 feet of dense, black magnetite, with no walls apparent. A strong belt of attraction has been traced from this point to and across Lake Sandford. Emmons describes in his Report on the Second District, 1842 (p. 249), several sections across this bed that were exposed by costeaning ditches. They showed a maximum of over 600 feet of ore and wet in streaks. The trenches have been filled up since then and at present only the open cut referred to above is exposed. The ore contains crystals of labradorite with reaction rims of brown hornblende and biotite between them and the ore itself. The analyses afford from 51.44 per cent. to 63.45 per cent. iron and 18.70 to 10.91 SiO_2. It does not appear that Emmons, in his early explorations, knew that the ore contained titanium, nor that the operators of the furnaces in those early days of iron smelting were aware of its presence.

Two miles west of Lake Henderson is the Cheney ore-body, said to show 40 feet clear ore without walls appearing. It is somewhat sulphurous, a very exceptional property in the case of titaniferous ores. On both sides of the Adirondack river that connects Lake Sandford and Lake Henderson, and in the bed of the river itself, there are several ore-bodies. The one called the

Millpond is the largest, with about 12 feet of solid ore, that was mined to a considerable extent in the early days. It really appears to be one streak in a large belt. Analyses have yielded over 60 per cent. iron.

There are several important belts of attraction in addition to this and other outcrops that have not been much, if at all, opened up. One has been also found on the west shore of Lake Henderson, and float has been noted off to the northwest near the Preston ponds. In addition to these, a number of belts have been shown by the dipping needle back in the hills and also further south near the lower works, now called Tahawus.

Several experimental runs have been made with these ores to test whether the generally prevalent prejudice against titaniferous magnetite was well based or not. The results of the first series have been set forth by Mr. August Rossi in the Trans. Amer. Institute Mining Engineers, vol. xxi (pp. 832–867), 1893. The past spring a more extended run in a small blast furnace of about 20 feet in height was made at Buffalo on 150 tons of ore. By calculating the slag on the composition of titanite or sphene, or, rather, some of its allied minerals, and allowing TiO_2 to replace SiO_2 up to 42 per cent., no difficulty was experienced and an iron of very superior properties for car wheels and chilled castings was produced. Mr. Rossi, who conducted the run, is intending to describe it at length at an early date.

III. Hematite Ores of St. Lawrence and Jefferson Counties.

The hematites, or red hematites, as distinguished from the brown hematites (limonites) are mined in a narrow belt, scarcely 30 miles long, stretching from Philadelphia, in Jefferson county, northeast into Hermon, in St. Lawrence county. The ore deposits are found associated with a so-called *serpentine* rock, and lying between the Potsdam sandstone and the crystalline rocks of the Archæan age. The geological horizon appears to be below the Potsdam, and it is probably Huronian, although it has not been so recognized by Dr. T. S. Hunt in his references to* the hematites of Canada and northern New York. The deposits are found to be very irregular in shape, due apparently to the

* "On the Mineralogy of the Laurentian Limestones of North America," in the 21st Ann. Report of the Regents of the University of New York, Albany, 1871, pp. 88–89.

way in which the "serpentine" rock is mixed with the hematite, but their general structure is that of stratified bodies. The cap rock is a sandstone; the bottom rock, slaty beds, underlain by a white, graphitic, crystalline limestone. From the variations in the ore, as tested by borings with the diamond drill at the Caledonia mines, it seems reasonable to assume the existence of two classes of deposits — one, the originally stratified sheets, and the other, secondary deposits in smaller and irregular shaped pockets.

The hematite of these mines is generally firm and massive, of a deep red color, soiling whatever it touches. In some of the mines there is a specular ore, which has a crystalline structure, metallic lustre and is of a steel-gray to black color. Calcite, carbonate of iron, ferruginous quartz, pyrite and millerite occur in the ore. These ores average from 48 to 53 per cent. of metallic iron. They contain an excess of phosphorus above the limit demanded by furnace managers for making Bessemer iron. For mixing with more refractory ores they are sought after, being almost self-fluxing. In the market they are often known as "Antwerp red hematites" and "Rossie hematites."

Charcoal furnaces were built early in this century at Rossie, St. Lawrence county, and at Sterlingville and Antwerp, in Jefferson county, for smelting these ores. Of the older mines the Shirtliff and Tate and Polly have been abandoned. Two new mines have become producers, the Clark and Pike. The total production of the district was 110,000 gross tons in 1888.

IV. The Clinton or Fossil Ores.

The red hematite of the Clinton group bears several names; thus: From its aggregated grains it is termed "oolitic ore" or "lenticular iron ore;" from its fossiliferous character, it is widely known as "fossil ore," and from its place in the geological series, it is often called "Clinton ore." It is remarkable for the thin, yet persistent beds over wide areas, which lie between green shales and calcareous strata. Following the outcrop of the Clinton group, the ore has been found in Herkimer, Oneida, Madison, Cayuga, Wayne, and Monroe counties. West of the Genesee river Prof. Hall reports that it was not seen.* There are two beds, generally about 20 feet apart, according to Vanuxem's report on the Clinton group, thin, averaging little more than a foot, and distinguished by more abundant oolitic particles in the lower bed and by the larger grains and concretions in the upper bed.† Very little mining has been done, excepting in the towns of Clinton, Oneida county, and Ontario, in Wayne county. The average thickness of the beds in these mines is 30 inches, and one bed only is worked. They lie almost horizontal, dipping slightly to the south; and in the extraction of the ore a part of the overlying shales has to be removed and the roof supported by timbering.

The ore consists of lenticular-shaped grains, closely aggregated in a firm solid mass, which has to be broken up by blasting and heavy sledging. It is more friable and soft on the outcrop. It is brownish red in color and soils like a paint. The percentage of metallic iron varies less than in the magnetic iron ores and in the brown hematites. The average is 44 to 48 per cent. The phosphorus is above the Bessemer limit. It is well adapted for making foundry iron and is used for that class of iron mainly. Local furnaces take nearly all the output of the mines. The first lease for digging Clinton ore was given in 1797.‡ The last United States census reported the total production to be 85,442 gross tons of ore. In 1888 it amounted to 75,000 tons.

V. The Limonites of Dutchess and Columbia Counties.

The ore deposits and mines, as here grouped, are in two principal ranges and limestone valleys. First, Fishkill-Clove belt, stretching northeast, from the Highlands of the Hudson, across the towns of Fishkill, East Fishkill, Beekman and Unionvale; second, the north-south valley, traversed by the New York and Harlem railway, from the Highlands across Dutchess county, and to Hillsdale in Columbia county. The limonite, or brown hematite ore, is found in small pockets of irregular shape, and also in large deposits, which are associated with ochreous clays, and in some

* See Prof. Hall's report on "Survey of the Fourth Geological District," Albany, 1843, p 61.

† Vanuxem's report on "Survey of the Third Geological District," Albany, 1842, p. 83.

‡ Birkinbine; "The iron ores east of the Mississippi River," in Mineral Resources of the United States for the calendar year 1886, p. 50.

cases, with a gray carbonate of iron, in beds underlying it. These ore bodies are wholly in the limestone or between the limestone and the adjacent slate or schist formations, or they are in the latter, and as a rule of occurrence they are found on or near the dividing line between these formations. Near Fishkill and at Shenandoah the deposits are at the border of the Potsdam sandstone and at the foot of the Archæan ridges. The existence of the carbonate ore in the deeper parts of some of the mines and interstratified with the limestones is suggestive of the origin of the oxide (limonite) by the decomposition of the ferriferous beds through oxidation and the agency of carbonated waters, and of the great masses of colored clays, also, through the disintegration and decay of the slaty rocks and more argillaceous limestone.* The limestone of these valleys and these overlying slaty rocks have been studied by Prof. Dana, and are referred by him to the Trenton limestone and the Hudson river slate formations.†

The ore occurs (1) in large masses, somewhat cellular, having the interstices filled with clays or sandy earths, (2) in cavernous and hollow "bombs," often with beautiful mammillary or stalactitic incrustations on the interior, and (3) in irregularly shaped, fragmentary masses, distributed unevenly through the ochreous clays ("ochres") and sandy earths. The more solid ore has to be broken down by blasting; in the more earthy parts of the deposit it can be picked down and nearly all of the ore be sorted by hand. In mining, pits are sunk and worked open, or drifts are cut from the pit, horizontally into the ore, and much of it is won by underground work. In this district nearly all of the ore is mined from open pits; and some of them have reached vertical depths of over 100 feet. The ore is commercially known as "rock ore" or "lump ore," that which is sorted by hand, and "wash ore," which is the residue after the earths and sands have been removed by washing. The brown hematite ores of Dutchess and Columbia counties vary considerably in their chemical composition, all containing more or less silica, little or no sulphur, but are rarely low enough in phosphorus to answer for Bessemer pig-iron manufacture. Although there have been many ore localities dis-

* For a clear and concise statement of the origin of these ores see "Note on the making of Limonite ore beds," by PROF. JAMES D. DANA, in Am. Jour. of Science (3), vol. XXVIII, pp. 398–400.

† Am. Jour. Science (3), vol. XVII, pp. 375–388 and vol. XXIX, pp. 205 *et seq.*

covered in these counties, 24 only have been developed into working mines, deserving of enumeration in this report.

The earliest iron manufacture in the State was in Columbia county, on Ancram creek, and was probably on these ores. The Salisbury mines in Connecticut, properly a part of this iron-ore district, were opened more than 150 years ago. The causes which have operated in the Highlands have been effective here also in closing many of the mines, so that, in 1888, there were but nine at work, and four of them were closed during the year. The aggregate output has declined from 144,878 gross tons for the census year, 1879–80, to 43,000 tons in 1888.

VI. The Limonites of Staten Island.

The group of iron mines on Staten Island are in a superficial deposit probably derived from the underlying rock in the process of decomposition which has produced the serpentine of that region.

VII. The Carbonate Ores of the Hudson River.

The mines of spathic iron ore, or carbonate ore, are in the valley of the Hudson river, in Columbia county, south of the city of Hudson, and in Ulster county near Napanock. The mines south of Hudson are known as the Burden iron mines; and, on account of their extent and productiveness, and the comparative insignificance of the Ulster county mines, they may be considered as practically the whole of this group. The range in which the Burden mines are opened is between one and two and a-half miles east of the river, opposite Catskill, and is four miles in length, from north to south. It lies partly in the town of Greenport and partly in Livingston. The ore crops out in the western face and near the crest of Plass Hill at the north, and in Cedar Hill and Mount Thomas at the south. It is stratified, and its bed dips at angles of 20° to 40° to the east. South of Mount Thomas and in mine No. 2, at Burden, a synclinal fold has been mined out. The thickness of the ore varies considerably, and for the greater part of the distance the average is from 10 to 20 feet. In the Burden mines as much as 30 feet of ore has been found; in mine No. 2 and in Mount Thomas upwards of 45 feet. The underlying beds are shaly and are probably of the Hudson river slate formation. Above the ore there is a silicious conglomerate, which is succeeded by a shale, and that by a gray sandstone, and that, in turn, by a calcareous conglomerate.

The ore varies in composition from a silicious and lean ore at the north, which contains generally too much phosphorus for making Bessemer pig-iron, to a rich, Bessemer ore at the south. Quartz in fine grains, calcite in small, crystalline nests and pyrite are common in it. All of it has to be roasted before smelting. The Burden mines are reached by a railway three and a-half miles long, from the Hudson river, near Catskill station.

The first mining of considerable extent done on this range was in 1874. Next year the Hudson River Spathic Iron Ore Company was organized, and the mines were worked by that company for about two years. In 1882 the property came into the possession of the Hudson River Ore and Iron Company, and a large establishment was at once set up. There are 10 roasting kilns on the river at the Burden docks; and the ore is shipped to Troy, Scranton, Pa., and Franklin Furnace, New Jersey.

LOCALITIES OF IRON ORE IN NEW YORK.

Magnetite.— There are two principal districts of this ore: (1) Highlands or southeastern, (2) Adirondack or northern. In the first there are mines at Sterling, near Greenwood, and Forest of Dean, besides many smaller mines in Orange county. There are numerous openings in northern Westchester and southwestern and central Putnam counties, east of the Hudson river (Croft's, Mahopac, Theall, Tilly Foster, etc.). In northern New York ore occurs at many localities in Washington, Saratoga, Warren, Essex, Clinton, Franklin, St. Lawrence, Lewis, Herkimer and Fulton counties. Mines are worked at Mount Hope in Washington county, near Crown Point; Paradox lake, in vicinity of Port Henry in Essex county, and very large deposits unworked occur at Adirondack and in Westport; Palmer Hill, Arnold ore bed, and Chateaugay in Clinton county; Clifton (idle), in St. Lawrence county; occurrences are also noted in Jefferson county.

Magnetic iron sand is found to some extent on the southern shore of Long Island, on the western shore of Lake Champlain and on the Hudson river and smaller streams in the northern part of the State.

An aluminous magnetic ore occurs near Peekskill, Westchester county; it is self-fluxing, but not now worked except for emery, though it occurs in large deposits.

Hematite specular iron ore, red hematite.— Gouverneur, Fullerville, St. Lawrence county; Philadelphia and Antwerp, Jefferson county, productive mines. It occurs in Hermon, Edwards, Fowler and Canton, in St. Lawrence county.

Hematite fossil ore, lenticular clay iron ore.— This ore has been worked chiefly at Verona, Westmoreland, New Hartford and Clinton, Oneida county; Ontario, Wayne county. It also occurs in Madison county in thin beds.

Limonite, brown hematite.— This ore occurs at East Fishkill, Sylvan lake, Beekman, Pawling, Dover, Unionvale, Amenia, Sharon, Millerton and Mount Riga, in Dutchess county; Copake, Ancram and Boston Corners, in Columbia county; the mines at these localities produce largely. Besides these are the Townsend mine, Cornwall, Orange county; Castleton Four Corners, New Dorp and Todt Hill, Staten Island.

Limonite, bog iron ore.— There are numerous localities and many small deposits of this ore in the northern and eastern parts of the State. It was formerly worked to a small extent, but is now abandoned.

