STATE OF NEW-YORK.

No. 275.

IN ASSEMBLY,

February 27, 1839.

COMMUNICATION

From the Governor, relative to the Geological Survey of the State.

Albany, February 23, 1839.

TO THE ASSEMBLY.

By an act of the Legislature, passed on the 15th of April, 1836, the Governor was authorized and directed to employ a suitable number of competent persons, whose duty it should be under his direction to make an accurate and complete geological survey of this State; which survey should be accompanied with proper maps and diagrams, and furnish a full and scientific description of the rocks, soils and minerals of the State, and of its botanical and zoological productions, together with specimens of the same. It was further provided, that such maps, diagrams and specimens should be deposited in the State library, and that similar specimens should be deposited in such of the literary institutions of the State as the Secretary of State should direct.

The act appropriated $26,000 annually, during four years, to defray the expenses to be incurred, and directed that the person or persons who should be employed should annually make a report to the Legislature before the 1st day of February, setting forth generally their progress in the survey.

I have received a communication from my predecessor, in which he informs me that on the first of January last the following persons were employed in the several departments, and for the compensation respectively mentioned, viz:

COMMUNICATION

From Messrs. Emmons and Hall, relative to a place of deposite for the different specimens collected by the Geologists.

To His Excellency Wm. H. Seward,
Governor of the State of New-York.

SIR—

We respectfully represent to your Excellency the urgent necessity of early providing for the proper disposition and arrangement of the specimens collected by the gentlemen engaged in the Geological Survey. That some definite disposal of them be soon made, is due not only to the individuals themselves, but to the people, who should be apprised of the extent and fruit of the enterprise which they have sanctioned.

Two plans have been proposed for this purpose. One is, the erection of a suitable building. We concur in recommending this as most accordant with the generous spirit which sanctioned the survey, although we are at the same time apprehensive that the necessary expense may deter from its adoption. The building in question should not be more than one story high, without windows, but lighted from the top, and of sufficient elevation to admit of a gallery round the upper part. A single room, if sufficiently large, will contain the whole collection; and in the rear of the rotunda, (for the room had best be circular,) might be one or two working rooms, for fitting and preparing the specimens.

As an alternative, it has been proposed to occupy the four corner rooms in the upper story of the new State Hall now building. The

REPORT

Of Dr. Lewis C. Beck, on the Mineralogical and Chemical Department of the Survey

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To His Excellency WILLIAM H. SEWARD,
Governor of the State of New-York.

SIR—

In fulfilling the duty which the act authorizing a Geological Survey of the State imposes upon me, I propose not only to report my operations during the past year, but to present a general view of what has been heretofore done in the department committed to my care.

1. The State of New-York is so very rich in minerals, and the examination of their chemical characters is in many instances a matter of so much scientific and practical importance, as to require the most careful and patient attention. These investigations have necessarily occupied so much of my time, that I have thus far visited only some of our more important mineral localities. And so much still remains to be done in the chemical part of my work, that it will not be possible for me within the period prescribed for the completion of the survey, to give a much wider range to my field operations. But by the aid of those gentlemen who are engaged in the minute survey of the different districts, I shall perhaps be enabled to present a sufficiently complete account of our mineral resources.

2. The following is a tabular view of the minerals which have hitherto been found in the State of New-York. In presenting it in this form, I beg leave to observe, that as this is a work which has been authorized by, and intended for, the people of the State, I think it proper to adopt that arrangement which will be most easily understood, and which, on the whole, appears to be best suited for a popular and practical treatise on the minerals and mineral waters of the State. I propose, however, to introduce into the final report all those descriptive

Chondrodite. Tremolite. Rensselaerite.
Boltonite. Asbestus. Terenite.

2. Alumina.

a. Minerals in which the alumina is nearly pure, or combined with an acid.

Corundum. Gibbsite. ? Eupyrchroite.
Spinelle.
Automalite.

Sulphate of Alumina.
Alum.

b. Minerals composed principally of silica and alumina.

Idocrase. Labradorite. Pyrophyllite.
Garnet, (several varieties.) Kaolin. Epidote.
Cyanite. Spodumene. Chlorite.
Zoizite. Zeolite. Mica.
Scapolite. Laumonite. Tourmaline.
Meionite. Stilbite. Clintonite.
Prehnite. Mesotype. Xanthite.
Staurotide. Apophyllite. ? Chiltonite.
Feldspar. Chabazie.

3. Glucina.

Emerald. Chrysoberyl.

4. Zirconia.

Zircon.

CLASS VII.

Metallic Minerals or Ores.

Composed either wholly or in part of the metals, commonly so called.

1. Iron.

Native iron. Iron pyrites. Carbonate of iron.
Magnetic iron ore. White iron pyrites. Sulphate of iron.
Specular iron ore. Arsenical pyrites. Chromate of iron.
Limonite, (several varieties.) Cube ore. Phosphate of iron. ?
Sulphuret of iron.

2. Manganese.

Earthy oxide of manganese. Babingtonite.

3. Zinc.

Blende, or sulphuret of zinc.

4. Lead.

Galena, or sulphuret of lead.
Sulphate of lead.
Carbonate of lead.
Molybdate of lead.?
Vauquelinite.

5. Bismuth.

Native bismuth.

6. Copper.

Pyritous copper.
Carbonate of copper.

7. Titanium.

Rutile.
Crichtonite.
Titaniferous iron.
Sphene.

8. Molybdenum.

Sulphuret of molybdenum.

