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University of the State of New York

BULLETIN

OF THE

New York State Museum

Vol. 3 No. 13

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

M34m-895-1500

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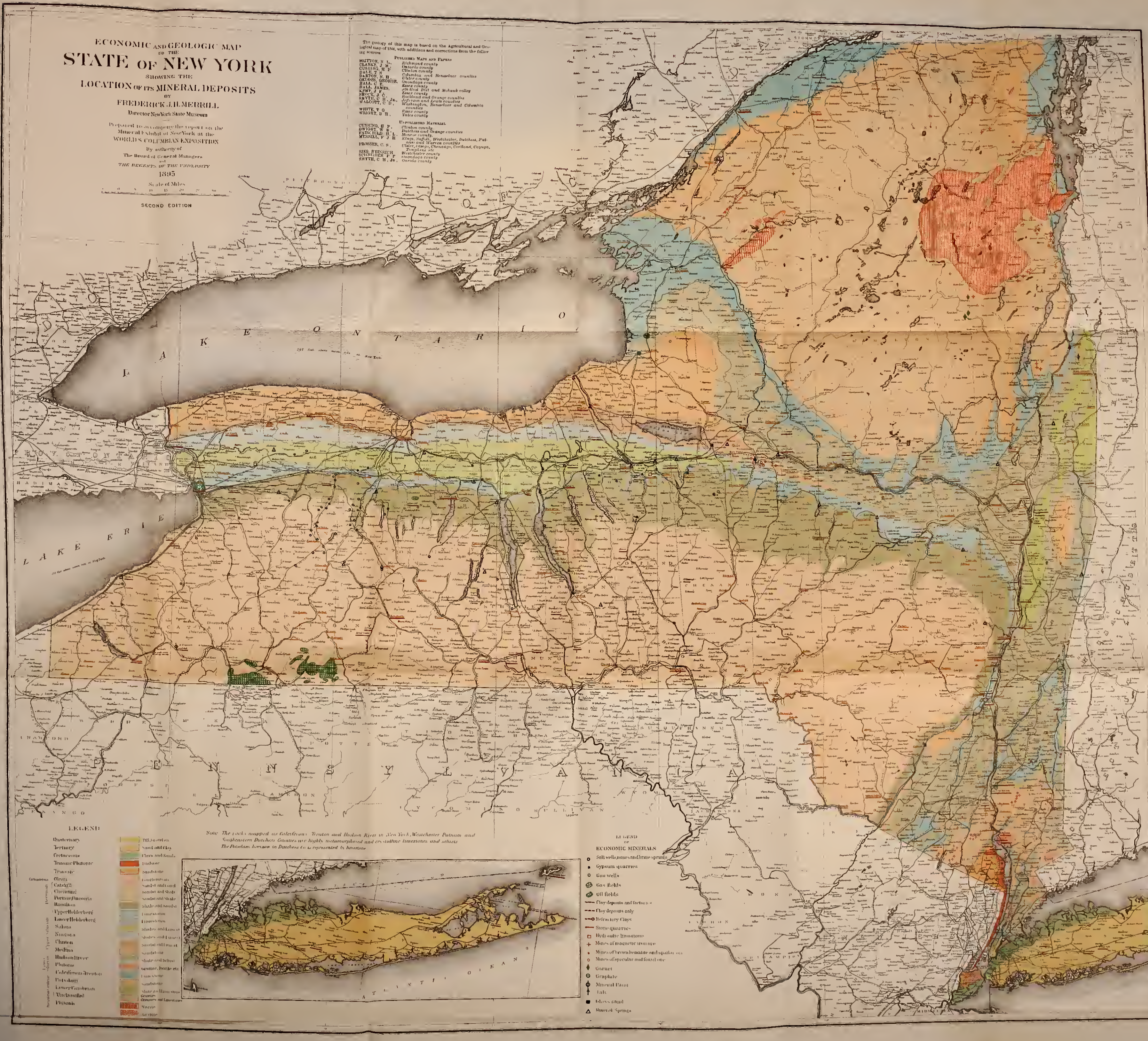
ECONOMIC AND GEOLOGIC MAP
OF THE
STATE OF NEW YORK
SHOWING THE
LOCATION OF ITS MINERAL DEPOSITS
BY
FREDERICK J. H. MERRILL
Director New York State Museum
Prepared to accompany the report on the Mineral Exhibit of New York at the WORLD'S COLUMBIAN EXPOSITION
By authority of
The Board of General Managers
and
THE REGENTS OF THE UNIVERSITY
1893
Scale of Miles
SECOND EDITION
The geology of this map is based on the Agricultural and Geological map of 1844, with additions and corrections from the following sources
PUBLISHED MAPS AND PAPERS
BRITTON, N. L., Richmond county
CLARKE, J. M., Ontario county
CUSHING, H. P., Clinton county
DALE, T. N., Columbia and Rensselaer counties
DARTON, N. H., Ulster county
GEDDES, GEORGE, Onondaga county
HALL, C. E., Essex county
HALL, JAMES, 4th Geol. Dist. and Mohawk valley
KEMP, J. F., Essex county
SMOCK, J. C., Rockland and Orange counties
SMYTH, C. H., Jr., Jefferson and Lewis counties
WALCOTT, C. D., Washington, Rensselaer and Columbia counties
WHITE, T. G., Essex county
WRIGHT, B. H., Yates county
UNPUBLISHED MATERIAL
CUSHING, H. P., Clinton county
DWIGHT, W. B., Dutchess and Orange counties
FAIRCHILD, H. L., Monroe county
MERRILL, F. J. H., Kings, Suffolk, Westchester, Dutchess, Putnam and Warren counties
PROSSER, C. S., Ulster, Otsego, Chenango, Cortland, Cayuga, Tompkins etc.
RIES, HEINRICH, Westchester county
SCHNEIDER, P. F., Onondaga county
SMYTH, C. H., Jr., Oneida county
LAKE ONTARIO
LAKE ERIE
PENNSYLVANIA
ATLANTIC OCEAN
LEGEND
Quaternary
Tertiary
Cretaceous
Triassic Plutonic
Triassic
Olean
Catskill
Chemung
Portage/Oneonta
Hamilton
Upper Helderberg
Lower Helderberg
Salina
Niagara
Clinton
Medina
Hudson River
Plutonic
Calciferous-Trenton
Potsdam
Lower Cambrian
Unclassified
Plutonic
Sand and Clay
Clays and Sands
Diabase
Sandstone
Sandst. and Shale
Sandst. and Shale
Limestone
Limestone
Sandstone
Shale and Schist
Granite, Diorite etc.
Sandstone
Norite
Note The rocks mapped as Calciferous, Trenton and Hudson River in New York, Westchester, Putnam and Southeastern Dutchess Counties are highly metamorphosed and crystalline limestones and schists
The Potsdam horizon in Dutchess Co. is represented by limestone
LEGEND
OF
ECONOMIC MINERALS
Salt wells, mines and brine springs
Gypsum quarries
Gas wells
Gas fields
Oil fields
Clay deposits only
Refractory Clays
Stone quarries
Hydraulic limestone
Mines of magnetic iron ore
Mines of brown hematite and spathic ore
Mines of specular and fossil ore
Garnet
Graphite
Mineral Paint
Talc
Glass sand
Mineral Springs