Siderite, spathic iron ore, carbonate of iron.— Near Catskill Station and Linlithgo, Columbia county, an immense deposit has been developed; at Napanock, Ulster county, a deposit was formerly worked; in Dutchess county it occurs in small quantity; at Antwerp, Jefferson county, in crystals only.

Mineral Paint.

The mineral paint of New York State is from comparatively few localities, and is manufactured from rocks of three different formations:

1. From Clinton iron ore.
2. From Cambrian red and green slate.
3. From Chemung shale.

No statistics of production are furnished by the manufacturers.

This material is produced as a by-product in several other industries. For instance near Whitehall red and green mineral paint are produced by grinding up the refuse of the slate mills. In Oneida county, paint is manufactured from the Clinton iron ore. At Randolph in Cattaraugus county, paint is made from red shales of the Chemung group. At Roxbury, Delaware county, paint is made from red Catskill shales and at Oneonta a similar pigment has been made.

Directory of Mineral Paint Manufacturers.

(Metallic paint.)

Clinton Metallic Paint Co	Clinton.
Rossie Iron Ore Paint Co	Ogdensburg.
Oneonta Mineral Paint Co	Oneonta.
Ontario Metallic Paint Co	Rochester.
Delaware Mining, Milling and Manufacturing Co.,	Roxbury.
Wm. Connors (also slate)	Troy.

Ochre.

Bruno, Grosche & Co	New York.

Shale.

Elko Mineral Paint Co	Randolph.

Slate.

William Connors (also met. pt.)	Troy.
Francis Thomas	Troy.
Robert A. Hall	Whitehall.

Salt.

The salt industry of New York is of great importance. Originally Syracuse was the center of this industry, but since the discovery of rock salt in and near the Genesee valley from which richer brines can be obtained than at Syracuse, the center of the industry has been transferred to this new district and the manufacture of salt at Syracuse will gradually diminish.

The salt mines of the Retsof, Lehigh, Livonia and Greigsville companies produce immense quantities of salt for the beef and pork packing industries, and in this respect are not directly competitors of the companies manufacturing salt from brine. About 15 miles south of Syracuse the Solvay Process Company having found rock salt in great quantity, by boring a large number of wells and availing itself of an abundant water supply is, by the aid of gravity, enabled to bring to its works at Syracuse through a pipe line, brine in a highly saturated condition. This is the basis of a very large industry in soda ash. The salt of New York occurs wholly in the Salina group.

A detailed description of the salt and gypsum deposits of New York is given in Bulletin No. 11 of the New York State Museum by Frederick J. H. Merrill. From this publication the following sketch of the geology of salt in New York is abstracted :

Geology of Salt in New York.

The salt of New York occurs almost exclusively in the Salina group or, as it is also called, the Onondaga salt group of the Upper Silurian period which was described by Vanuxem as follows : *

"This important group contains all the gypsum masses of western New York, and furnishes all the salt water of the salines of the counties of Onondaga and Cayuga. From the point where the Niagara group terminates at the east, it rests upon the Clinton group; and as the latter group also comes to its end near the first district, it reposes there upon the Frankfort slate, upon which it continues to near the Hudson river.

* Report on the Geology of the Third District of New York.

"It forms a part of the high range on the south side of the Mohawk; appearing at the north end of Otsego county, and in Herkimer and Oneida, being its northern outcrop. It makes its first appearance by the side of the Erie canal at the east end of Madison county, and thence west the canal was excavated in the group.

"The Onondaga salt group may be divided into four deposits. There are no well-defined lines of division between the deposits; but for practical purposes the divisions are sufficiently obvious.

"The first or lowest deposit is the red shale, showing green spots at the upper part of the mass. 2d. The lower gypseous shales, the lower part alternating with the red shale, which ceases with this mass. 3d. The gypseous deposit, which embraces the great masses quarried for plaster, consisting of two ranges, between which are the hopper-shaped cavities, the vermicular limerock of Eaton, and other porous rocks. 4th and lastly. Those rocks which show groups of needle-form cavities placed side by side, caused by the crystallization of sulphate of magnesia* and which may from that circumstance be called the magnesian deposit.

"The whole of these deposits are found between Oneida creek and Cayuga lake. To the east of the creek, they do not all occur, as will subsequently be made known. They thin out to the eastward and probably terminate entirely a few miles east of the Hudson river; from which point their thickness gradually increases toward the west, and reaches its maximum in the counties of Onondaga and Cayuga, where it is not less than 700 feet. The gypsum has not been seen east of the western part of Oneida county. The red shale comes to its end at the east end of Herkimer county; and the whole group is reduced, in the Helderberg in Albany county to a few feet of light-gray or lavender-colored compact calcareous rock with pyrites, separating the Frankfort portion of the Hudson River group from the water lime series."

The outcrop of the Salina shales is shown on the accompanying map.

The red shale is fine grained, earthy in fracture and without regular lines of division. It breaks or crumbles into irregular fragments. This deposit is not found east of Herkimer county

*Sulphate of lime most probably.

and varies in thickness from 100 to nearly 500 feet. The second member of the series consists of shale and calcareous rock of a light-green color intermingled with a red shale at its lower part. But little gypsum occurs in this member. The rock is extremely porous, easily penetrated by water and falls to pieces at once on exposure to the air. The third or gypseous deposit, which is important commercially on account of its plaster beds, is also the horizon from which the brine springs of Onondaga, Cayuga and Madison counties were supposed by Vanuxem to have been derived. The mass of the deposit consists of rather soft yellowish or brownish shale and slate, both argillaceous and calcareous. It may be called a gypseous marl. It falls to pieces when exposed to the weather, breaking in a series of joints nearly at right angles to each other which give the rock a rhombic cleavage. In the third district the gypsum of this horizon does not often occur in layers or veins, it usually occurs in isolated masses of irregular form. At many points there appear to be two ranges or levels of these plaster beds, as they are called, separated by shale containing hopper-shaped cavities. These cavities, which are from one to ten inches in diameter, are of much interest for they represent the external casts of salt crystals, which were probably formed during the evaporation of the water from the basin in which the Salina deposits were laid down. But few fossils are found in the Salina group, for at the time when the shale and gypsum were deposited the water contained too high a percentage of soluble salts to support animal life.

The fourth deposit was called the magnesian deposit on account of the assumption that the needle-like cavities were due to the crystallization of sulphate of magnesia. As needle-like crystals of sulphate of lime are well known, and as gypsum is abundant in this horizon, it seems more probable that these needle like crystals were crystals of gypsum.

Prof. James Hall* describes the Salina group as follows: Succeeding the Niagara group is an immense development of shales and marls with shaly limestones including veins and beds of gypsum. The general color is ashy approaching drab with some portions of dark bluish green. The lower part is of deep red with spots of green. Succeeding this, where protected from

* Geology of the Fourth District.

atmospheric influences, the rock is blue, like ordinary blue clays, with bands of red or brown. This portion and that succeeding it are often green and spotted, and contains seams of fibrous gypsum and small masses of reddish selenite and compact gypsum. From this it becomes gradually more gray with a thin stratum of clayey limestone, which is sometimes dark, though generally of the same color as the surrounding mass. The formation terminates upward with a gray or drab limestone called by Vanuxem the "magnesian deposit." The red shale forming the lower division of the group is well developed, but in the third district has not been found west of the Genesee river. It appears in the eastern part of Wayne county as indicated by the deep red color of the soil which overlies it.

At Lockville a greenish-blue and marl with bands of red has been quarried from the bed of the Erie canal. West of the Genesee this is the last of the visible mass. The red shale has either thinned out or lost itself, gradually becoming a bluish-green, while otherwise the lithological character remains the same. On first exposure it is compact and brittle, presenting an earthy fracture. But few days are necessary to commence the work of destruction, which goes on until the whole becomes a clayey mass. The prevailing features of the second division of the group are the green and ashy marl with seams of fibrous gypsum and red or transparent selenite often embracing nodules of compact gypsum. The third division comprises all the gypsum beds of the fourth district which are of economic importance. In this third division hopper-shaped cavities occur in Wayne and Monroe counties, but rarely in Genesee or Erie.

There is scarcely any well-defined division between the shales and shaly limestones of the third division and the so called magnesian deposit which overlies it. This limestone in the western part of the State is used extensively for hydraulic cement and is now worked by the Cummings Cement Company of Akron and the Buffalo Cement Company.

In their studies of the Salina group, Professors Hall and Vanuxem found no rock-salt because this soluble mineral can not remain at the surface. However from various wells and shafts, sunk during the past 11 years, we have sections of the Salina group which show the position and relation of the salt beds.

Producers of Salt in New York State.

Onondaga District.

C. & A. Stillwell *	Collamer, N. Y.
Geddes Coarse Salt Co	Geddes (via Syracuse), N. Y.
Highland Solar Salt Co.*	Liverpool, N. Y.
P. Corckings	Syracuse, N. Y.
T. K. Gale	"
M. Prell	"
American Dairy Salt Co.*	"
Highland Coarse Salt Co	"
Salina Coarse and Fine Salt Co	"
N. E. Loomis, executor	"
Turk's Island Coarse Salt Co	"
James M. Gere	"
William J. Kilian	"
John White & Co	"
P. Rogers & Co	"
M. R. Hayes	"
H. H. Freeman	"
Richard Farrell *	"
P. Prendergast	"
Salt Springs Solar Coarse Salt Co	"
W. B. Boyd	"
Syracuse Solar Salt Co.*	"
Foster, Ely	"
Cape Cod Coarse Salt Co	"
Empire Coarse Salt Co	"
Salina Coarse and Fine Salt Co	"
Western Coarse Salt Co	"
Theodore L. Poole	"
Draper & Porter	"
W. & D. Kirkpatrick	"
Union Coarse Salt Co	"
Robert Young	"
C. B. Murray	"
George Brown & Co	"
Andrew Martin	"
Edward Lynch	"

* Idle in 1893.

James Salmon	Syracuse, N. Y.
W. A. & J. B. Gere	"
A. L. Mason	"
Duncan W. Peck	"
Le Roy Salt Co	Le Roy, N. Y., 21 grainers, 13 wells.
Genesee Salt Co. (5 pans, 5 wells)	Mercantile Exchange, N. Y.
Pavilion Salt Co	Pavilion, N. Y.
Kerr Salt Co	Rock Glen, N. Y.
Duncan Salt Co	Silver Springs, N. Y.
Pearl Salt Co	Warsaw, N. Y.
W. C. Gouinlock	"
Empire Dairy Salt Co	"
Warsaw Salt Co	"
Crystal Salt Co	"
Hawley Salt Co	"
Bradley Salt Co	"
Miller Salt Co	"

Rock Salt.

Retsof Mining Co	Retsof, N. Y.
Livonia Salt and Mining Co	115 Broadway, N. Y. city.
Lehigh Salt and Mining Co	Scranton, Pa.
Greigsville Salt Mining Co	Greigsville, N. Y.
Cayuga Lake Salt Co	Ludlowville, N. Y.
—— Hyman	Livonia Station, N. Y.
J. C. Reed	"
Glen Salt Co	Watkins, N. Y.

Gypsum.

Gypsum is quarried in New York on the outcrop of the Salina group in Madison, Onondaga, Cayuga, Ontario, Monroe and Genesee counties. It is chiefly used as a fertilizer in the form of land plaster, though at Oakfield, Genesee county, a factory has been established to utilize the gypsum in the manufacture of wall plaster.

DIRECTORY OF PRODUCERS OF GYPSUM.

* Parties producing in 1894. † Parties producing previous to 1894 now idle.

Post-office.	NAME.	Location of Quarry.	
		Town.	County.
Cottons	Buttons, R. D.*	Sullivan	Madison.
Fayetteville	Condee, W. W.*	De Witt	Onondaga.
"	Edwards, A. W	"	"
"	Lansing, H H.*	"	"
"	Severance, F. M.*	"	"
"	Snook, Clark	"	"
"	Todd, R. J.*	Manlius	"
"	Wheeler, Horace.*	"	"
Garbutt	Garbutt, John W.*	Wheatland and Garbutt,	Monroe.
Half Way	Kenna & Allen †	Camillus	Onondaga.
Hobokenville	Tuttle, Irving *	Lenox	Madison.
Jamesville	Alvord, E. B. & Co.*	De Witt	Onondaga.
"	Dunlop, Robert & Co.*	"	"
Marcellus Falls	Sherman, J. N.*	Marcellus	"
Oakfield	Olmstead Stucco Company *	Oakfield	Genesee.
Perryville	Hodge, F. W.*	Sullivan	Madison.
"	Worlock, Cyrus.*	"	"
Phelps	Miller, A. D.*	Phelps	Ontario.
Port Gibson	Grinnell, Ezra *	Manchester	"
Syracuse	Alvord, A E.*	Onondaga	Onondaga.
Union Springs	Cayuga Plaster Company	Springport	Cayuga.
Victor	Conover, Theodore	Victor	Ontario.

Graphite.

Graphite of excellent quality is produced near Ticonderoga, the deposit being controlled by the Dixon Crucible Company of Jersey City. The mineral occurs in a mica schist and in crystalline limestone. It is used in the manufacture of pencils, crucibles, lubricant and a variety of other purposes.

Quartz.

This material is quarried for pottery at Bedford, Westchester county, and is shipped to Trenton, N. J. White quartz of Potsdam age which is quarried at Fort Ann in Washington county, has been ground for use as a wood filler. It has also been used at the Troy Iron Works for lining Bessemer converters and similar refractory purposes.

Glass Sand.

The two chief sources of this material in New York are Ellenville, Ulster county, and Durhamville, Oneida county. At the former locality the quarries are operated by the Crystal Sand Manufacturing Co. The sand is obtained from the Shawangunk grit, which is crushed to exceeding fineness. Much of the product is sent to the glass works at Corning.

Large glass sand deposits of Quaternary age occur at Durhamville near Oneida Lake. They are operated by William Williams. The sand is not as white nor as fine as that from Ellenville, and is used for the commoner grades of glassware. Much of it is shipped to Lockport. The sand contains 97–97.5 per cent. Si. 02.