9. Arsenic.

Orpiment, or yellow sulphuret of arsenic.

10. Silver.

Native silver.
Sulphuret of silver.

In continuing my remarks upon the Mineralogy of the State, it will be convenient to follow the order here given. I shall, however, confine my attention chiefly to the more useful minerals.

Gaseous Minerals.

The nature of these bodies will be sufficiently understood from the definitions given in the table.

3. The first two, viz. *Hydrogen and Carburetted hydrogen*, are found among the gases evolved by many of our springs. Hydrogen gas is seldom abundant in its pure uncombined form; but carburetted hydrogen often contains an excess of hydrogen. Both these gases are characterized by their inflammability, and by their being destitute of the offensive odour of sulphuretted hydrogen gas.

Carburetted hydrogen is evolved by numerous springs in our State, extending from the valley of the Hudson to the shores of Lake Erie. In my last report I gave an account of such gas springs as were known to me at the time it was written; during the past season I have added a few others to the list, and the final report will embrace as complete a view as I can prepare of this interesting subject.

13. *Lignite.*—This substance, which is merely mineralized or altered wood, is associated with iron pyrites in a bed of astringent clay near Rossville, in Richmond county. Some of the specimens have the appearance of wood charred by the action of an acid, as, for example, the sulphuric; and it is not improbable that this lignite owes its origin to the action of the excess of acid which this clay contains, upon drift wood from time to time deposited on this shore of the island.

14. *Peat.*—Of this useful, but in the State of New-York, almost entirely neglected combustible, we have already discovered numerous important localities; and many others will undoubtedly be added before the completion of the survey. The time cannot be far distant when the value of this article will be duly appreciated. In many countries it is extensively employed as fuel; and in several manufactures it might be used here with great advantage; as, for example, in the burning of bricks, of limestone, &c. Specimens from the most extensive peat bogs in the State should be analyzed to determine their composition. Some varieties of peat contain substances which render them unfit for culinary purposes.*

UNCOMBINED ACIDS, NOT GASEOUS.

15. *Sulphuric acid.*—This is the only mineral belonging to this class, which has, I believe, been found in New-York. An interesting locality of it occurs in Byron, Genesee county, of which I gave a particular account in my last report. The occurrence of this substance in such quantities is the more worthy of notice, as it is stated by the highest authority on this subject, "that sulphuric acid in a free state is found only in springs connected with volcanoes, to which it is obviously referable."†

ALKALINE MINERALS.

16. *Sulphate of soda.*—This salt, mixed with various proportions of other salts, is found in the form of an efflorescence on the calciferous slate of Mr. Eaton, near Rochester, Monroe county. It is also held in solution by the waters of some of the mineral springs found in the western part of the State.

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* For particulars concerning the mode of collecting and preparing peat, I would refer to *Dumas, Chimie appliquée aux Arts*, I. 587. This article seems to be at present exciting some attention as a manure.

† Dr. Daubeny's Report on Mineral and Thermal Waters.—*Transactions of the British Association for the Advancement of Science, for* 1836.

17. *Carbonate of soda.*—Found, in a nearly pure form, on the walls of several buildings in the cities of Albany and New-York. It is also an ingredient of the mineral waters of Saratoga and Ballston.

18. *Muriate of soda, or common salt.*—This important mineral is found abundantly in solution in the western part of the State, forming what are called salt or brine springs. Of these, I presented a view in my last report. Several others have been added to the list during the past year, and in the final work I intend to present a complete table of them, and to designate the localities of the most important ones on a skeleton map, with the other mineral springs.*

19. *Sulphate of potash, Muriate of potash, Hydrobromate of potash, Hydriodate of Soda.*—These are met with only in solution in mineral or sea waters.

Alkaline—Earthy Minerals.

20. *Sulphate of baryta.*—This mineral, some varieties of which resemble marble, but are easily distinguished from it by their greater specific gravity, occurs in various parts of the State. At Pillar Point in Jefferson county, it may be obtained in large blocks, and is compact,

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* During the last session of the Legislature an act was passed authorizing "the Superintendent of the Onondaga Salt Springs to procure a set of standard instruments, and make observations once a week upon the strength of the brine in the different salt wells in use by the State, and state the result of such observations in his annual report to the Legislature." At the request of the superintendent and inspector at Salina, these instruments were constructed under my direction. Two objects were to be attained, viz: 1st, That the instruments, which from their particular use may be called *Salometers*, should be so sensible as to indicate slight differences in the density of the brine; and 2dly, That they should be made of some material less frail than glass, and not liable to be corroded by the brine. After a series of experiments in which I was assisted by Mr. Allen H. Gill, then in my laboratory, to determine the size of the bulb, length of the stem, &c.—they were constructed of silver, with the bulbs nearly two inches in diameter, the stems of flattened silver tube about twelve inches in length, and with a proper weight at the lower extremity. The graduation was accomplished by sinking one of the instruments to a certain depth in brine taken from the Salina well. The density and exact proportion of saline matter in this brine were then accurately ascertained. This gave one point. A known quantity of rain water was now added to this brine, and after allowing time for the mixture to be complete, the instrument was put into this diluted brine. It, of course, sunk lower than before, and having marked this point on the stem, as I did the former, the density of the mixture was ascertained. This gave two known points, and the graduation was then easily completed.