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TABLE OF CONTENTS.

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 complete 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.

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 hyper-

sthene 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 Mr. Heinrich Ries,* the oil pools by Messrs. C. A. Ashburner and D. Van Ingen, the salt wells by R. D. White, Jr., C. E., and the gypsum quarries by Wm. C. Clarke, E. M. The other mineral localities were mapped by the author.

In preparing the base, various practical difficulties had to be met. Among these were the lack of accurate information concerning the boundaries of the Chemung and Catskill formations in New York, the impossibility of undertaking any new field work, and the lack of sufficient funds to permit of more than fifteen printings in the press work of the map. It has, therefore, been necessary to emphasize the economic character of the map rather than the geologic character, to associate in color, rocks of similar economic or lithologic features, and for lack of information and funds for printing, to indicate without differentiation the great mass of sandstones, shales and conglomerates included between the base of the Portage and the top of the Catskill.

When the large geologic map of New York, now in preparation by the State Geologist, is published and distributed, there will be a definite expression of opinion on the boundaries of these formations, but at present there is no official presentation of the subject.

The map will be found in the pocket of the cover of the bulletin and the legend will explain the various tints and symbols used.

Geologic Map of Westchester and New York Counties.

Since the scale of the State economic map is not sufficiently large to give in detail the areas of building stone, in New York and Westchester counties, a map of that region is published on a scale of four miles to one inch. This map is based on the studies of the author and shows the present state of geologic knowledge in that region.

Economic Minerals of New York.

Under this head are described the minerals of New York which are commercially important. So far as possible a directory 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.

* 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 southeastern 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

* 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.

* 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 millstones.

The accessibility of the outcrops to the New York, Lake Erie and Western railroad, the New York, Ontario and Western railroad, 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 Skunnemunk 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 railway 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.

* 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 building 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

* 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.

* 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.

* 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 exclusively. 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 re-

strictions 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 1859 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 building 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 engtb, 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 town 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 un-

favorable 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 $44,577, making a total value of $120,603.