Molding Sand.

Sand for molding is found in Albany county immediately below the surface soil. When this is removed the sand is skimmed off to a depth of about six inches. It is quite extensively shipped from the town of Bethlehem. Near Poughkeepsie molding sand is obtained from a silicious limestone which, in decomposing, leaves a fine sand which has been found very satisfactory for this purpose.

Garnet.

Garnet is mined or quarried in New York State in and near the valley of the upper Hudson river in Warren county on the borders of the Adirondack region. It all appears to be of the common variety, Almandite, and occurs in a formation of crystalline limestone which appears to form the bed-rock of the valley in the vicinity of North Creek and Minerva and in gneissic rocks which adjoin or are intercalated with the crystalline limestone. It is found in segregated masses of varying sizes from that of a pigeon's egg to a diameter of 20 feet. It is commercially classified as massive garnet, shell garnet and pocket garnet, the former being impure from the admixture of other minerals. The shell garnet is almost entirely pure and the most valuable for industrial purposes. The pocket garnet is that which occurs in small segregations or incipient crystals in the gneiss. Garnet is also found in Delaware county, Pa., where it is quarried under the name of "Rose" garnet by Herman Behr & Co., to the extent of about 1,000 tons annually. It occurs there in small crystals thickly disseminated through a quartzose gneiss. There is also a deposit of garnet at Chester, Pa., which is worked to some extent Large deposits of the mineral have been found in North Carolina, but its quality is not considered as satisfactory as that from the Adirondack region. Other deposits are said to occur in Georgia and Alaska, but no definite information can be obtained concerning them. Connecticut is also mentioned as a source of garnet.

This garnet is used almost exclusively in the manufacture of sandpaper, or garnet-paper, as it is called, which is employed extensively for abrasive purposes in the manufacture of boots and shoes. It is also employed to some extent in the wood manufacturing industry. For metals garnet is not as good as emery, although some satisfactory results have been obtained from its use on brass It has been experimentally mixed with emery in the manufacture of emery-wheels but without very satisfactory results. The firms quarrying and using garnet from the Adirondack region are H. H. Barton & Co., of Philadelphia, who control very extensive deposits there; Baeder, Adamson & Co., of Philadelphia; Herman Behr & Co., of New York, who also are interested in the deposits in Delaware county, Pa.; Wiggins & Stevens of Boston, who are also interested in the deposit at Chester, Pa.; the Boston Flint-paper Co., and the Union Sandpaper Co., of Boston.

In commercial use garnet is found to be harder, sharper and more lasting than quartz and is preferred to it for certain kinds of work, although it costs about eight times as much as quartz. The Adirondack garnet is said to be worth about $40 a ton at the railroad, although the average value of the mineral throughout the country is stated to be about $35. The superiority of garnet to quartz is probably due to the fact of its ready cleavage, which enables it to present, as it breaks away, new and sharp cutting edges, whereas quartz, which has no cleavage, becomes dulled by friction. The only garnet now mined in the Adirondack region is the pocket garnet, which is used to make the better grade of garnet-paper. Some of the massive garnet has been used to make sandpaper for wood-working, and also mixed with corundum to make emery-wheels. The total production of Adirondack garnet in 1893 was about 520 tons, but this was much less than the usual output owing to the general stagnation of business and the small demand for garnet-paper. For several years previous to 1893 H. H. Barton & Co. are said to have mined from 800 to 1,000 tons per year. In 1893 the shipments from North Creek amounted to 1,475 tons. During 1894 almost nothing has been done in the mining of garnet. Only 294 tons were shipped from Warren county, New York. William Hooper & Sons of Ticonderoga have recently erected a mill near Minerva to crush the garnet-bearing rock and separate the garnet by water. This, if successful, will to some extent revolutionize the garnet business as many deposits not worth working by hand-sorting could be made to pay in this way.

Emery.

Emery is quarried at many points in Cortlandt township, Westchester County, from deposits which occur in the eruptive rocks known as the "Cortlandt series." It is used by the New York Emery Company at Peekskill.

Diatomaceous Earth --- Infusorial Earth.

This material consists of hydrated silica, and is the accumulation of the minute skeletons of microscopic forms of vegetable life known as diatoms. It accumulates in the bottoms of ponds and lakes, and is found in recent as well as Tertiary and Cretaceous formations. While the living diatoms are found in all the waters of the State, deposits of diatomaceous earth have been reported from only two localities. One of these is in White lake, town of Wilmurt, Herkimer county, and the other is on the shore of Cold Spring Harbor, Long Island, on the property of Dr. Oliver Jones. The latter is a fossil deposit in beds probably of Tertiary age. The White lake deposit is the only one in use commercially at present. The material is dug from the bottom of the lake, which covers about four acres, and has a thickness of two to thirty feet, being covered by about four feet of water. It is washed and run through strainers and pipes to settling vats, where it stands for twenty-four hours. The water is then drawn off and the material shoveled into the press. Here it is made into cakes four feet square and four inches thick. These are subdivided into cakes one foot square and piled under sheds to dry. For this information I am indebted to Mr. Thomas W. Grosvenor, of Herkimer, the proprietor.

The White lake material is at present only used for polishing, though similar material is used for absorbing nitroglycerine in the manufacture of dynamite.

The following analysis by Dr. Gideon E. Moore, of New York city, is furnished by Mr. Grosvenor:

Water and volatile matter	12.120
Silica	86.515
Alumina	0.449
Ferric Oxide	0.374
Lime	0.120
Undetermined	0.422
	100.000

Talc.

This material occurs near Edwards, St. Lawrence county, N. Y., in a narrow belt several miles long and about a mile wide. There are several quarries on the line of this belt. It is ground in mills near Gouverneur under the control of the Asbestos Pulp Co. It is chiefly used in the manufacture of paper and a small quantity is used in soap, paint and other minor purposes. The annual product is about 30,000 tons, valued at about $240,000.

Peat.

This material, which is the residue from the partial decay of plants in water, is of frequent occurrence but is only used locally as a fertilizer.

Petroleum and Illuminating Gas.

The occurrence of petroleum in New York was first recorded by a Jesuit missionary who visited the oil spring at Cuba, Allegany county, in 1627. Late in the present century the oil from this spring was highly valued by the Indians for external applications and was thought to have a highly curative power. It was widely known under the name of "Seneca oil." The production of oil in New York is at present confined to Cattaraugus and Allegany counties. The Cattaraugus county field is a northward extension of the Bradford field of Pennsylvania and is continuous over the State line. The Allegany field is more isolated, although the oil comes from the same geological horizon. This has been discussed in great detail by Charles A. Ashburner in the Transactions of American Institute of Mining Engineers for 1887 and does not need detailed consideration here. Within a few weeks discoveries of oil are reported from Greig in Lewis county, but the value of the find is uncertain.

Natural illuminating gas was first used in New York at Fredonia, Chautauqua county, in 1821. This material is still in use at the locality in question. Besides Fredonia, at the present time Buffalo, Honeoye Falls, Pulaski and Sandy Creek are using natural gas for heating and illuminating purposes and a well is being bored in the vicinity of Oswego. Gas wells have been bored tentatively at a large number of places in New York State and small quantities of gas have been found, but the enterprises have not been financially successful. At present many of the wells in Buffalo have ceased to yield and a large quantity of the natural gas now consumed in that city is brought in pipe-lines from Canada.

On the economic map the oil pools are shown as mapped by C. A. Ashburner and corrected to 1893 by D. A. Van Ingen, who has written a brief sketch of the oil districts.

PETROLEUM.

By D. A. Van Ingen.

Petroleum in New York State.

The oil territory in New York State is a continuation of the Bradford field of Pennsylvania. The counties of Cattaraugus and Allegany contain almost all the developed territory for oil. The first drilling was done at Limestone in Cattaraugus county in 1865, followed by wells at Petrolia and Richburg in Allegany county in 1881 and 1882, respectively. The oil sand is called the "Richburg" in Allegany county, and the "Bradford" in Cattaraugus county, but many claim them to be identical. The sandstone is a close, fine-grained rock of a dark-brown color. The general direction of the strata runs northeast and southwest, dipping to the southwest from three to twenty-five feet to the mile. In the southern part of Allegany county a fourth sand, known as the "Waugh and Porter" is drilled into. This lies some eighty feet below the "Richburg" sand and seems to be a different oil sand, although there is much difference of opinion with regard to it.

The oil varies in color from light yellow to almost black, although the dark-green oil is by far the most abundant. Its specific gravity at 10° C. runs from 38° to 45° B. Up to date about 8,000 wells have been drilled in the State, and some 6,000 are now producing. They started anywhere from five to 250 barrels per day, but now only average sixty-five-one-hundredths barrels in Cattaraugus county, and sixty-two one-hundredths barrels in Allegany county. With the oil considerable gas has been found, but now there is little more than enough to supply fuel for pumping. "Edge territory" usually produces good gas wells.

I. Allegany Field.

The Allegany field is the towns of Greenwood in Steuben county, and Andover, Scio, Alma, Bolivar, Wirt, Clarksville and Genesee in Allegany county. There have been up to December 1, 1892, 5,327 wells drilled, and about 4,000 are now producing. On January 1, 1889, 25,105,000 barrels of oil had been taken out. The greatest daily production was in 1882 when 17,000 barrels marked the limit. At present about 2,500 barrels is the daily production. This field is divided into six pools, viz.: 1. Andover; 2. Alma P. O.; 3. Alma; 4. Bolivar, Richburg and Wirt; 5. Waugh and Porter; 6. Clarksville and Niles.

1. *Andover.*— This is situated in Greenwood, Steuben county, and Andover, Allegany county. It was originally drilled for gas to supply the neighboring towns, and all drilling has been done by the Mutual Gas Company, of Andover. In all, 15 wells have been finished since the field was opened in 1889. In depth the wells run from 800 feet in the valley to 1,300 feet on the hills, with oil sand from 15 to 95 feet thick. The field gives a good yield of both gas and oil, the rock pressure being 350 feet on the average and a yield of one to eight barrels of oil per well per day. At present all the wells but three are shut in, as this number is sufficient to furnish the gas needed.

2. *Alma P. O.*— This really belongs to the Alma pool, but as there is a dry streak between them it has been treated by itself. It is very small, covering only five lots in the southwest corner of the town of Alma. The wells are few and run from 800 to 1,500 feet deep, with only 10 to 20 feet of oil sand. The yield of oil and gas is very small.

3. *Alma.*— This pool is a long narrow strip running northeast and southwest and covering about 30 lots in the town of Alma. There are about 250 producing wells, yielding about 125 barrels of oil daily. In depth they run from 1,100 to 1,200 feet, with 15 to 20 feet of producing oil sand. The southwest edge is good gas territory.

4. *Bolivar, Richburg and Wirt.* — This is the oldest and largest part of the Allegany field. It is situated in the towns of Alma, Scio, Bolivar, Wirt, Genesee and Clarksville. The first wells drilled were at Richburg, in about the center of the field. The wells are deep, ranging from 1,400 to 1,800 feet. The Richburg sand is from 25 to 50 feet thick. The yield now is only a little more than a half barrel a day, but at first ran as high as 100 barrels a day per well.

5. *Waugh and Porter.*— This pool covers seven lots lying in the southern part of the town of Bolivar. It was opened in 1882, and it was here that the fourth or Waugh and Porter sand was discovered. There are in all 36 wells, yielding about 40 barrels of oil daily. In depth they run from 1,350 to 1,700 feet. The oil

sands, the Richburg and Waugh and Porter, are 25 and 28 feet thick respectively, separated by some 100 feet of shale and slate. At the outset the yield was about 10 barrels a day.

6. *Clarksville and Niles.*— These two pools are only about one-half a mile apart and can almost be considered as one in spite of the dry streak between. The former covers 15 lots in the towns of Clarksville and Wirt, and the latter six in the northern part of Wirt. Clarksville was first drilled in 1883, and has about 250 producing wells, while Niles dates one year earlier with about 140 wells. The wells are from 1,000 to 1,500 feet deep, and yielded when first shot from 5 to 25 barrels a day, but are now only doing about half a barrel. The oil sand is thicker in Clarksville than in Niles, being 5 to 60 feet as compared to two to five feet. The gas pressure is light except on the northern edge, where it has been recorded as high as 400 pounds to the square inch.

II. Cattaraugus County Field.

The territory in this county is a continuation of the Bradford field and comprises part of the towns of Carrollton, Allegany and Olean. The first drilling was done at Limestone in 18[illegible]5, followed soon after by exploration at Rock City, Four Mile and Knapp's Creek. The field may best be considered by dividing it into two, viz : A. Bradford (proper); B. Allegany town.

A. Bradford.— This portion of the field covers about thirty square miles, its greatest length being twelve and one-half miles and its average breadth being two and one-half miles. There are now some 1,850 producing wells, yielding about six-tenths of a barrel each daily. In depth they run from 1,600 to 1,800 feet with 18 to 60 feet of good oil sand, although it often happens that the oil sand is badly broken up by shale and slate.

B. Allegany Town.— This field is comparatively new, having been opened about five years ago. It is situated in the townof Allegany along the Allegheny river, and is about five miles long by one and one-half wide. There are now about 175 producing wells yielding each about three barrels daily. The oil sand runs about 18 to 25 feet thick, while the wells are 1,000 to 1,200 feet deep. At the start the output ran as high as 40 barrels per well. So far no connection has been made with the Bradford, but there is no reason why it will not be made some day should the price of oil go up to allow drilling to pay.

Natural Carbonic Acid Gas.

This material is obtained at Saratoga Springs and vicinity by boring wells to a depth of about 35 ' feet. Carbonated waters flow to the surface and are conducted through pipes to large gas holders, where the gas is separated from the water and is then pumped into compressors from which it is forced into steel cylinders under pressure of about 1,000 pounds to the square inch. These cylinders when filled are shipped to the consumers, who use it chiefly in the manufacture of soda water, both for wholesale and retail sales. At present this gas is shipped from Saratoga Springs to New York, New Jersey, Pennsylvania, Massachusetts, Connecticut and Rhode Island. In addition to the large quantities consumed within this State, it is also being used for refrigerating purposes and in the manufacture of cod liver oil.