At the request of the officers at Salina, I graduated the instruments according to the centigrade scale, that is, distilled water being 0, and saturated brine 100°. Their range is from 10 to 12 degrees of this scale. The stems being about a foot in length, a difference of one-eighth of a degree, or of less than 4-100ths in the proportion of salt which the brine contains, can be easily detected. An increase in the range of the instruments would have impaired their delicacy, and the principal object for which they were constructed, viz. to determine whether the density of the brine is influenced by the seasons, by the height of the water in the lake, &c. could not have been attained.

cement. This subject will be noticed more in detail in a subsequent part of the report.

25. Beds of marble equal to those of Stockbridge and Egremont exist in various parts of Dutchess county, as in the towns of Northeast, Amenia, Dover, Pawlings, Beekman and Fishkill.* The Dover quarries are extensively wrought, and the marble which they afford, though dolomitic, is pure white, fine grained, and takes a higher polish than that found at Sing-Sing. Clouded marbles also occur in some parts of this county. All these, now comparatively neglected mines of wealth, would at once be opened up if some easy and direct mode of communication could be established between these quarries and the Hudson river.

26. Beds of marble similar to those above described, occur in the county of Putnam and in the interior of Columbia; while in the latter county, as well as in that of Ulster, dark coloured marbles are found, some of which take a fine polish, and are beautifully variegated with fossil remains. The town of Coeymans, in Albany county, contains a grey marble, which although it does not receive a good polish, is a valuable stone. In Schoharie county, black marble is found in the towns of Broome and Esperance; and the Cherry-Valley marble has long been celebrated.

27. In passing to the western part of the State, we have, in Oneida county, the Trenton limestones, which will furnish beautiful black marbles, and the grey marble near the Holland patent and on a branch of Steuben creek;† and in the counties of Madison and Onondaga the grey crinoidal limestone, which affords a marble scarcely excelled by any in the country for beauty, durability, and the fine polish which it receives. The quarries in Onondaga county are moreover very extensive, and yield blocks of great size. The marble is not only used for ornamental purposes, but in its dressed state is employed in the construction of locks, aqueducts, and other similar structures. The public works now building in the vicinity of Syracuse present a striking proof of the great superiority of this material over that formerly used for similar purposes, while at the same time they offer a no less striking illustration of the great advances which have been made in the arts of construction.

28. I have analyzed two specimens of the grey crinoidal limestone, the one from the quarry, near the Chittenango Falls, in Madison county,

* See *Prof. Mather's Report for* 1838.

† *Mr. Vanuxem's Report for* 1838.

the other from the Split Rock quarry, in Onondaga county. The following are the results: No. 1 is from the former,—No. 2 from the latter.

	1.	2.
Inscluble matters, consisting of silica and alumina,.	0.90	0.40
Oxide of iron,.....	0.35	0.20
Carbonate of lime, ...	98.50	99.30
	99.75	99.90

29. Wayne and Niagara counties also contain marbles of excellent quality, both for ornamental and ordinary purposes. The Lockport marble contains fragments of organic remains, which give to its surface, when polished, a variegated and beautiful appearance. It also frequently presents on fracture that singular columnar structure, at right angles to the layers, which has been quite aptly compared by Mr. Vanuxem to the sutures of the skull. In consequence of a suggestion made by that gentleman that the appearance in question was owing to sulphate of magnesia,* I subjected a specimen to analysis, and was somewhat surprised to find in it a large proportion of that earth. The composition is as follows:

Silica and alumina, ...	2.25
Oxide of iron,.....	0.35
Carbonate of lime, ...	75.65
Carbonate of magnesia,.....	20.70
Moisture and loss,.....	1.05
	100.00

It will be interesting to ascertain whether this composition prevails in the rocks of this series.

30. In the northern part of the State the localities of marble are no less numerous and important than in the southern and western parts. Thus, in Washington county, there is a fine clouded variety near Granville; in Warren county, dove coloured marbles occur in ledges at the head of Lake George; and in Essex county, near Port Henry, is a white primitive lime-stone, which will probably be, when properly quarried, an excellent and beautiful building stone.

* *Mr. Vanuxem's Report for* 1838.

in volume, and without the evolution of much heat; and they moreover form with it a paste possessing little tenacity, and which when placed under water, hardens after the lapse of a few days. These are now known by the name of *Hydraulic, or Water Limes.* They differ much in the rapidity with which they harden under water, and in the degree of solidity which they ultimately attain.

There are still other limestones which afford limes, possessing the remarkable and very useful property of becoming hard almost instantly, like plaster of Paris, whether exposed to the air or in contact with water. These are sometimes called *Roman Cements.* It should be remarked, however, that the French generally employ the term *ciment*, to designate fine pounded bricks or tiles; while in this country, the term *cement* is most commonly used in a generic sense, and includes the hydraulic constituent of mortars, whatever that may be.

It must always be considered as a most fortunate circumstance, that so soon after the commencement of the Erie canal, a material was found in its immediate vicinity, which yielded a lime well suited for the construction of locks and aqueducts. It is worthy of inquiry, however, whether in these and in similar works since constructed, sufficient attention has been paid to the selection and preparation of the hydraulic limes thus employed.

33. There is still some difference of opinion, as to which of the ingredients of these impure limestones, the hydraulic property is to be ascribed. Some of those who have examined the subject, have fixed upon the oxide of iron, as the important ingredient; while the claims of the oxide of manganese, silica, alumina, magnesia, and even soda, have each been urged by respectable authority. It is, after all, however, more than probable, that the hydraulic property is not due to a single ingredient, but belongs rather to several substances, or to a class of compounds.