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 silicio-

magnesian 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 foothills 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 20.77 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 Pough-

keepsie 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 loca-

tion 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.	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.	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	Martin, 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.	"	" "
"	Guinna, 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, T. 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.	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.	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.	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.	"	"	"
"	Mullen, 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.	"	"	"
"	Baban, 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, John.	"	"	"
"	.....	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.	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		Clarendon	Orleans.
Clayton		Clayton	Jefferson.
Cobleskill		Cobleskill	Schoharie.
"		"	"
Crown Point		Crown Point	Essex.
Dolgeville	Murphy, M	Oppenheim	Fulton.
Dover Plains	Denney, Leander	Dover Plains	Dutchess.
"	Brandenstein, John.* L. S.	"	"
Fayetteville	Reilly, Wm.* "	Manlius	Onondaga.
Fort Edward		Whitehall	Washington.
Fort Plain	Dodge, Alfred.* L. S.	Fort Plain	Montgomery.
Franklin Iron Works	Ketcham, Geo. W	Augusta	Oneida.
Glens Falls	Preston Quarries	Queensbury	Warren.
"	Ransier, Huestis B.* L. S.	"	"
"	Harris, John F.* L. S.	"	"
"		"	"
Gouverneur	Juhl, M.† L. S.	Gouverneur	St. Lawrence.
"	Glens Falls Co.* L. S. & M.	"	"
"	Glens Falls Portland Cement Co	"	"
"	Jointa Lime Co.* L. S	"	"
"	Reynolds & Riordan.* L. S.	"	"
Greenwich	Empire State Marble Co M	Greenwich	Washington.
Harrisville	Gouverneur Marble Co.* M	Diana	Lewis.
Hastings	Northern New York Marble Co.* M.	Hastings	Westchester.
Holland Patent	St. Lawrence Marble Co.* M	Trenton	Oneida.
Hoosick Falls	Whitney Marble Co M	Hoosick	Rensselaer.
"	Bennett, H. C * L. S.	"	"
"	Brady, Mary.† "	"	"
Howe's Cave		Howe's Cave	Schoharie.
Hudson	Hillidge, James G.* L. S.	Hudson	Columbia.
	Carey, Wm.* "		
	Dolan, Jno.* "		
	McCaffery, Cornelius		
	Howe's Cave Association* L. S		
	Jones, F. W. M		

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.	D ver	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.*	R chester	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.

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 have 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. 382.

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.	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., O. 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.	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.*	Coxsackie	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*		
Evans	Bolton, Wm.* *C. B*	Elmira	"
Farmingdale	The Queens County Brick Manufacturing Co.* *C. B*	Evans	Erie.
Fishkill	Dinan, Thos.* "	Oyster Bay	Queens.
"	Dinan & Butler	Fishkill	Dutchess.
"	McClure & Co	"	"
"	McClean, Alex.† *C. B*	"	"
"	Page & Sherman	Catskill	Greene.
Fishkill Landing	Dow, Geo.* *C. B*	Fishkill	Dutchess.
"	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.	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.	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	"	"
Rodman	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.	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, Stephen.*	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	Carbonate Ore.
		Spathic Iron 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 McIntye 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

* 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 suc-

ceeded 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-shapped 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 ess than th 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, West chester 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 1885, 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 350 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	.....	48	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 Canandalgua 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	16.52	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				99.55
Calcium sulphide				
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	.....	2.37
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	1.08
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	359.345

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	.....
Magnesium 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	0.30	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		3.63		
Calcium sulphide		0.60		
Iron oxide	0.36	0.36		
Alumina				
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.	Yates Sulphur Springs.	Doxtatter's, or Longmuir's Well, Rochester.	Verona Mineral Springs.
	Phosphate Spring.			
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	17.97			
Manganese bicarbonate	0.01			
Iron bicarbonate	0.20			
Sodium sulphate	0 04	13.28	55.92	
Calcium sulphate	41.13	102.00		63.19
Magnesium sulphate	0.47			
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		562.80
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	731.29
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			8.33	
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	.002			
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	24.28	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 Maguesia 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	22.00
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	1.23	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	35.84
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	1.30
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.*l	*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	.....	1 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.	
Solids.	*Grains per gallon.*a	*Grains per gallon.*b	*Grains per gallon.*c	*Grains per gallon.*d	*Grains per gallon.*e
Sodium carbonate	.....	.....	.....	.....	16.00
Sodium bicarbonate	17.62	15.40	10.06	8.98	.....
Calcium carbonate	.....	68.00	.....	98.10	144 00
Calcium bicarbonate	237.07	.....	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.	
Solids.	*Grains per gallon.*a	*Grains per gallon.*g	*Grains per gallon.*h	*Grains per gallon.*c	*Grains per gallon.*i
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	344.07	.....

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 iodiue.

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	.....	.....	.....	0.61	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	.....	.....	.....	10.88	.....
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	84.89	17.54
Calcium 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	.....	.....	Trac	.....	.....
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 1888). g C. F. Chandler, analyst.

Analyses of Mineral Springs in New York — (*Continued*).