Mineral Waters.

The mineral springs of New York are widely known. In addition to the revenue from mineral springs used for bathing at health resorts, a large industry now exists in the bottling and shipment of mineral waters for domestic consumption.

List of Mineral Springs in New York which are Commercially Productive.

Adirondack Mineral Springs (H. V. Knight), Whitehall, Washington county.

Avon Sulphur Springs (O. D. Phelps), Avon, Livingston county.

Artesian Lithia Spring (C. O. McCreedy), Ballston Spa, Saratoga county.

Cairo White Sulphur Spring (H. K. Lyon), Cairo, Greene county.

Cayuga Mineral Spring (Lucius Baldwin), Cayuga, Cayuga county.

Chittenango White Sulphur Springs (W. H. Young), Chittenango, Madison county.

Chlorine Springs (J. L. Grover), Syracuse, Onandaga county.

Clifton Springs (Dr. Henry Foster), Clifton Springs, Ontario county.

Dansville Springs (J. Arthur Jackson, secretary and manager), Dansville, Livingston county.

Deep Rock Spring (Deep Rock Spring Co.), Oswego, Oswego county.

Massena Springs (Shedden & Stearns), Massena, St. Lawrence county.

Nunda Mineral Springs (Daniel Price), Nunda, Livingston county.

Reid's Mineral Spring (J. R. McNeil), South Argyle, Washington county.

Richfield Springs (T. R. Proctor), Richfield Springs, Otsego county.

Champion Spring (J. Z. Formel), Saratoga Springs, Saratoga county.

Empire Spring (H. W. Hayes, manager), Saratoga Springs, Saratoga county.

Excelsior Spring (F. W. Lawrence), Saratoga Springs, Saratoga county.

Geyser Springs (Geyser Spring Co.), Saratoga Springs, Saratoga county.

Hathorn Spring (Hathorn Spring Co.), Saratoga Springs, Saratoga county.

Old Red Spring (E. H. Peters, superintendent), Saratoga Springs, Saratoga county.

Vichy Springs (L A. James, superintendent), Saratoga Springs, Saratoga county.

Sharon Springs (John H. Gardner & Son), Sharon Springs, Schoharie county.

Slaterville Magnetic Springs (W. J. Carns & Son), Slaterville, Tompkins county.

Verona Mineral Springs (A. A. Hunt, M. D.), Verona, Oneida county.

White Sulphur Springs (T. C. Luther), Ballston Spa, Saratoga county.

White Sulphur Springs (J. Hochstatter), Berne, Albany county.

Star Spring, Saratoga Springs.

Elkhorn Spring (Clark Snook), Manlius.

Royal Spring (A. Putnam, Jr., president), Saratoga Springs, Saratoga county.

Lebanon Thermal Spring (P. Carpenter), Lebanon Springs.

Crystal Rock Water Co. (L. G. Deland, president), Fairport.

Victor Spring (H. J. Dickinson, Buffalo), Darien, Genesee county.

Geneva Magnetic Mineral Spring (C. A. Steele), Geneva, N. Y., Ontario county.

Oneita Springs (Oneita Spring Co.), Utica, N. Y., Oneida county.

Empire Seneca Spring (M. W. Cobb, of Fredonia), Dunkirk, N. Y., Chautauqua county.

Crystal Spring (Asa D. Baker), Barrington, N. Y., Yates county.

Great Bear Spring, Fulton, Oswego county.

The following list of New York springs and their analyses was compiled by Mr. A. C. Peale, of the United States Geological Survey, and published in Bulletin No. 32 of that organization.

Mineral Springs of New York.

NAME AND LOCATION.	Number of springs.	Flow in gallons per hour.	Temperature (Degrees Fahr.).	Character of the water.	Remarks.
Adirondack Mineral Springs, Whitehall, Washington county.	2	200	38	Chalybeate	Used commercially.
Albany Artesian Well (500 feet), Albany, Albany county.	1			Saline	
Auburn Spring, 4 miles west of Auburn, Cayuga county.	1			Sulphureted	Has a local reputation and is sold to small extent.
Avon Sulphur Springs, Avon, Livingston county.	4	7,660	50	do	Used commercially and as a resort.
Ballston Spa Springs, Ballston, Saratoga county.					Resort.
Artesian Lithia Spring	1	5	52	Saline	Used commercially.
Franklin Spring	1		52	do	
Iron Spring	1	4,000		do	
Sans Souci Spring	1			do	
United States Spring	1		50	do	
Washington Lithia Well	1		49	do	do
Barton Sulphur Spring, near Waverly, Tioga county.					
Byron Acid Spring, Byron, Genesee county.				Acid	
Cairo White Sulphur Springs, Cairo, Greene county.				Sulphureted	Resort.
Calcic springs:					
Near Sempronius, Cayuga county					
Near Chateaugay, Franklin county					
On Otsquago Creek, Stark Township, Herkimer county.					
Near Starkville, Herkimer county.					
At Caledonia, Livingston county					
Near Cartersville, Monroe county					Unimproved.
In southwestern part of Wheatland Township, Monroe county.					do
In Cather's Cave, near Niagara Falls, Niagara county.					
Near Syracuse, Onondaga county					
At Manlius Centre, Onondaga county.					
At Onondaga, Onondaga county					
North of Otisco lake outlet, Onondaga county.					
At Schoharie, Schoharie county					
Four miles northwest of Gouverneur, St. Lawrence county.					
Near Ithaca, Tompkins county					
In Washington county					
Canoga Springs, Canoga, Seneca county					
Cayuga Mineral Spring, 2½ miles north of Cayuga, Cayuga county.	1	50			Used commercially.
Chalybeate springs:					
Five miles northwest of Auburn, Cayuga county.					Used locally for medicinal purposes.
Four or five miles from West Troy, Albany county.					
South of Canaan Centre, Columbia county.					
Livingston, Columbia county					
Near Sidney Plains, Delaware county.					
Two miles from Bloomville, Delaware county.					
Three miles above Walton, Delaware county.					
Near Upton pond, Dutchess county					
Near Kline's Corners, Dutchess county.					
Near Williamsville, Erie county					
Two miles north of Elba, Genesee county.					
North part of Warren Township, Herkimer county.					
Bethel, in Stark Township, Herkimer county.					
South part of Pittsford Township, Monroe county.					Unimproved.
Near Lewiston, Niagara county					
Van Buren Township, Onondaga county.					
Near West Point, Orange county					
Shawangunk Mt., Orange county					

Mineral Springs of New York — (*Continued*).

NAME AND LOCATION.	Number of springs.	Flow in gallons per hour.	Temperature (Degrees Fahr.).	Character of the water.	Remarks.
Chalybeate springs — (*Continued*):					
Near Sand Lake, Rensselaer county	......	....	......	....	
In Richmond county	......	....	......	....	
Between West Neck and Lloyd's Neck, Suffolk county.	......	....	......	....	
Near North Blenheim, Schoharie county.	......	....	... ..	....	
In Steuben county.............	......	....	......	....	
Three miles from Sag Harbor, Suffolk county.	......	....	......	....	
Horton's Point, Suffolk county.....	......	....	......	....	Small and unimportant
Hudson's Point, Riverhead, Suffolk county.	......	....	......	....	
East Hampton, Suffolk county	.....	....	......	....	
At Little Cow Harbor, Suffolk county.	......	....	......	....	Unimportant.
At North Salem, Westchester county.	......	....	......	....	
Chappaqua Spring, Chappaqua, Westchester county.	......	....	......	....	
Cherry Valley Phosphate Spring, Cherry Valley, Otsego county.	1	10	.... .	....	Not used at present.
Cherry Valley Springs, Cherry Valley, Otsego county.	2	....	......	Sulphureted	
Chittenango White Sulphur Springs, Chittenango, Madison county.	3	....	49½	do	Resort.
Chlorine Springs, Syracuse, Onondaga county.	5	2,000	49	Saline...........	Used commercially and as a resort.
Clifton Springs, Clifton Springs, Ontario county.	3+	....	54	Sulphureted	Resort.
Clinton Spring, Cliff street, New York, New York county.	......	....	......	....	
Columbia White Sulphur Springs, 4 miles north of Hudson, Columbia county.	4	....	55	Saline, sulphureted.	do
Crystal Springs, Crystal Spring, Yates county.	6	1,250+	48	....	do
Dansville Springs, Dansville, Livingston county.	4	1,000	......	Alkaline, calcic.	Sanitarium and resort.
Darien Mineral Spring, Darien Centre, Genesee county.	1	40?	.....	Acid	Used commercially.
Darrow Spring, south of Baldwinsville, Onondaga county.	1	....	.....	Calcic, sulphur.	Has a local reputation.
Deep Rock Springs, Oswego, Oswego county.	2	....	50	Sulphureted, saline.	Used commercially and as a resort.
Diamond Rock Mineral Well, Williamson, Wayne county.	1	30	44	Sulpho-saline ...	Used commercially and as a resort.
Doxtatter's Mineral Well (Longmuir's Well), Rochester, Monroe county.	1	....	52	Saline, sulphureted.	Used for bathing.
Dryden Springs, ½ mile west of Dryden, Tompkins county.	....	....	48 to 54	Chalybeate and sulphureted, saline.	Resort.
Elkhorn Springs, north of Manlius Village, Onondaga county.	3	....	50	Saline, sulphureted.	Local resort.
Excelsior Spring, Syracuse, Onondaga county.	1	1,000	48	Saline...........	Used commercially and as a resort.
Fairport Mineral Springs, Fairport, Monroe county.	2	....	......	Sulphureted, etc.	Has a local reputation.
Florida Springs, Florida Township, Montgomery county.	2	....	43	Sulphureted	Local resort.
Franklin Springs, Cowlesville, Wyoming county.	1	....	40	....	Resort.
Grove Springs, near Hammondsport, Steuben county.	......	....	......	....	
Halleck's Spring, near Westmoreland, Oneida county.	1	....	......	Saline...........	Was improved and used as a resort about 1838 to 1840, but is now unimproved.
Harrowgate Springs, Rensselaer county, 3 miles from Albany.	......	....	. ....	Sulphureted	
Kingsley Springs, near Marion, Wayne county.	3	....	40	Saline?..........	Unimproved.
Lebanon Thermal Spring, Lebanon Springs, Columbia county.	1	30,000	75	Chalybeate......	Used commercially and as a resort.
Lockport Mineral Spring, 1½ miles north of Lockport, Niagara county.	.....	....	......	Saline.....	Unimproved, but used by residents of Lockport.
Madrid Springs, Madrid Springs, St. Lawrence county.	......	....	......	....	Unimproved at present.

Mineral Springs of New York — (*Continued*).

NAME AND LOCATION.	Number of springs.	Flow in gallons per hour.	Temperature (Degrees Fahr.).	Character of the water.	Remarks.
Massena or St. Regis Springs, St. Lawrence county.	2	700+	45	Saline, sulphureted.	Used commercially and as a resort.
Massena Sulphur Springs, 3 miles east of Syracuse, Onondaga county.	3	5	50	Sulphureted	
Mineral Springs, 1½ miles northwest of Cayuga, Cayuga county.	......	....	......	....	Has local reputation and is sold.
Mineral Springs, Mineral Springs, Schoharie county.	2	120	44	....	Unimproved at present; was once a resort.
Mineral springs:					
At Watervliet Centre, Albany county.	......	....	......	Sulphureted, chalybeate, carbonated.	
At Montezuma, Cayuga county	......	....	......	Saline............	Unimportant.
Near Crown Point, Essex county..	......	....	......	do	
Northwestern part of Columbia Township, Herkimer county.	......	....	......	....	
Two miles northeast of Pittsford, Monroe county.	......	....	......	Saline, sulphureted.	Sold to some extent.
North of Elbridge, Onondaga county.	1	....	......	Saline ?..........	Unimproved.
At Quaker Springs, Saratoga county.	......	....	......	Sulphureted.....	do
Monroe Springs, 5 miles from Rochester, Monroe county.	......	....	......	do	
Nanticoke Sulphur Springs, near Lamb's Corners, Broome county.	......	....	......	....	
Nunda Mineral Springs, Nunda, Livingston county.	3	30	......	Saline........ ...	Resort and water is sold.
Oak Orchard Acid Springs, Alabama, Genesee county.	8	....	......	Acid and chalybeate.	Used commercially.
Pitcher Springs, Pitcher Springs, Chenango county.	......	....	......	Sulphureted	
Pittsford Sulphur Springs, Olcott's farm, northwest part of Pittsford Township, Monroe county.	......	....	......	do	Once a resort.
Reid's Mineral Spring, South Argyle, Washington county.	1	8	......	Carbonated, saline.	Local resort.
Richfield Springs, Richfield Springs, Otsego county.	3	....	47	Sulphureted, chalybeate and saline.	Resort.
Riga Mineral Springs, Riga, Monroe county.	.....	....	......	Carbonated, chalybeate.	
Sauquoit Sulphur Spring, near Sauquoit, Oneida county.	1	4	.....	Saline	Unimproved.
Saratoga Springs, Saratoga county	......	....	......	....	Resort.
Champion Spring.........	1	2,500	49	Saline carbonated.	Used commercially.
Columbian Springs.................	4	....	55	Saline carbonated.	do
Congress Spring	......	....	51	Saline carbonated.	do
Crystal Springs.....................	6	129	.....	....	
Ellis Spring	1	....	......	....	Surface spring.
Empire Spring.................. ...	.....	....	......	Saline carbonated.	Used commercially.
Eureka Spring	......	....	......	....	Not in general use at present.
Excelsior Spring	1	33	45	Saline carbonated.	Used commercially.
Flat Rock Spring............	......	....	......	Saline carbonated.	
Geyser Spring	3	900+	46	Saline carbonated.	do
Hamilton Spring	......	....	49½	....	
Hathorn Spring.....................	......	....	......	Saline carbonated.	do
High Rock and Apollis Springs	2	1,000	......	Saline carbonated.	do
Indian Encampment Spring........	......	....	......	....	Abandoned.
Lake Sulphur Spring..........	......	....	......	....	
Minnehaha Spring................	......	....	......	....	
Monroe Spring.............	......	....	......	....	
Old Red Spring	1	60	......	Saline carbonated.	Used commercially.
Pavilion Spring.....................	1	12,000	50	Saline carbonated.	Not used commercially at present.
Putnam Springs	2	24	40	Saline carbonated.	Used commercially.
Saratoga A (or alum) Spring...	......	....	......	....	