It appears, from the experiments of Berthier and Vicat, the highest authorities upon this subject;—That no mixture, of which silica does not form a part, acquires hydraulic properties;—That limes containing only silica or alumina, or better those containing silica and magnesia, acquire a much greater degree of hardness than the silicates of pure lime; and that the oxides of iron and manganese contribute nothing to the hardening of these bodies.

More recently, M. Vicat has asserted, that magnesia alone, when in sufficient quantity, will render pure lime hydraulic. The proportions of magnesia which he recommends, are from thirty to forty per cent of

it weighed after calcination, to every forty of pure anhydrous lime. "M. Vicat also points out the importance of these observations;—hydraulic lime never having been found in the calcareous formation below the lias, is because the dolomites have never been examined; but it is now probable that it may be found in this lower formation."*

It would be impossible in the compass of a report like the present, to enter fully into the consideration of this subject. Several important works have recently appeared in reference to it, which should be attentively studied by all who have the direction of aquatic structures. In France, where the arts of construction have for several years received such distinguished attention, much has been done towards establishing correct principles in regard to the preparation and mode of using hydraulic limes, cements and mortars. Valuable information will be found upon these points, in the extensive treatises of Dumas and Berthier, and in the able work of Vicat. Important service has also been rendered to the arts of construction in this country, by Col. Totten, who has translated and published in the Journal of the Franklin Institute, for 1837 and 1838, a very excellent memoir on hydraulic and common mortars, by General Treussart; and the same valuable periodical contains several other papers on those subjects which may be advantageously consulted.

34. As the proper selection and management of hydraulic limes is a matter of vast importance, I trust I shall be excused in adverting to a few points, to which there is reason to fear that sufficient attention has not been heretofore paid, in the construction of our public works.

1. It is agreed on all hands, that there is a great difference in the hydraulic limes obtained from different limestones, and that the value of each, and the proper mode of using it can be determined only by experiment.

2. It is admitted that in all cases the process of burning or calcining the limestone requires great care. A limestone, very proper in other respects, gives, when the heat is urged too high, what is called a *dead lime*, in consequence of the partial fusion of the mass; whereas, when the calcination is effected at too low a temperature, the resulting lime is meagre and not hydraulic.

3. Hydraulic lime should be used as soon as possible after calcination, and when kept for any time, it should be carefully protected from the

* *London and Edinburgh Philosophical Magazine, &c. 3d Series*, VIII. 501.

By calcination, therefore, this limestone is reduced to a state approaching that of a double silicate and aluminate of lime and magnesia, and the theory of the hardening of this cement is sufficiently in accordance with the views above suggested. The cement, moreover, forms a jelly with muriatic acid, which still further proves that its chemical nature has been changed during the calcination.

38. An important practical inference from these experiments and observations is, that the more completely the carbonic acid is driven off from the limestone by calcination, without causing its fusion, the more energetic will be the resulting product. It is probable that a long continued, rather than a very high, heat, will best effect this object.

39. It remains to be mentioned, that the limestone which over lies this cement has a blue colour, a structure somewhat granular, contains organic remains, and occasionally nodules of calcareous spar and sulphuret of zinc, with alternating layers or masses of hornstone. On analyzing a fragment of this rock, I found it to consist of carbonate of lime, with a minute portion of oxide of iron and bituminous matter, and with about eight per cent of argil, or silica and alumina. It does not contain even a trace of magnesia, although so closely associated with the magnesian stratum above described.

40. Water limestones occur in Albany county, in the Helderberg;* in Montgomery county, about ten miles northwest of Schenectady; also in Herkimer county, some of which Mr. Vanuxem thinks would afford cements equal to any elsewhere made in the extensive range to the west; while, according to the same geologist, they are found in immense series in Oneida county.†

41. The hydraulic limestone of Madison county has long been in high repute. One of the most important localities, and I believe one of the first, if not the very first, discovered in the State, is situated about a mile and a half southwest of the village of Chittenango. It has usually a drab colour, sometimes striped with reddish bands, a conchoidal fracture, an earthy texture, and is covered by layers of the calciferous slate of Eaton. The process of burning and grinding is similar to that heretofore described. When this cement is used in the construction of works, it is mixed with from two to three parts of sand.

* I have not yet had an opportunity of analyzing a specimen from this locality. According to an analysis of Prof. Eaton, which, however, he did not deem very accurate, it contains 25 per cent carbonic acid, 26 lime, 28 silica, 18 alumine and magnesia, 1 iron, and 2 water.—*Transactions of the Albany Institute, vol.* 1, *app.* p. 53.

† *Mr. Vanuxem's Report for* 1838.

It is computed that 100,000 bushels of hydraulic lime are annually sent from this town. The average price is fourteen cents a bushel, which therefore yields a return of $14,000.

42. The following are the results of two analyses of hydraulic limestone from this county; the first, by Mr. H. Seybert;* the second, by myself.

	1.		2.
Carbonic acid,	39.33		38.65
Lime,	25.00		27.35
Magnesia,	17.83		16.70
Silica,	11.76		8.95
Alumina,	2.73		4.90
Peroxide of iron,	1.50		1.75
Moisture,	1.50	Moisture, bituminous matter & loss	1.70
	99.65		100.00

The composition of the calcined lime in the state in which it is ordinarily used as a cement, is as follows:

Carbonic acid and moisture,	10.90
Lime,	39.50
Magnesia,	22.27
Silica,	16.56
Oxide of iron and alumina,	10.77
	100.00

The proportion of carbonic acid, however, depends entirely upon the manner in which the calcination is conducted, and it probably differs considerably in different specimens.