CONSTITUENTS.	Saratoga Springs.			
	Kisssingen 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	1.23	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	0.86	1.84
Magnesium chloride	.....	.....	Trace.	.....
Sodium bromide	1.52	.....	.....	0.63
Calcium fluoride	Trace.	.....	.....	Trace.
Sodium iodide	Trace.	.....	.....	0.08
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 (1340). 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	453.30	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	123.69	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	2.94	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.

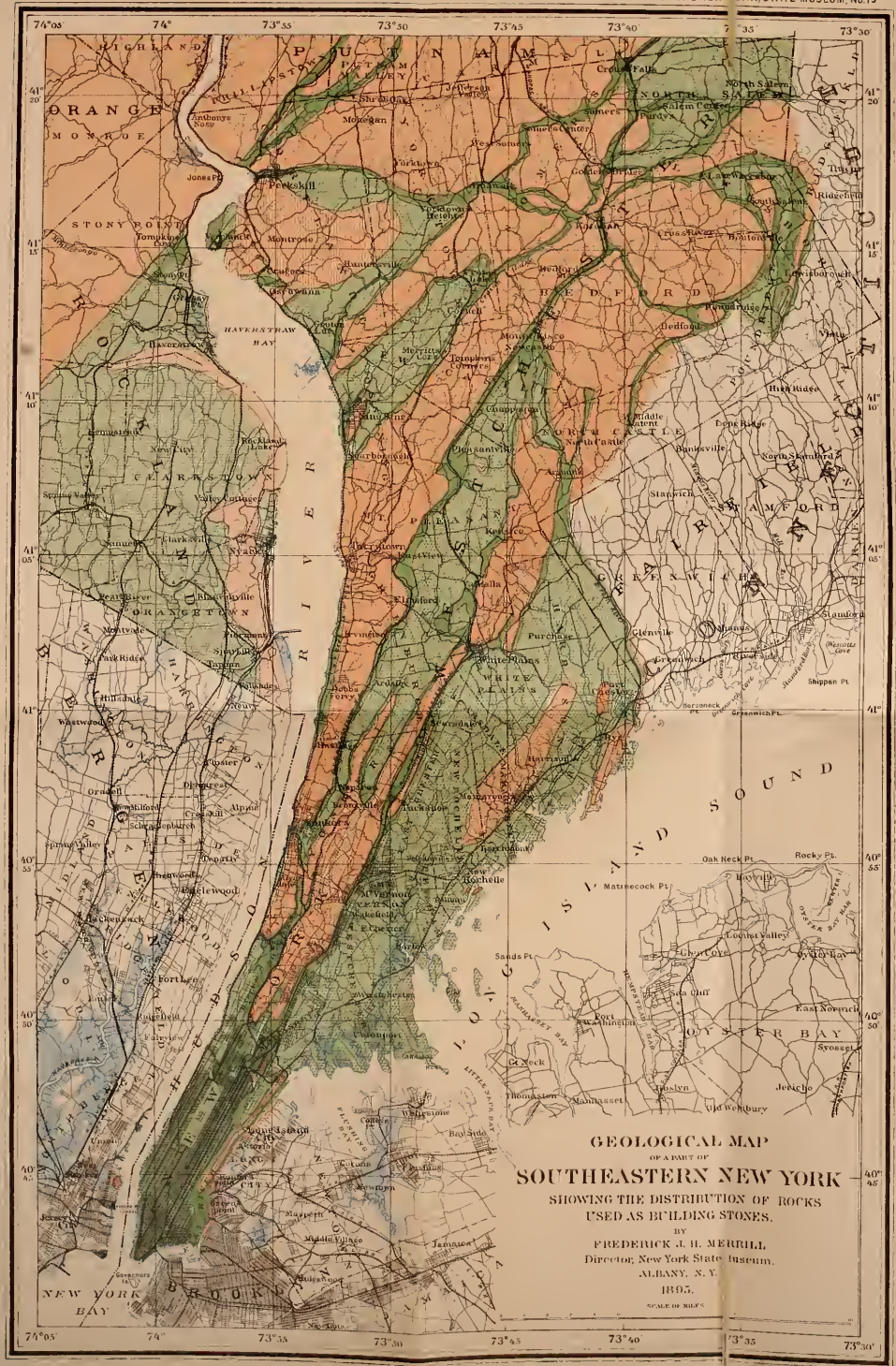
Coal and lignite, while they occur in New York, can never be found in commercial quantities. The coal measures of Pennsylvania are not found north of the boundary line between Pennsylvania and New York, and what coal has been discovered in the latter State is in older formations which do not contain 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.

INDEX

The superior figure shows the exact place on the page in ninths; e. g. 530^{7} means seven ninths of the way down page 530. Dates are printed in italics.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DIABASE
TRAP
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