MINERAL SPRINGS OF NEW YORK — (*Continued*).

NAME AND LOCATION.	Number of springs.	Flow in gallons per hour.	Temperature (Degrees Fahr.).	Character of the water.	Remarks.
Saratoga Springs — (*Continued*).					
Saratoga Seltzer Spring	1	......	50	Saline carbonated.	Not used commercially at present.
Star Spring (formerly Walton or Iodine Spring).	1	80	50	Saline carbonated.	Used commercially.
Triton Spring (Kissingen)	......	......	......	......	do
Union Spring	1	12	48	Saline carbonated.	do
United States Spring	......	......	......	......	
Vichy Spring	1	240	50	Alkaline, saline carbonated.	do
Walton Spring (same as Star)	......	......	......	......	
Washington Spring	......	......	45	Carbonated saline.	do
White Sulphur Springs	2	2,400 +	48	......	Used for bathing.
Seneca Spa or Deer Lick Springs, 4 miles east of Buffalo, Erie county.	......	......	......	Sulphureted	
Sharon Springs, Sharon Springs, Schoharie county.	5	7,680 +	48	Alkaline and saline, sulphureted.	Used commercially and as a resort.
Shee's Spa, McDonough Township, Chenango county.	......	......	......	Sulphureted.....	
Slaterville Magnetic Springs, Slaterville, Tompkins county.	27	2,700 ?	47	......	Used commercially and as a resort.
Spencer Springs, Spencer, Tioga county.	......	......	......	......	
Sulphur springs:					
At Wendell's Hollow, near Albany, Albany county.	......	......	......	......	
At Coeymans, Albany county	......	......	......	......	
At Guilderland, Albany county	......	......	......	......	
Four miles west of Rensselarville, Albany county.	......	......	......	......	
Two miles west of Auburn, Cayuga county.	......	......	......	......	Unimproved.
One and one-half miles north of Auburn, Cayuga county.	......	......	......	......	do
Two miles north of Union Springs, Cayuga county.	2	......	......	......	
Near Randolph, Cattaraugus county.	......	......	......	......	
Near Van Buren Harbor, Chautauqua county.	......	......	......	......	
Near Fredonia, Chautauqua county	......	......	......	......	
Near Sheridan, Chautauqua county	......	......	......	......	
Near Laona, Chautauqua county	......	......	......	......	do
Two miles from Norwich, Chenango county.	......	......	......	......	
Near Pharsalia, Chenango county	......	......	......	......	
Near Beekmantown, Clinton county.	......	......	......	......	
Near Kinderhook, Columbia county	......	......	......	......	do
Near Millers, in Claverack Township, Columbia county.	......	......	......	......	Unimportant.
At Oakhill, near Catskill, Columbia county.	......	......	......	......	Unimproved.
At Preble, Cortland county	......	......	......	......	
Three miles from Chehocton, Delaware county.	......	......	......	......	
Near Amenia, Dutchess county	......	......	......	......	do
At Grand Island, Erie county	......	......	......	......	
In Amherst Township, Erie county,	......	......	......	......	
Clarence Township, Erie county	......	......	......	......	
One and one-half miles west of Durham, Greene county.	......	......	......	......	do
One mile from Catskill, Greene county.	......	......	......	......	do
Three-fourths mile west of Athens, Greene county.	......	......	......	......	
Four miles west of Athens, Greene county.	......	......	......	......	
Near Richfield Springs, Warren Township, Herkimer county.	6	......	......	......	Used locally.
Near Starkville, Herkimer county,	......	......	......	......	
Near Winfield, Herkimer county	......	......	......	......	
In Danube Township, Herkimer county.	......	......	......	......	
At Mohawk, Herkimer county	......	......	......	......	
Near Newville, Herkimer county	......	......	......	......	

Mineral Springs of New York — (*Concluded*).

Name and location.	Number of springs.	Flow in gallons per hour.	Temperature (Degrees Fahr.).	Character of the water.	Remarks.
Sulphur springs — (*Continued*).					
Near Martinsburg, Lewis county	......	....	......	....	
At Caledonia, Livingston county	......	....	......	....	
One-half mile south of Spencerport, Monroe county.	......	....	......	....	
In Gates Township, Monroe county	......	....	......	....	
In Mendon Township, Monroe county.	......	....	......	....	
At Ogden, Monroe county	......	....	......	....	
In Deep Hollow valley, northwestern part of Rochester, Monroe county.	......	....	......	....	Used locally.
In Niagara county, 2 miles from Tonawanda.	......	....	......	....	
Near Niagara Falls, Niagara county	......	....	......	....	
Above Lewiston, Niagara county	......	....	......	....	
North part of Pendleton Township, Niagara county.	......	....	......	....	
In Augusta, Oneida county	......	....	......	....	
Near Vernon, Oneida county	......	....	......	....	
Near Paris, Oneida county	......	....	......	....	
West of Elbridge, Onondaga county	......	....	......	....	
South of Manlius village, Onondaga county.	......	....	......	....	
In Caruthers (?) Township, Onondaga county.	......	....	......	....	
Near Syracuse, Onondaga county	......	....	......	....	
Near Split Rock, Onondaga county	......	....	......	....	
Lake Sodom, near Manlius Centre, Onondaga county.	......	....	......	....	
In La Fayette Township, Onondaga county.	......	....	......	....	Used locally for medicinal purposes.
At outlet of Canandaigua lake, Ontario county.	......	....	......	....	
Two and one-half miles from Newburgh, Orange county.	......	....	......	....	
In New Windsor Township, Orange county.	......	....	......	....	
In Holley, Orleans county	2	....	......	....	Weak and unimportant.
North end of Troy, Rensselaer county.	......	....	......	....	
Near Bath, Rensselaer county	......	....	......	....	
Near Waterloo, Seneca county	......	....	......	....	
Near Campbell, Steuben county	1	....	......	....	Unimportant.
At Jasper, Steuben county	10	....	......	....	
Near Hammondsport, Steuben county.	......	....	......	....	
Two and one-half miles southwest of Sag Harbor, Suffolk county.	......	....	......	....	
At Tioga Centre, Tioga county	......	....	......	....	
West of Springtown, Ulster county	......	....	......	....	
Two miles southeast of Ithaca, Tompkins county.	......	....	......	....	
Near Newark, Wayne county	......	....	......	....	Unimportant.
Near Palmyra, Wayne county	......	....	......	....	Unimportant.
In Sodus Township, Wayne county	......	....	......	....	
At Clyde, Wayne county	3	....	......	....	Unimportant.
Near Marion, Wayne county	4	....	......	....	Only one spring utilized.
Sulphur well, Peterson's farm, northwest of Rochester, Monroe county.	......		......	....	Unimproved.
Sulphuric acid springs:					
North part of Alabama Township, Genesee county.	......	....	......	....	
In Elba Township, Genesee county	......	....	......	....	
Near South Byron, Genesee county	......	....	......	....	
Union Springs, Union Springs, Cayuga county.	2	10	......	Sulphureted and chalybeate.	Unimproved.
Vallonia Springs, Vallonia Springs, Broome county.	......	....	......	....	
Verona Mineral Springs, near Verona, Oneida county.	4	160+	48	Saline	Used to some extent commercially and as a resort.
Victor Spring, Darien Centre, Genesee county.	1	40	......	Acid saline	Used commercially.
Yates Sulphur Springs, 1 mile south of Chittenango, Madison county.	......	....	......	....	
Yellow Spring, Southampton (Long Island), Suffolk county.	......	....	......	Chalybeate	Unimportant.

Analyses of Mineral Springs in New York.

CONSTITUENTS.	Adirondack Spring.	Albany Artesian Well.		Auburn Spring, West Auburn.
Solids.	*Grains per gallon.* a	*Grains per gallon.* b	*Grains per gallon.* c	*Grains per gallon.* d
Sodium carbonate	5.14	40.00	40.00	....
Potassium carbonate	5.32	....	....	....
Calcium carbonate	18.54	32.00	32.00	....
Magnesium carbonate	16.62	16.00	12.00	....
Lithium carbonate	0.02	....	....	....
Manganese carbonate	Trace.	....	....	....
Iron carbonate	5.04	e 8.00	8.00	....
Calcium sulphate	11.13	....	....	120.00
Magnesium sulphate	....	....	....	25.60
Sodium chloride	14.34	504.00	472.00	6.00
Calcium chloride	....	....	4.00	....
Magnesium chloride	....	....	....	2.00
Alumina	Trace.	....	....	....
Silica	0.74	....	....	....
Total	76.89	600.00	568.00	153.60
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	....	....	....	12.00
Carbonic acid	67.27	184.00	....	....
Total	67.27	184.00	208.00	12.00

CONSTITUENTS.	Avon Sulphur Springs.			
	Upper Spring. f	Lower Spring.	New Bath Spring.	Congress Hall Spring.
Solids.	*Grains per gallon.* g	*Grains per gallon.* d	*Grains per gallon.* c	*Grains per gallon.* h
Calcium carbonate	8.00	29.33	26.96	9.25
Sodium sulphate	16.00	13.73	38.72	21.02
Calcium sulphate	84.00	57.44	3.52	27.61
Magnesium sulphate	10.00	49.61	8.08	19.07
Sodium chloride	18.40	....	5.68	29.11
Calcium chloride	....	8.41	....	....
Sodium iodide	....	i Trace.	....	....
Sodium sulphide	....	....	....	
Calcium sulphide	....	....	....	99.55
Magnesium sulphide	....	....	....	
Total	136.40	158.52	82.96	205.61
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	12.00	10.02	31.28	27.63
Carbonic acid	5.60	3.92	....	22.04
Oxygen	....	0.56	....	0.97
Nitrogen	....	5.42	....	3.88
Total	17.60	19.92	....	54.52

a C. Collier, analyst. b Wm. Meade, analyst (1827). c L. C. Beck, analyst (1842).
d J. R. Chilton, analyst. e With silica. f Same as Middle Spring of Beck's report.
g J. Hadley, analyst. h H. M. Baker, analyst (1874). i Contains iodine and bromine.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Ballston Spa Springs.				
	Sans Souci Spring.	Artesian Lithia Spring.	Franklin Artesian Well.	United States.	Washington Lithia Well (Old Conde Dentonian).
Solids.	*Grains per gallon.*a	*Grains per gallon.*b	*Grains per gallon.*c	*Grains per gallon.*d	*Grains per gallon.*e
Sodium carbonate	12.66	......	......	16.88	......
Sodium bicarbonate	......	11.93	94.60	......	34.40
Calcium carbonate	43.41	......	......	f 29.20	......
Calcium bicarbonate	......	238.16	202.33	......	173.48
Magnesium carbonate	......	......	......	5.76	......
Magnesium bicarbonate	39.10	180.60	177.87	......	158.35
Strontium bicarbonate	......	0.87	Trace	......	0.19
Lithium bicarbonate	......	7.75	6.78	......	15.51
Iron carbonate	5.95	......	......	......	......
Iron bicarbonate	......	1.58	1.61	......	2.30
Barium bicarbonate	......	3.88	1.23	......	4.74
Sodium sulphate	......	......	......	1.76	......
Potassium sulphate	......	0.52	0.76	......	......
Sodium phosphate	......	0.05	0.01	......	Trace
Sodium biborate	......	Trace	Trace	......	Trace
Sodium chloride	143.73	750.03	659.34	424.96	645.48
Potassium chloride	......	33.28	33.93	......	9.23
Sodium bromide	......	3.64	4.67	......	2.87
Calcium fluoride	......	Trace	Trace	......	Trace
Sodium iodide	1.30	0.12	0 24	......	0.22
Alumina	......	0.08	0.26	......	0.40
Silica	1.00	0.76	0.74	8.00	1.03
Organic matter	......	Trace	Trace	......	Trace
Total	247.15	1,233.25	1,184.37	486.56	1,047.70
Gases.					
Carbonic acid	......	426.114	460.066	244.00	358.345

CONSTITUENTS.	Chittenango Springs.			Clifton Springs Sulphur Spring.	Columbia White Sulphur Springs.
	White Sulphur Spring.	Cave Spring.	Magnesia Spring.		
Solids.	*Grains per gallon.*c	*Grains per gallon.*c	*Grains per gallon.*c	*Grains per gallon* g	*Grains per gallon.*h
Calcium carbonate	......	......	......	9.68	21.79
Magnesium carbonate	......	......	......	13.12	......
Magnesinm bicarbonate	22.02	23.97	......	......	......
Iron carbonate	......	......	20.78	......	......
Iron bicarbonate	0.08	0.16	0.32	......	......
Sodium hyposulphite	......	0.26	0.02	......	8.15
Sodium sulphate	0.21	......	......	7.76	......
Calcium sulphate	81.42	106.12	115.09	69.20	64.94
Strontium sulphate	Trace	Trace	Trace	......	......
Magnesium sulphate	1.95	7.59	12.72	16.48	......
Sodium phosphate	......	......	......	......	2 14
Sodium chloride	1.04	1.57	1.83	9.28	84.72
Calcium chloride	......	......	......	4.08	......
Potassium chloride	0.16	0.23	0.33	......	1.19
Magnesium chloride	......	......	......	4.08	31.43
Lithium chloride	Trace	Trace	Trace	......	......
Iron sesquichloride	......	......	......	......	3.42
Sodium sulphide	0.12	0.39	0.75	......	......
Calcium sulphide	......	1.12	0.93	......	......
Alumina	0.08	0.22	Trace	......	......
Silica	0.28	0.52	0.58	......	......
Sulphur	Trace	......	......	......	......
Loss	......	......	......	......	0.82
Organic matter	......	......	......	Trace	......
Total	107.36	142.15	153.35	133.68	218.60
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	0.884	2 754	5.623	Present	4.491
Carbonic acid	20.480	15.934	19.436	Present	......

a John H. Steele, analyst (1830). b C. F. Chandler, analyst (1868). c C. F. Chandler, analyst. d L. C. Beck, analyst. e C. F. Chandler, analyst (1869). f With iron oxide. g J. R. Chilton, analyst (1852). h Atwood, analyst.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Barton Sulphur Springs.	Cherry Valley Springs		
		Bath-house Spring.	Spring north of bath-house.	Phosphate Spring.
Solids.	*Grains per gallon.*a	*Grains per gallon.*b	*Grains per gallon.*c	*Grains per gallon.*c
Sodium carbonate	11.12	...	...	...
Calcium carbonate	3.65	9.41	14.75	2.87
Magnesium carbonate	1.99	17.82	9.96	4.58
Iron carbonate	...	...	2.45	0.62
Ammonium carbonate	6.95	...	...	...
Sodium sulphate	...	11.08	...	...
Calcium sulphate	0.20	57.68	149.46	5.27
Magnesium sulphate	...	24.56	...	...
Calcium phosphate	...	...	...	13.77
Sodium chloride	2.05	12.44	2.13	0.47
Calcium chloride	...	2.80	...	...
Potassium chloride	0.11	...	2.49	...
Magnesium chloride	...	3.68	...	...
Calcium sulphide	...	0.60	...	...
Iron oxide, Alumina	0.36	0.36	...	...
Silica	1.16	...	3.64	0.62
Sulphur	1.52	...	...	...
Organic matter	...	0.28	...	...
Carbonic acid	2.62	...	...	...
Total	31.73	140.71	184.88	28.20
Gases.				
Oxygen	0.20	...	...	...