43. The blue fetid limestone which is associated with the water lime is a nearly pure carbonate of lime, containing 0.70 per cent of insoluble matter, and a trace of oxide of iron and bitumen, to which last is probably to be ascribed the odour which it gives out when struck with a hammer. It contains no magnesia.

44. I have also analyzed a specimen of the calciferous slate of Eaton, from the hill on the east side of the village of Chittenango. The results are as follows:

* *Transactions of the American Philosophical Society. New Series*, II. 229.

Gypsum, when pure, has a snow white colour, but it is often tinged with red, yellow, blue and grey, in consequence of the admixture of foreign substances. When crystallized, it is foliated, but it also occurs granular and compact. The foliated varieties are called *selenite*, while the compact ones are often known by the name of *alabaster*. It is distinguished from carbonate of lime by its being less hard, as it may be scratched by the finger nail; acids, when applied to the carbonate of lime, cause an effervescence, owing to the escape of carbonic acid,—but no such effect is produced by a similar application to the sulphate of lime.

The variety of sulphate of lime which is most abundant, is composed of sulphuric acid and lime, with about twenty per cent of water. Whenever it is used for architectural purposes, this water is driven off by the application of heat, the operation being commonly known by the name of *boiling*. The calcined or boiled plaster, when made into a paste with water, speedily hardens, and it is employed in this way for walls, for stucco, for taking casts of statues, in stereotyping, &c. Gypsum is moreover largely used in agriculture, and it is considered an invaluable fertilizer.

Of this useful mineral we have numerous and very important localities. They are, however, almost exclusively confined to the district bordering on the Erie canal. I am aware that it occurs in the counties of Columbia, Albany and Schoharie, but however interesting the specimens here procured may be for the cabinet of the mineralogist, the quantity is nowhere sufficient to answer any other purpose.

50. The west end of the town of Starke, in Herkimer county, is the most eastern point at which gypsum has been found in any great quantity. According to Mr. Vanuxem, it occurs in a white sandstone, the grey band of Mr. Eaton, and he represents it as being white and equal to the Nova Scotia both before and after calcination. From twenty to thirty tons had been obtained by Mr. Crill, the proprietor, during the summer of 1837.

51. In Oneida county, gypsum is found in beds of vast extent. It is sometimes pure, being foliated and transparent; but the largest proportion is dark coloured, and is mixed with carbonate of lime, constituting what is usually called *plaster stone*. This last is used for agricultural purposes, and when deprived of its water by calcination, as a cement.

52. Localities of this mineral abound in the county of Madison. It is sometimes foliated and granular, but usually, as in the above county, it belongs to the common or impure variety. It occurs imbedded in gypseous marl, every where forming irregular or somewhat rounded or conical masses rarely more than forty or fifty feet in diameter, and usually from ten to twenty feet in height. These hillocks seem to be detached, and the conclusion is almost irresistible that they have been formed after the upper strata of rock have been deposited. The masses of gypsum are a foot or more in thickness, and weigh from four to six hundred tons. I can give no details concerning the amount of this mineral annually raised in this county, but in the town of Sullivan alone it is said to be from four to seven thousand tons.

On the route from Chittenango to Syracuse, in Onondaga county, conical elevations similar to those already noticed are of frequent occurrence; some of which have already been opened and found to contain deposits of gypsum, while others are left as the reward of future enterprise and labor.

53. The interesting region around Onondaga lake, of which I have heretofore attempted to give an account, contains, in addition to its other sources of wealth, some important deposits of gypsum. At Liverpool, the fibrous variety, then comparatively rare in this State, was found several years since, about twelve feet below the surface of the earth, associated with marly clay. Recently the excavations made for the construction of the rail-road from Syracuse to the Split-Rock quarry, have opened an extensive bed of the same valuable mineral. At this locality are to be found several varieties; as the foliated, the fibrous, the snowy, and the common or dark coloured—the whole imbedded in a kind of gypseous marl which effervesces freely in acids, and contains variable proportions of the oxide of iron. Gypseous beds, similar in their general characters, also occur in the vicinity of Manlius, from which large quantities have been exported. But probably the most valuable deposits that have yet been opened up are those along the line of the Syracuse and Auburn rail-road, near the village of Camillus. We find here, among other varieties, noble specimens of transparent selenite, and what renders the locality peculiarly interesting, are the associated strata of calcareous tufa, and of the singular hopper-form crystals of marly clay. From forty to fifty thousand tons of gypsum have been obtained simply from the excavations which were necessary for the construction of this road. And this may be considered as merely a specimen of what is still hidden in the adjoining hills.

59. In the account which I gave, in my last report, of our sulphur springs, or those which evolve sulphuretted hydrogen, it was remarked that the common explanation of the production of this gas, viz: the decomposition of iron pyrites, seemed to me to be quite unsatisfactory. The doubts then expressed, have been rather confirmed than removed by the discovery of several other springs of the same kind, in various parts of the State. During the past season, I visited, in company with Mr. Vanuxem, Dr. Wright of Syracuse, and Mr. W. P. Wainwright of New-York, a lake or pond, two miles east of Manlius Centre, known in that vicinity, by the name of Lake Sodom or Green Pond. This pond is about a mile and a half in length, and half a mile in breadth, at the widest part. The water is of a deep green colour, which is probably owing to the partial decomposition of the sulphuretted hydrogen which it holds in solution. The depth of the water gradually increases as we proceed from the northern outlet, from twenty-five to a hundred and sixty-eight feet; the latter depth continuing for some distance around what we supposed to be the centre of the basin. Water drawn from the depth of 168 feet, was found to be strongly charged with sulphuretted hydrogen. On being afterwards tested, it blackened nitrate of silver powerfully, and gave copious precipitates with solutions of oxalate of ammonia and muriate of barytes, indicating the presence of sulphuretted hydrogen, and sulphate of lime. Its specific gravity was scarcely above that of distilled water, and it contained not even a trace of iron.