CONSTITUENTS.	Cherry Valley Springs. Phosphate Spring.	Yates Sulphur Springs.	Doxtatter's, or Longmuir's Well, Rochester.	Verona Mineral Springs.
Solids.	*Grains per gallon.*d	*Grains per gallon.*e	*Grains per gallon.*e	*Grains per imp. gal.*f
Calcium carbonate	...	7.04	g 11.84	38.47
Magnesium bicarbonate	17.27	...	...	...
Manganese bicarbonate	0.01	...	...	...
Iron bicarbonate	0.20	...	...	...
Sodium sulphate	0.04	13.28	55.92	...
Calcium sulphate, Magnesium sulphate	41.13 / 0.47	102.00	...	63.19
Potassium sulphate	0 46	...	...	...
Strontium sulphate	Trace	...	...	...
Lithium sulphate	0.02	...	...	...
Barium sulphate	0.01	...	...	...
Calcium phosphate (acid)	0.60	...	...	...
Sodium biborate	Trace	...	...	...
Sodium nitrate	Trace	...	...	...
Sodium chloride	0.68	1.12	...	562.89
Calcium chloride	...	...	52.16	82.61
Potassium chloride	...	...	...	4.06
Magnesium chloride	...	...	...	27.11
Lithium chloride	...	...	...	2.37
Sodium bromide	Trace	...	...	...
Alumina	0.14	...	...	...
Silica	0.29	...	...	0.59
Organic matter	Trace	Trace	...	...
Total	61.32	123.44	119.92	784.29
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	...	...	17.28	...
Carbonic acid	...	...	Trace	...

a F. F. Thomas, analyst. b J. R. Chilton, analyst. c Perkins, analyst. d C. F. Chandler analyst (1876). e L. C. Beck, analyst (1842). f Peter Collier, analyst (1870). g With magnesium carbonate and iron oxide.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Crystal Springs.	Deep Rock Mineral Spring.	Florida Spring.	Halleck's Spring.
Solids.	*Parts in* 100.a	*Grains per gallon*.b	*Grains per gallon*.c	*Grains per gallon*.d
Sodium bicarbonate			22.14	
Calcium carbonate		18.19		
Calcium bicarbonate			8.32	
Magnesium bicarbonate			6.97	
Sodium hyposulphate			0.71	
Calcium sulphate				40.00
Potassium sulphate			1.39	
Sodium chloride		308.18	5.88	624.00
Calcium chloride				104.00
Potassium chloride		149.68		
Magnesium chloride		10.25		32.00
Iron sulphide			0.18	
Sodium sulphide			2.01	
Magnesia	.003			
Lime	.008			
Iron oxide	.001	Trace.		
Alumina	Trace.		Trace.	
Silica	Trace.	71.70	0.79	
Soda	.001			
Chlorine	.003			
Iodine and phosphoric acid	Trace.			
Carbonic acid (combined)	.012			
Sulphuric acid	.001	Trace.		
Loss		1.78		
Total	0.029	559.18	48.39	800.00
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Carbureted hydrogen				Trace.
Sulphureted hydrogen	Trace.		3.765	
Carbonic acid	Trace.	Undetermined.	32.169	Trace.

CONSTITUENTS.	Lebanon Thermal Spring.	Nunda Mineral Springs.	Chlorine Spring.	Excelsior Spring.	Lockport Mineral Spring.
Solids.	*Grains per gallon*.e	*Grains per gallon*.f	*Grains per gallon*.g	*Grains per gallon*.g	*Grains per gallon*.h
Sodium carbonate	2.41				
Calcium carbonate	4.04	104.10	22.38	15.24	9.27
Iron carbonate		1.05			
Calcium sulphate		184.41	38.63	36.45	5.72
Potassium sulphate	1.04				
Magnesium sulphate	1.06	203.58			
Sodium chloride	0.96	6.82	646.42	538.53	111.42
Sodium sulphide	0.02				
Iron oxide	0.94		Present.		0 05
Alumina	0.45	Trace.		1.02	
Silica	3.25	000.12	0.29		0.90
Organic matter	10.21				Trace.
Magnesium carbonate					3.21
Sodium sulphate			26.28	13.16	
Calcium chloride					45.08
Potassium chloride					3.52
Magnesium chloride			17.86	17.69	11.04
Magnesium bromide				0.15	
Sodium bromide					1.57
Sodium iodide					2.36
Free carbonic acid			Present.	Present.	
Total	24.38	500.08	751.86	668.24	194.14
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen					2.86
Carbonic acid	0.48				5.79
Oxygen	2.00				
Nitrogen	3.52				

a J. Fowler, analyst (1880). b S. H. Douglas, analyst (1871). c C. F. Chandler, analyst (1870). d J. Noyes, analyst. e H. Dussance, analyst. f S. A. Lattimore, analyst (1878). g Charles A. Goessman, analyst (1868). h J. Hadley, analyst (1861).

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Sharon Springs.				
	White Sulphur Spring.	Magnesia Spring.	Red Sulphur Spring.	Gardner Magnesia Spring.	Eye-Water Spring.
Solids.	*Grains per gallon.* a	*Grains per gallon.* a	*Grains per gallon.* b	*Grains per gallon.* c	*Grains per gallon.* a
Sodium bicarbonate	....	....	0.49	0.54	....
Calcium bicarbonate	....	....	12 93	9.70	....
Magnesium bicarbonate	24.00	30.50	0.69	1.36	32.00
Calcium sulphate	85.40	76.00	96.64	93.50	77.50
Magnesium sulphate	34.00	22.70	18.96	19.68	7.50
Sodium chloride }	2.70	3.00	0 33	1.28	2.50
Magnesium chloride }			0.73	0.44	
Calcium chloride	....	....	0.07	0.16	....
Calcium sulphide }	3.00	0.50	0.89	0.63	....
Magnesium sulphide }					
Silica	....	....	0.45	0.40	....
Total	149.10	132.70	132.18	127.64	119.50
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	20.50	3.30	10.50	6.00	....
Carbonic acid	....	....	4.58	2.22	....
Atmospheric air	....	....	4.00	3.00	....

CONSTITUENTS.	Sharon Springs.			
	Chalybeate Spring.	Gardner Magnesia Spring.	Red Sulphur Spring.	White Sulphur Spring.
Solids.	*Grains per gallon.* d	*Grains per gallon.* e	*Grains per gallon.* e	*Grains per gallon.* f
Sodium carbonate	....	0.34	0.34	....
Calcium carbonate	....	6.73	8.97	....
Magnesium carbonate	8.96	0.80	0.41	....
Sodium sulphate	3.74	....	....	....
Calcium sulphate	63.80	93.59	96.64	55.84
Potassium sulphate	Trace.	....	....	....
Magnesium sulphate	8.15	19.68	18.96	21.29
Iron protosulphate	1 40	....	....	....
Sodium chloride	....	1.23	0.33	1.12
Calcium chloride	....	0.16	0.06	....
Magnesium chloride	....	0.43	0 73	1.20
Sodium sulphide	....	....	....	g 1.12
Calcium sulphide }	....	6.25	0.89	....
Magnesium sulphide }	....			
Silica	....	0.40	0 45	....
Organic matter	28.48	....	....	....
Total	114.53	129.52	127.78	80.48
Gases.	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*	*Cubic inches.*
Sulphureted hydrogen	....	6.00	10.48	8.00
Carbonic acid	....	2.21	4.56	....
Atmospheric air	....	3.00	4.00	....
Total	....	11.21	19 04	8.00

a Lawrence Reid, analyst (1845). b J. G. Pohle, analyst. c J. G. Pohle, analyst (1865). d Maische, analyst (1861). e Lawrence Reid, analyst. f J. R. Chilton, analyst. g With extractive matter.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Oak Orchard Acid Springs.					
	Spring No. 1.		Spring No. 2.	Oak Orchard Acid Water.		
Solids.	*Grains per gallon.* a	*Grains per gallon.* b	*Grains per gallon.* c	*Grains per gallon.* d	*Parts in* 1,000. e	*Parts in* 1,000. f
Sodium sulphate	6.34	....	....	3.16	0.12	0.09
Calcium sulphate	74.89	39.60	12.41	13.72	1.11	1.12
Potassium sulphate	5.52	....	....	2.48	0.11	0.08
Aluminium sulphate	21.69	9.68	....	6.41	0.37	0.32
Magnesium sulphate	35.60	8.28	4.98	8.49	0.46	0.53
Iron sulphate	....	....	39.23	....	0.43	0.42
Iron protosulphate	28.62	14.32	....	32.22	....	....
Sodium chloride	2.44	....	....	1.43	....	0.04
Silica	4 59	1.04	1.84	3.33	0.06	0.07
Chlorine	....	....	....	....	Trace.	....
Organic matter	....	3.28	10.88	6.65	Trace.	....
Sulphuric acid	134.73	82.96	129.06	133.31	2.01	2.01
Total	314.42	159.16	198.40	211.20	4.67	4.68

CONSTITUENTS.	Massena or St. Regis Springs.	Massena Sulphur Springs.	Richfield Springs.				
			Name of spring unknown.	Sulphur Spring.	White Sulphur Spring.	Iron Spring.	Magnesia Spring.
Solids.	*Grains per gall.* g	*Grains per gall.* h	*Grains per gall.* i	*Grains per gall.* j	*Grains per gall.* k	*Grains per gall.* i	*Grains per gall.* i
Calcium carbonate	....	14.80	6.96	....	....	....	....
Calcium bicarbonate	4.85	....	....	24.47	....	11.71	16.11
Magnesium carbonate	....	....	11.84	....	....	....	....
Magnesium bicarbonate	....	....	....	6.01	31.74	12.52	3.97
Iron bicarbonate	0.49	....	....	0.24	Trace.	4.92	0.13
Sodium hyposulphate	4.21	....	....	....	....	....	....
Sodium sulphate	0.50	....	....	22.29	....	0.30	12.79
Sodium hydrosulphate	....	....	....	....	0.38	....	....
Calcium sulphate	60.03	68.40	20.00	67.39	112.34	5.00	38.63
Potassium sulphate	....	....	....	....	1.67	....	....
Strontium sulphate	....	....	....	....	0.01	....	....
Magnesium sulphate	....	10.88	30.00	32.82	5.15	....	18.81
Barium sulphate	....	....	....	....	Trace.	....	....
Sodium phosphate	1.32	....	....	....	....	....	....
Calcium phosphate	....	....	....	....	Trace.	....	....
Sodium chloride	76.79	....	l 1.49	21.73	0.52	0.43	10.20
Calcium chloride	....	10.64	....	....	....	....	....
Potassium chloride	0.51	....	....	8.23	....	....	4.51
Magnesium chloride	29.93	....	....	....	....	....	....
Lithium chloride	....	....	....	....	0.02	....	....
Magnesium bromide	0.67	....	....	....	....	....	....
Sodium sulphide	1.40	....	....	....	1.72	....	....
Sodium and calcium sulphide	....	....	....	6.22	....	....	0.06
Calcium sulphide	....	....	....	....	0.09	....	....
Calcium & magnesium sulphides	....	....	2.00	....	....	....	....
Alumina	....	....	....	0.10	Trace.	....	....
Silica	....	....	....	1.35	0.64	0.81	1.17
Organic matter	m 11.18	....	n 153.50	....	....	....	....
Total	191.88	104.72	225.79	190.85	154.28	35.69	106.38
Gases.	*Cub. in.*	*Cub. in.*	*Cub. in.*	*Cub. in.*	*Cub. in.*	*Cub. in.*	*Cub. in.*
Sulphureted hydrogen	5.307	....	24.24	3.6288	14.206	....	0.3160
Carbonic acid	....	....	....	2.9412	....	15.9236	2.2032

a Silliman & Norton, analysts. b J. R. Chilton, analyst. c E. Emmons, analyst. d Porter, analyst. e H. Erni, analyst (1850). f W. J. Craw, analyst (1850). g Ford F. Mayer, analyst. h L. C. Beck, analyst. i Lawrence Reid, analyst. j Theo. Deecke, analyst. k C. F. Chandler, analyst. l With magnesium chloride. m With silicate of soda. n Undetermined matter.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Saratoga Springs.				
	Champion Spouting Spring.	Columbian Springs.	Crystal Springs.	Congress Spring.	
	Grains per gallon.a	*Grains per gallon*.b	*Grains per gallon*.c	*Grains per gallon*.d	*Grains per gallon*.e
Solids.					
Sodium carbonate	...	...	...	...	16.00
Sodium bicarbonate	17.62	15.40	10.06	8.98	...
Calcium carbonate	...	68.00	...	98.10	144 00
Calcium bicarbonate	227.07	...	101.88	...	...
Magnesium bicarbonate	193.91	46.71	75.16	95.79	32.00
Strontium bicarbonate	0.08	...	Trace.	...	...
Lithium bicarbonate	6.25	...	4.33	...	...
Iron carbonate	...	5.58	...	5.07	...
Iron bicarbonate	0.65	...	2.04	...	...
Barium bicarbonate	2.08	...	0.73	...	...
Potassium sulphate	0.25	...	2 16	...	...
Sodium phosphate	0.01	...	Trace.	...	...
Sodium biborate	Trace.	...	Trace.	...	...
Sodium chloride	702.24	267.00	328.47	385.00	434.40
Potassium chloride	40.45	...	8.33	...	...
Potassium bromide	...	Trace.	...	Trace.	...
Sodium bromide	3.58	...	0.41	...	...
Calcium fluoride	Trace.	...	Trace.	...	...
Sodium iodide	0.23	2.56	0.06	3.50	...
Alumina	0.46	...	0.31	...	...
Silica	0.70	2.05	3.21	1.50	f Trace.
Organic matter	Trace.	...	Trace.	...	...
Total	1,195.58	407.30	527.15	597.94	626.40
Gases.					
Atmospheric air	...	4.50	...	7.00	...
Azote	...	...	...	...	7.20
Carbonic acid	465.46	272.06	317.45	311.00	312.80