Here then is a natural sulphur bath, of a mile and a half in length, half a mile in width, and 168 feet in depth; and this, let it be remembered, is neither a solitary, nor as it regards extent, an uncommon locality, in the western part of the State. Surely there must be some very general and powerful cause in operation, to produce such vast results. The few scattered grains of iron pyrites, which some of our rocks contain, are as entirely inadequate to these phenomena, as they are to those of the volcano and the earthquake.

60. As all our sulphuretted waters, without exception, contain sulphate of lime, and as sulphur springs are most numerous and extensive in those parts of the State where gypsum beds abound, it is, I think, a fair inference, that the production of gypsum and the evolution of sulphuretted hydrogen are referable to the same general agency. Now as it is known that the decomposition of the sulphuret of calcium, or the compound of sulphur, and the metallic basis of lime, by water, will give rise to sulphuretted hydrogen and sulphate of lime, it is not improbable that there exits beds of this substance, at different and unknown

depths, to which all these phenomena may be ascribed. The access of water to these beds of sulphuret of calcium, causes its decomposition, and as a necessary consequence, gaseous sulphuretted hydrogen is evolved. This gas, in its course to the surface, is partly absorbed by water, while, from its reaction upon that liquid, a portion of sulphuric acid is also formed, a result which we constantly observe in the laboratory. The sulphuric acid thus formed, acting upon the upper strata produces sulphate of lime, and causes the evolution of carbonic acid, a substance which is almost always found in the mineral waters of the west.

This view appears to me conformable to the known laws of chemistry, and is sustained by the facts which are presented. The only assumptions, are the existence of the sulphuret of calcium, in quantities sufficient to produce these results, and the agency of water. In regard to these, I will here only remark, that they are supported by the same train of argument, that is brought to bear upon the chemical theory of volcanic action; of which action, many evidences, in addition to those above noticed, are presented in various parts of our State.

Earthy Minerals.

61. The minerals included under this class are composed chiefly of one or more of the earths proper; frequently, however, containing some alkali, alkaline earth, acid or metallic oxide. They have also sometimes been termed earthy compounds or stones, and they are probably more interesting to the mineralogist than those belonging to any other class. In some cases, the composition of these minerals is very complex, which renders their analysis difficult. At the same time, this very circumstance makes their careful study the more important, and as slight differences in chemical composition not unfrequently form the basis of specific distinctions, increases the chances of new discoveries. To show that I have not been inattentive to this part of my work, I beg leave to state, that a portion of every season since its commencement has been devoted to the collection and study of the minerals belonging to this class. Seven or eight weeks of the last summer were spent among the rich localities of Orange county, in company with my friend, Dr. Wm. Horton, who is so well acquainted with the minerals of that county, and who was then engaged in examining its geology as the assistant to Prof. Mather. I should do injustice to my own feelings, did I not thus publicly acknowledge the important assistance which I have at various times received from Dr. Horton, who has perhaps done as much, if not more, than any other individual towards bringing into notice the vast mineral resources of Orange county.

The magnesia contained in either of these minerals would furnish, by combination with sulphuric acid, upwards of two hundred parts of sulphate of magnesia or epsom salts, in the form in which it is ordinarily sold in the shops. Moreover, the sulphate of magnesia, thus obtained, may be decomposed by carbonate of soda or potash and produce carbonate of magnesia, which, as well as the sulphate, is used for medicinal purposes.* By this operation, when serpentine is employed, a large quantity of Venetian red is also procured, as that mineral contains a considerable proportion of oxide of iron. This manufacture is now carried on near Baltimore, in Maryland, and there seems to be no reason why it may not be profitably pursued in the vicinity of New-York.

63. Serpentine, similar in every respect to that found on Staten-Island and at Hoboken, in New-Jersey, occurs in considerable abundance in the counties of New-York, Westchester, Putnam, Rockland and Orange; and extensive deposits of the same mineral are also found in the county of St. Lawrence.

The beautiful green colour of serpentine, and the fine polish which it takes when pure, give it great value as an ornamental marble. When mixed with granular limestone it forms the celebrated *verd antique*. Unfortunately in almost all the localities in the southern part of the State, at least so far as they have been explored, the serpentine, although in great abundance, is so mixed with carbonate of magnesia, asbestus and other magnesian minerals, as to render it unfit to be worked as a marble. Thus a block obtained from a quarry in the county of Westchester, concerning which high expectations had been raised, was found to have an unequal degree of hardness in its different parts, and to be filled with seams and nodules of other magnesian minerals which could not be polished, or were too friable to sustain the rough usage which is required for the dressing of marble.