CONSTITUENTS.	Saratoga Springs.				
	Congress Spring.			Empire Spring.	
	Grains per gallon.a	*Grains per gallon*.g	*Grains per gallon*.h	*Grains per gallon*.c	*Grains per gallon*.i
Solids.					
Sodium carbonate	...	0.56	7.20	...	...
Sodium bicarbonate	10.77	...	...	9.02	20.85
Calcium carbonate	...	116.00	86.14	...	...
Calcium bicarbonate	143.40	...	...	109.66	141.82
Magnesium carbonate	...	56.80	78.62	...	...
Magnesium bicarbonate	121.76	...	...	42.96	41.98
Strontium bicarbonate	Trace.	...	...	Trace.	...
Lithium bicarbonate	4.76	...	...	2.08	...
Iron carbonate	...	...	0.84	...	...
Iron bicarbonate	0.34	...	...	0.79	Trace.
Barium bicarbonate	0.93	...	...	0.07	...
Sodium sulphate	...	...	0.65	...	...
Potassium sulphate	0.89	...	...	2.77	...
Sodium phosphate	0.02	...	...	0.02	...
Sodium biborate	Trace.	...	...	Trace.	...
Sodium chloride	400.44	385.44	363 83	506.63	269.70
Potassium chloride	8.05	...	...	4.29	...
Potassium bromide	...	Trace.	j 5.92	...	...
Sodium bromide	8.56	...	...	0.27	...
Calcium fluoride	Trace.	...	...	Trace.	...
Sodium iodide	0.14	4.02	...	Trace.	k 12.00
Iron oxide	...	0.64	...	...	...
Alumina	Trace.	...	0.32	0.42	...
Silica	0.84	...	0.47	1.46	...
Organic matter	...	...	...	Trace.	...
Total	700.90	563.46	543.99	680.44	496.35
Gases.					
Atmospheric air	...	...	5.41	...	...
Carbonic acid	392.30	...	284.65	344.67	...

a C. F. Chandler, analyst (1871). b John H. Steele, analyst (prior to 1838). c C. F. Chandler, analyst. d John H. Steele, analyst. e J. D. Dana, analyst. f With iron. g Davy and Faraday, analysts, London. h J. R. Chilton, analyst (1843). i E. Emmons, analyst. j With sodium iodide. k Or iodine.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Saratoga Springs.				
	Eureka Spring.	Excelsior Spring.	Flat Rock Spring.		Geyser Spouting Spring.
Solids.	*Grains per gallon.*a	*Grains per gallon.*b	*Grains per gallon.*c	*Grains per gallon.*d	*Grains per gallon.*e
Sodium bicarbonate	8.75	15.00	20.79	9.10	71.23
Calcium carbonate	...	...	60.57	...	...
Calcium bicarbonate	41.32	77.00	...	98.63	168.39
Magnesium bicarbonate	29.34	32.33	42.70	29.47	149.34
Strontium bicarbonate	...	...	...	0.01	0.43
Lithium bicarbonate	...	...	...	3.23	9.00
Iron carbonate	...	...	5.39	...	...
Iron bicarbonate	3.00	3.22	...	0.09	0.98
Barium bicarbonate	...	...	...	0.10	2.01
Sodium sulphate	...	1.32	...	...	...
Potassium sulphate	...	...	...	0.48	0.32
Strontium sulphate	...	Trace.	...	...	...
Magnesium sulphate	2.15	...	...	...	...
Sodium phosphate	...	...	...	0.04	Trace.
Sodium biborate	...	...	...	Trace.	Trace.
Sodium chloride	166.81	370.64	148.87	108.85	562.08
Potassium chloride	...	...	...	7.99	24.64
Magnesium chloride	...	...	...	10.83	...
Potassium bromide	1.57	Trace.	Trace.	...	...
Sodium bromide	...	...	...	0.32	2.21
Calcium fluoride	...	...	...	...	Trace.
Sodium iodide	4.67	4.24	1.33	0.01	0.25
Alumina	0.23	...	Trace.	0.04	Trace.
Silica	0.53	...	Trace.	1.34	0.66
Organic matter	...	...	...	Trace.	Trace.
Sodium silicate	...	4.00	...	...	...
Potassium silicate	...	7.00	...	...	...
Total	258.37	514.75	279.65	270.53	991.54
Gases.					
Atmospheric air	...	...	6.50	...	...
Carbonic acid	239.00	250.00	287.50	...	454.08

CONSTITUENTS.	Saratoga Springs.				
	Hamilton Spring.		Hathorn Spring.	High Rock Springs.	
Solids.	*Grains per gallon.*f	*Grains per gallon.*a	*Grains per gallon.*g	*Grains per gallon.*g	*Grains per gallon.*f
Sodium carbonate	...	34.25	...	...	...
Sodium bicarbonate	27.04	...	4.29	34.89	17.54
Calclum carbonate	92.40	97.99	...	...	69.29
Calcium bicarbonate	...	...	170.65	131.74	...
Magnesium carbonate	...	39.06	...	...	...
Magnesium bicarbonate	35.20	...	176.46	54.92	61.59
Strontium bicarbonate	...	...	Trace.	Trace.	...
Lithium bicarbonate	...	...	11.45	...	...
Iron carbonate	...	4.62	...	...	5.58
Iron bicarbonate	5.39	...	1.13	1.48	...
Barium bicarbonate	...	...	1.74	Trace.	...
Potassium sulphate	...	...	...	1.61	...
Sodium phosphate	...	...	Trace.	...	...
Calcium phosphate	...	...	...	Trace.	...
Sodium biborate	...	...	Trace.	...	...
Sodium chloride	297.30	298.66	509.97	390.13	189.10
Potassium chloride	...	...	9.60	8.50	...
Potassium bromide	Trace.	...	...	...	Trace.
Sodium bromide	...	...	1.53	0.73	...
Calcium fluoride	...	...	Trace.	Trace.	...
Sodium iodide	3.00	3.59	0.19	0.08	2.50
Alumina	...	...	0.13	1.22	Trace.
Silica	...	1.00	1.26	2.26	Trace.
Organic matter	...	...	Trace.	Trace.	...
Total	460.33	479.17	888.40	627.56	345.60
Gases.					
Atmospheric air	4.00	...	...	...	5.00
Carbonic acid	316.00	320.00	375.75	409.46	304.00

a Allen, analyst. b Allen, analyst (1879). c John H. Steele, analyst. d C. F. Chandler, analyst (1885) e C. F. Chandler, analyst (1870). f John H. Steele, analyst (prior to 1838). g C. F. Chandler, analyst.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Saratoga Springs.			
	Kissingen or Triton Spring.	Pavilion Spring.		Putnam Spring.
Solids.	*Grains per gallon.*a	*Grains per gallon.*b	*Grains per gallon.*c	*Grains per gallon.*c
Sodium carbonate	....	....	4.92	....
Sodium bicarbonate	67.62	3.76	....	14.32
Calcium carbonate	....	....	52.84	....
Calcium bicarbonate	140.26	120.17	....	68.80
Magnesium carbonate	....	....	56.92	....
Magnesium bicarbonate	70.47	76.27	....	51.60
Strontium bicarbonate	Trace.	Trace.	....	....
Lithium bicarbonate	5.13	9.49	....	....
Iron carbonate	....	....	3.51	....
Iron bicarbonate	1.56	2.57	....	7.00
Barium bicarbonate	0.99	0.88	....	....
Sodium sulphate	....	....	1.48	1.68
Potassium sulphate	Trace.	2.03	....	....
Sodium phosphate	....	Trace.	....	0.21
Calcium phosphate	....	....	0.19	....
Sodium biborate	....	Trace.	....	....
Sodium chloride	338.50	459.90	187.68	214.00
Potassium chloride	16.98	7.66	....	....
Potassium bromide	....	....	d2.59	Trace.
Sodium bromide	1.80	0.99	....	....
Calcium fluoride	Trace.	Trace.	....	....
Sodium iodide	0.04	0.07	....	2.00
Alumina	Trace.	0.33	0.42	0.56
Silica	1.28	3.16	1.16	0.84
Organic matter	....	Trace.	....	....
Total	644.63	687.28	311.71	361.01
Gases.				
Carbonic acid	361.50	332.46	359.50	326.40
Atmospheric air	....	....	5.30	6.40

CONSTITUENTS.	Saratoga Springs.			
	New Putnam Spring.	Red Spring.	Saratoga A or Alum Spring.	Seltzer Spring.
Solids.	*Grains per gallon.*b	*Grains per gallon* c	*Grains per gallon.*f	*Grains per gallon.*g
Sodium bicarbonate	8.08	15.33	6.75	29.43
Calcium bicarbonate	157.56	101.26	56.85	89.87
Magnesium bicarbonate	173.61	42.41	20.48	40.34
Strontium bicarbonate	0.11	Trace.	....	Trace.
Lithium bicarbonate	9.83	0.94	1.72	0.90
Iron bicarbonate	0.45	....	1.72	1.70
Barium bicarbonate	0.38	....	....	Trace.
Sodium sulphate	....	....	2.50	....
Calcium sulphate	....	....	0.45	....
Potassium sulphate	2.26	....	0.37	0.56
Magnesium sulphate	....	....	0.29	....
Sodium phosphate	Trace.	....	....	Trace.
Calcium phosphate	....	....	....	Trace.
Sodium biborate	Trace.	....	....	Trace.
Sodium chloride	268.04	83.53	565.30	134.29
Calcium chloride	....	....	Trace.	....
Potassium chloride	14.87	6.86	0.36	1.34
Magnesium chloride	....	....	Trace.	....
Sodium bromide	1.52	....	....	0.63
Calcium fluoride	Trace.	....	....	Trace.
Sodium iodide	Trace.	....	....	0.03
Boracic acid	....	....	....	Trace.
Iron oxide	....	} b2.10 {	....	....
Alumina	0.22		0.38	0.37
Silica	3.00	3.25	1.46	2.56
Organic matter	Trace.	....	Trace.	Trace.
Total	640.03	255.68	658.63	302.02
Gases.				
Carbonic acid	....	....	212.00	324.08

a Sharples, analyst (1872). b C. F. Chandler, analyst (1882). c J. R. Chilton, analyst (1840). d With sodium iodide. e Appleton, analyst. f J. G. Phole, analyst. g C. F. Chandler, analyst (1869). h With traces of phosphates.

ANALYSES OF MINERAL SPRINGS IN NEW YORK — (*Continued*).

CONSTITUENTS.	SARATOGA SPRINGS.			
	Star Spring.	Union Spring.		United States Spring.
Solids.	*Grains per gallon.* a	*Grains per gallon.* b	*Grains per gallon.* c	*Grains per gallon.* a
Sodium carbonate	...	12.80	...	...
Sodium bicarbonate	12.66	...	17.01	4.67
Calcium carbonate	...	41.60	...	...
Calcium bicarbonate	124.46	...	96.70	93.12
Magnesium carbonate	...	84.27	...	...
Magnesium bicarbonate	61.91	...	109.69	72.88
Strontium bicarbonate	Trace.	...	Trace.	0.02
Lithium bicarbonate	1.50	...	2.61	4.85
Iron carbonate	...	5.45	...	...
Iron bicarbonate	1.21	...	0.27	0.71
Barium bicarbonate	0.10	...	1.70	0.91
Potassium sulphate	5.40	...	1.82	...
Sodium phosphate	Trace.	...	0.03	0.02
Sodium biborate	Trace.	...	Trace.	Trace.
Sodium chloride	398.36	243.62	453.80	141.87
Potassium chloride	9.70	...	8.73	8.62
Potassium bromide	...	Trace.	...	...
Sodium bromide	0.57	...	1.30	0.84
Calcium fluoride	Trace.	...	Trace.	Trace.
Sodium iodide	0.13	3.60	0.04	0.05
Alumina	Trace.	1.57	0.32	0.09
Silica	1.28		2.65	3.19
Organic matter	Trace.	...	Trace.	Trace.
Total	617.37	392.91	696.17	331.84
Gases.				
Carbonic acid	407.65	344.16	384.97	245.73
Atmospheric air	...	4.62	...	...