Prof. Emmons informs us that there are several localities in St. Lawrence county in which the soundness of the serpentine rock is remarkable; and the only impediment to the introduction of this article for ornamental and useful purposes, he thinks, is the expense of transportation. At Pitcairn is a fine locality of *verd antique*. The colours are green and white, arranged in the usual forms of clouded marble. The serpentine has a bright green colour, and belongs to the variety usually called pre-

* Should the preparation of these salts of magnesia become important, the dolomites or double carbonates of lime and magnesia which occur at Sing-Sing and elsewhere, may be also advantageously employed for that purpose. The double carbonate is first to be calcined and then treated by sulphuric acid, or sulphate of iron. There is thus formed an insoluable sulphate of lime and a soluble sulphate of magnesia, which can be easily separated.

cious. The carbonate of lime is white, and forms a handsome ground for the translucent serpentine.*

64. Usually associated with serpentine, when it occurs in extensive beds, is a mineral which has nearly the same chemical composition, generally known by the name of soapstone. This is particularly the case in the counties of Richmond and St. Lawrence. In consequence of its softness and tenacity soapstone may be turned or cut into articles of various shapes, and rendered hard by exposure to heat. It is hence much used for the hearths of furnaces, the sides of fire places, the linings of stoves, and for similar purposes.

65. Another substance often found with these magnesian minerals is asbestus, under which I include the variety composed of flexible silky fibres, sometimes known by the name of amianthus, there being no line of specific distinction to warrant its separation. This mineral has acquired notoriety from the fact that some of its varieties may be woven into cloth which is indestructible by heat. It is to uses similar to these that it is accordingly applied, being employed in the preparation of the incombustible cloth proposed for firemen's robes, and for the lining of the metallic safes now so generally introduced into counting houses.

Materials for the manufacture of Porcelain.

66. The localities of clays suitable for the manufacture of brick and the common kinds of earthern ware, are too numerous in this State to be at present noticed, and their description belongs rather to the department of geology than to that of mineralogy. Many of these have already been noticed in the reports of the geologists, and Prof. Mather has presented some details which show the importance of the branch of industry included under the art of brickmaking.

The manufacture of the finer kinds of pottery has not heretofore been carried on with much success in our country. Whether this be owing to the superior facilities which are possessed by the English and French in regard to materials, or to the reduced price of labour, it is not easy to determine. My present object is merely to show that New-York is not destitute of the materials necessary for this branch of art.

The finer kinds of pottery require for their manufacture the purest clays,—such as contain little or no oxide of iron and which consequently do not turn red in burning. To these a portion of pure silica is added, which is prepared for the purpose by heating masses of flints or

* *Prof. Emmons' Report for* 1838.

72. Several beds of magnetic iron ore have recently been opened in the county of Orange. Some of these I visited during the last year, and from the observations then made I have no doubt that when the direct communication with our great market is completed, the interior of the counties of Rockland and Orange will present a scene of activity and enterprise which will equal the most sanguine expectations. The revival of business has already had its effect upon the iron works now in operation, and it is not too much to predict that when the improvements recently introduced into the manufacture of iron shall have been perfected, this will become one of the great manufacturing districts of the State.

73. The following table will exhibit the composition of some of the iron ores recently analyzed.

	1.	2	3.	4.	5.	6.	7.	8.
Protoxide of iron,	42.26	.....	.....	44.10	.....			
Peroxide of iron,	53.69	.....	.....	52.75	.....	99.75	72.37	68.00
Protoxide and peroxide of iron,	.....	95.75	96.50	.....	98.90			
Silica,	.....	.....	.....	.....	.....	0.25		
Silica and alumina,	4.05	4.25	3.50	3.15	1.10	.....	15.43	6.50
Oxide of manganese,	.....	.....	.....	trace.	.....	.....	.....	8.50
Oxide of titanium,	.....	.....	.....	trace.	trace.			
Water,	.....	.....	.....	.....	.....	.....	12.20	17.00
Sulphur,	.....	.....	.....	.....	trace.			
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00

	1.	2.	3.	4.	5.	6.
Peroxide of manganese,	68.50	58.50	50.50	53.00	33.40	11.45
Peroxide of iron,	16.75	22.00	24.50	32.15	34.10	28.20
Earthy matters, (silica and alumina,)	3.25	2.50	4.50	6.90	8.75	44.75
Water,	11.50	17.00	20.50	6.85	24.00	15.60
Copper,	.....	.....	.....	trace.		
	100.00	100.00	100.00	98.90	100.25	100.00

No. 1.—Specimen from the farm of Joseph Goodsell, two miles north-west of Hillsdale, Columbia county. Earthy, friable, of a blackish-brown colour.

No. 2.—From the farm of H. W. Gott, two miles west of Austerlitz, Columbia county. External characters similar to those of the preceding.

No. 3.—From the farm of David Parsons, three-quarters of a mile south of Canaan Centre, Columbia county. External characters similar to the former. The specific gravity of these is not above 3.

No. 4.—From Sing-Sing, in Westchester county. Colour blueish or brownish-black, compact. Specific gravity 4.33. Found only in small masses, in the Dolomite.

No. 5.—Found near Keeseville, in Essex county. Occurs in rounded masses, about the size of a pea, brown externally, and brownish-black in the centre; earthy, friable. It contains a large proportion of water and oxide of iron. Other specimens may be purer.

No. 6.—From Tug Hill, Lewis county. Colour jet black or brownish-black; earthy, friable. The only specimen I have at present, contains a very large proportion of impurities. Others will no doubt afford a greater amount of oxide of manganese.

Lead.