CONSTITUENTS.	SARATOGA SPRINGS.			
	Vichy Spring.	Walton or Iodine Spring (Star Spring).	Washington Spring.	
Solids.	*Grains per gallon.* a	*Grains per gallon.* d	*Grains per gallon.* e	*Grains per gallon.* f
Sodium carbonate	...	2.00	...	...
Sodium bicarbonate	82.87	...	8.48	16.50
Calcium carbonate	...	26.00	...	99.60
Calcium bicarbonate	95.52	...	84.10	...
Magnesium carbonate	...	75.00	...	...
Magnesium bicarbonate	41.50	...	65.27	40.92
Strontium bicarbonate	Trace.	...	...	...
Lithium bicarbonate	1.76	...	...	...
Iron carbonate	...	1.00	...	3.25
Iron bicarbonate	0.05	...	3.80	...
Barium bicarbonate	0.59	...	...	...
Potassium sulphate	Trace.	...	...	...
Magnesium sulphate	...	...	0.05	...
Sodium phosphate	Trace.	...	...	...
Sodium biborate	Trace.	...	...	...
Sodium chloride	128.69	187.00	182.73	281.50
Calcium chloride	...	...	0.20	...
Potassium chloride	14.11	...	...	...
Magnesium chloride	...	...	0.68	...
Potassium bromide	...	...	0.47	...
Sodium bromide	0.99	...	...	...
Calcium fluoride	Trace.	...	...	...
Sodium iodide	Trace.	3.50	2.24	2.75
Alumina	0.48	...	Trace.	...
Silica	0.76	...	1.50	1.50
Organic matter	Trace.	...	...	...
Total	367.32	294.50	350.22	439.01
Gases.				
Carbonic acid	383.07	326.00	363.77	262.50
Atmospheric air	...	4.00	...	6.80

a C. F. Chandler, analyst. b J. R. Chilton, analyst (1841). c C. F. Chandler, analyst (1873).
d E. Emmons, analyst (1839). e J. R. Chilton, analyst. f John H. Steele, analyst (prior to 1838).

Minerals Not Commercially Important.

In addition to the minerals which have already been mentioned there are many deposits in New York which are not at present of commercial importance. These may be roughly classified as metallic minerals and non-metallic minerals. In the first class are iron pyrites, arsenopyrite, chromite, chalcopyrite, cuprite, galenite, cerusite, sphalerite, wad or bog manganese, millerite and molybdenite. The galenite and pyrites have respectively yielded small quantities of silver and gold at certain places, but at no locality in New York have enough of the precious metals been found at any time to pay for the expense of extracting them. From time to time capital is invested for the purpose of gold or silver mining in New York, but always without practical results. The experience of 50 years has shown that neither in New York nor in England have either of the metals been found in paying quantities.

The following† is a list of the principal localities at which these various metallic minerals are to be found:

Iron, Sulphur, Arsenic.

Pyrite, iron pyrites, bisulphide of iron.—Anthony's nose, Montgomery, Westchester county, mine formerly worked; Phillip ore bed, Phillipstown, Patterson, southeast of Carmel and near Ludington mills, in Putnam county; with galena at Wurtsboro lead mine, Sullivan county; Flat creek, Montgomery county; near Canton, St. Lawrence county, in extensive beds; Duane, Franklin county, large bed; Martinsburg, Lewis county; Eighteen-mile creek, Erie county, and many other localities, sparingly in rocks.

Arsenopyrite, mispickel.— Near Edenville, Orange county, with arsenical iron and orpiment, in a vein in white limestone; near Pine pond in Kent, and near Boyd's Corner, Putnam county. These localities have been opened, but not worked for arsenic.

† From an article by I. C. Smock in Mineral Resources of the U. S., Washington, 1882.

Chromite, chrome iron ore.— In serpentine, Phillipstown, Putnam county; Wilks' mine, Monroe, Orange county.

Copper.

Chalcopyrite, copper pyrites; sulphide of iron and copper.— Ancram lead mine, Columbia county; Bockee mine, Columbia county; near Edenville, Orange county; with arsenopyrite; near Wurtsboro, Sullivan county, with galena in considerable abundance; Ellenville and Red Bridge lead mines, Ulster county; near Rossie, and also near Canton, in St. Lawrence county, once worked. Many additional occurrences are reported where it is in small quantity.

Cuprite, red oxide of copper.— Near Ladentown, Rockland county, in thin seams, in traprock.

Lead.

Galenite, galena; sulphide of lead.— Otisville, Orange county; Ellenville and Red Bridge, Ulster county; with copper pyrites and blende in a gangue of quartz in Oneida conglomerate, mines no longer worked; Wurtsboro, Sullivan county; near Sing Sing, in Westchester county; northeast township, Dutchess county; Ancram, Columbia county; strings of galena, blende and pyrites in limestone; White creek, Washington county; Martinsburg, Lewis county; Spraker's basin, Montgomery county; Rossie and vicinity, St. Lawrence county; *mines largely worked years ago;* ore occurs in vein with blende, pyrites and copper pyrites. These mines have all been idle for several years.

Cerusite, carbonate of lead.— Rossie, Robinson, Ross, and other lead mines, in St. Lawrence county; Martinsburg, Lewis county; near Sing Sing, on Hudson, associated with galena, in small quantity.

Zinc.

Sphalerite, zinc blende; sulphide of zinc.— Associated with galena at lead mines in Sullivan, Ulster and Orange counties; Ancram, Columbia county; Flat creek, Montgomery county; Salisbury, Herkimer county; Martinsburg, Lewisburg, Lewis county; Cooper's Falls, Mineral Point, and in Fowler, St. Lawrence county.

Manganese.

Wad, earthy manganese, bog manganese.— In town of Austerlitz, Columbia county, are several localities; also in Hillsdale and Canaan, same county; smaller deposits near Houseville, Lewis county, and southeast of Warwick, Orange county.

Nickel.

Millerite, sulphide of nickel.— Sterling iron mine, Antwerp, Jefferson county, famous for crystalline forms.

Molybdenum.

Molybdenite; sulphide of molybdenum.— West Point and near Warwick, Orange county; Phillip mine, Putnam county; Clinton county, but sparingly, in granite rocks.

Non-Metallic Minerals.

Under the heading of non-metallic minerals which do not occur in New York in sufficient quantity to be of economic importance may be enumerated apatite, barite, calcite, muscovite, biotite, serpentine, asbestus and magnesite. The principal localities for these minerals are given herewith:

Calcite, calcareous tufa, travertine; carbonate of lime.—Vicinity Schoharie Courthouse, Schoharie county; Sharon Springs, a large deposit; Howe's Cave, Schoharie county; near Catskill, Greene county; head of Otsquaga creek, Stark, Herkimer county; Saratoga Springs; near Syracuse and in Onondaga valley, Onondaga county; between Camillus and Canton, same county; near Arkport, Steuben county; near Ellicott's mills, Erie county, and many lesser deposits.

Fluorite, fluorspar; fluoride of lime.— Muscalonge lake, Alexandria, Jefferson county, very fine crystals; Lowville, Lewis county; Niagara, county, at Lockport; Auburn, Cayuga county; Rossie and Mineral Point, St. Lawrence county.

Apatite, phosphate of lime.— Hammond, St. Lawrence county, crystalline, with calcite, zinc ore and feldspar; near Gouverneur, St. Lawrence county, crystals in calcite, Vrooman lake, Jefferson county; Greenfield, Saratoga county; near Hammondsville, Essex county; with magnetite in some of iron ores near Port Henry; other localities of occurrence.

Barite, barytes, heavy spar; sulphate of baryta.— Ancram, Columbia county; near Schoharie Courthouse, with strontianite, in Water-lime group; Carlisle, Schoharie county; near Little Falls and Fairfield, Herkimer county; near Syracuse, Onondaga county; Pillar Point, Jefferson county, in large veins; Hammond and De Kalb, St. Lawrence county.

Magnesite, carbonate of magnesia.— Near Rye, Westchester county; Warwick, Orange county; New Rochelle, Westchester county; Stony Point, Rockland county; Serpentine hills, Staten Island; everywhere in thin seams and strings.

Muscovite, mica.— As a rock constituent, common In large plates near Warwick and at Greenwood at Mount Basha pond, in Orange county; Pleasantville, Westchester county, once opened and mined; Henderson, Jefferson county; Potsdam and Edwards, in St. Lawrence county.

Serpentine.— Staten Island, near New Rochelle and near Rye, Westchester county; Phillipstown, Putnam county; near Amity, Orange county, verd antique; Johnsburg and Warrensburg, Warren county; Shelving rock, Lake George, Washington county; Gouverneur, Fowler, Edwards and Pitcairn townships, in St. Lawrence county; other localities of occurrence in small quantity.

Coal and Lignite.

Coal and lignite, while they occur in New York, can never be found in commercial quantities. The coal measures of Pennsylvania are not found north of the boundary line between Pennsylvania and New York, and what coal has been discovered in the latter State is in older formations which do not contain this valuable mineral in commercial quantities. Many thousands of dollars have been spent in fruitless efforts to obtain coal in New York, but year after year persons appear in the field who seem anxious to pay for their own experience. It can not be too strongly urged upon the attention of the people of the State that it is absolutely useless to seek for coal in New York.

Coal.—Woodstock, Ulster county, thin vein in Catskills, worked out; in the seams interstratified with shales, in Chautauqua, Erie, Livingston and Seneca counties.

Lignite, brown coal.— Near Rossville, Staten Island, thin seam in clay; also in Suffolk county in clays.

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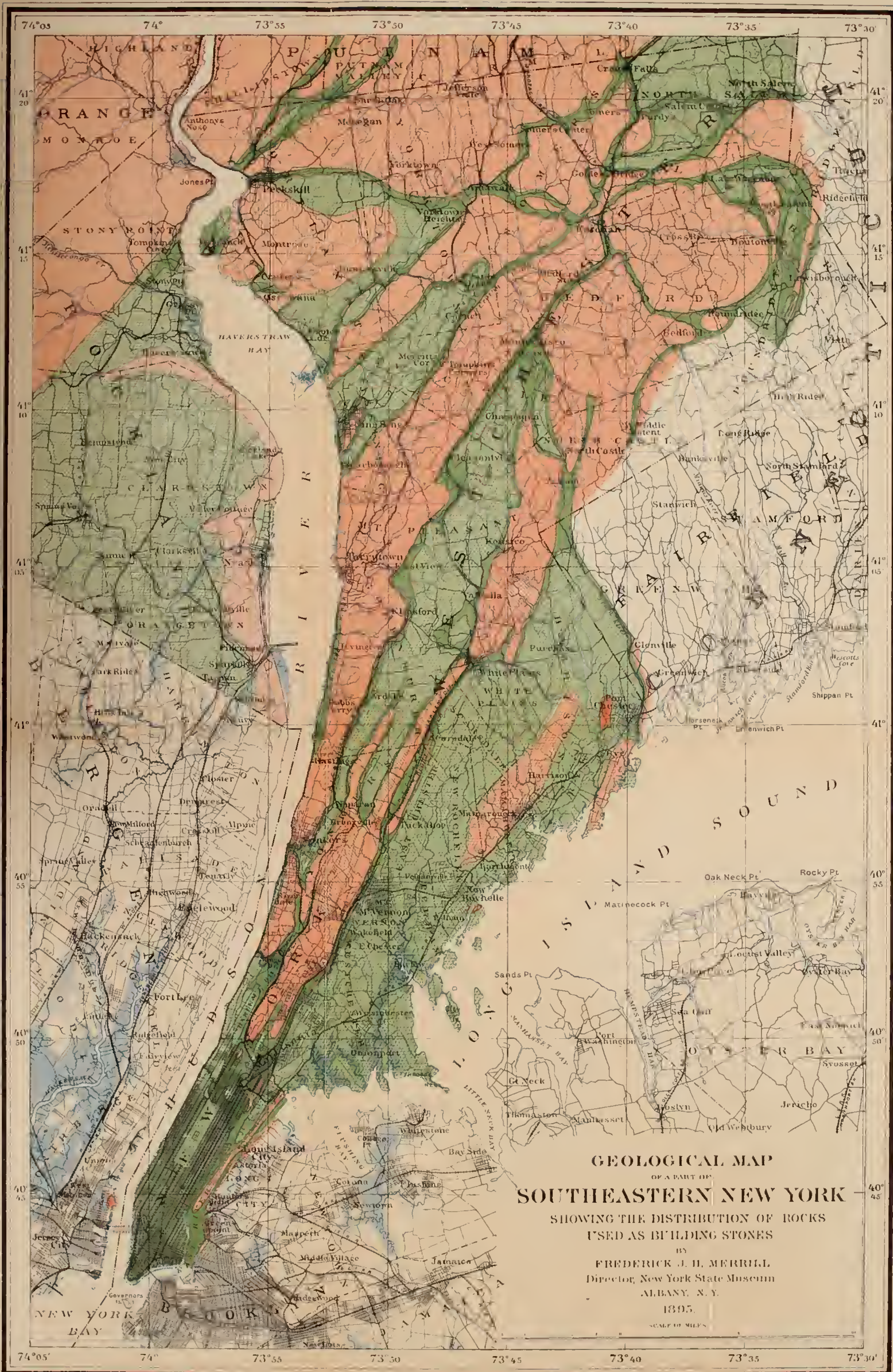

LEGEND.

GEOLOGICAL AGE AND CHARACTER

	IGNEOUS					TRIASSIC	LOWER SILURIAN		PRECAMBRIAN
	TRIASSIC DIABASE	ALTERED BASIC ROCKS	CORTLAND SERIES	HARRISON DIORITE	YONKERS GNEISS		HUDSON RIVER	CALCIFEROUS-TRENTON	
SCIENTIFIC NAME	DIABASE	SERPENTINE	DIORITE AND NORITE	GRANITE DIORITE	GNEISSOID GRANITE	SANDSTONE	MICA SCHIST	DOLOMITE	GNEISS AND GRANITE
COMMERCIAL NAME	TRAP		TRAP	GRANITE	GRANITE	SANDSTONE		MARBLE	GRANITE

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