In my report for 1837, I gave an account of the lead mines, which had previously been opened in the counties of Columbia, Lewis and St. Lawrence. During the past season, I have visited some interesting localities of the sulphuret of lead, with other accompanying minerals, in the counties of Sullivan and Ulster, of which I shall now give a brief description.

76. The principal deposit of lead ore, in the county of Sullivan, is situated near the summit of the Shawangunk mountains, two miles north-west of the village of Wurtzboro', and three-quarters of a mile from the Hudson and Delaware canal. This mine is situated in the millstone grit of which this mountain is composed, and the ore appears to be in a bed, alternating with the strata, although its inclination is somewhat different. At the place where the lead ore was first observed, a perpendicular shaft has been sunk about thirty-eight feet in depth. At the time of my visit, the miners were engaged in constructing horizontal drifts or levels to intersect the deposit of ore below the present shaft. The first level is about fifty-two feet below the opening of the shaft.

82. The lead mines of Ulster county are situated in the same range of mountains which contain those of Sullivan; and only a few miles distant from the latter, mining operations have been conducted during the past year by the North American Coal and Mining Company. The principal mine is situated on the northwest face of the Shawangunk, about three-quarters of a mile from the Red Bridge, which forms the boundary between the counties of Ulster and Sullivan, on the Hudson and Delaware canal. The general character of the deposit of lead ore at this place is similar to that of the Sullivan mine, but in consequence, as it appeared to me, of some disturbance in the stratification, the rock and the bed of galena dip towards the north at a high angle. This, however, will hereafter be described by the geologist of the district. The mine has been worked by a perpendicular shaft, to which levels or drifts, passing into the mountain at different heights, are now constructing. The galena here, as at the Sullivan mine, is associated with copper pyrites and blende, in a gangue of quartz. The quartz often occurs in large and fine crystals;—these, however, are seldom doubly terminated, and are usually opaque.

At the time of my visit, the amount of lead ore obtained at this mine was quite inconsiderable, and it seemed to me that the prospect was far from being favorable to the proprietors. Perhaps, however, the mining operations were not then sufficiently advanced to enable me to form a correct opinion concerning the extent of this deposit of ore. But taking into consideration the nature of the rock in which the ore is found, the limited quantity of ore heretofore obtained, and the various foreign matters with which it is mixed, I more than doubt whether either of these mines will ever yield an amount of lead equal in value to the outlay which must be incurred in working them.

83. I have now examined and described, in my several annual reports, the principal deposits of lead ore which are at present known to exist in this State. A connected account of these will be introduced into the final work, with such additional information as may have been, in the mean time, obtained. It may be proper to add, that the lead mines of St. Lawrence county are the only ones which now give promise of successful exploration. The purity and abundance of the ore, and the ease with which it is reduced, all conspire to render these mines of the highest value and importance. No better evidence of the correctness of this assertion need be offered, than the fact that during the last year, (1838,) there were produced from the three mines in Rossie, 3,347,463

pounds of lead, which, estimated at five cents a pound, amounts to $167,373.15.*

Titanium.

84. The metal titanium was discovered in 1791, but its properties were not satisfactorily determined until the year 1822, when Dr. Wollaston found it in a slag at the bottom of a large smelting furnace in Wales. It has since been found at several other iron works in Great Britain. Dr. Emmons obtained this metal from the hearth stone of an iron furnace in St. Lawrence county, and I have detected it also in the slag of the Greenwood's furnace in Orange county. It usually occurs in the form of cubic crystals, which in colour and lustre resemble burnished copper. In my specimen there is also associated with the metal a coating of a beautiful purple colour, which may be the oxide of titanium, supposed to exist only in the rare mineral called *anatase*.

85. There is another oxide of titanium, now more correctly termed titanic acid, which exists in variable proportions in several of the ores of iron, and from the decomposition of which, during the smelting of these ores, the metallic titanium is obtained. This substance closely resembles silica in many of its characters, and when in considerable proportion, it is supposed to have an injurious effect upon the quality of the ore with which it is associated. In its pure or nearly pure form, it is used for the purpose of giving a yellowish tint to artificial teeth, and in consequence of its comparative scarcity, and the difficulty of its separation from other substances, is sold at a high price.

Of the titaniate of iron in the crystalline form, and now known by the name of Crichtonite, we have an interesting locality in Warwick, in Orange county, where it is imbedded in a dark coloured serpentine; and variable proportions of titanic acid are also contained in several of the iron ores of St. Lawrence, Jefferson and Orange counties.

Arsenic.

86. Arsenical pyrites from which the compounds of arsenic used in the arts are obtained, has been found in this State, in the counties of Essex and Orange. In the former it is probably in considerable quantity.

87. There is a locality of arsenical minerals on the lands of Mr. B. Hopkins, near the village of Edenville, in Orange county, which is

* *Report of the St. Lawrence rail-road committee, December, 1838.*

SECOND ANNUAL REPORT

Of T. A. Conrad, on the Palæontological Department of the Survey.

The classification of the organic remains of New-York is approaching to a state sufficiently complete for an accurate grouping of the various strata. In Europe, the equivalents of the New-York formations are divided into two great systems, termed Cambrian and Silurian, which are unconformable to each other. The organic remains do not greatly differ in each, but they are far more rare and limited in number of species in the older, or Cambrian system (in this country,) except in the two overlying rocks, or the lowest of the Silurian system. Still in the fossils of the older division, we can recognize a character sufficiently marked and distinct, to enable us readily to classify the strata wherever we may find them in the most distant localities. The upper term of the Cambrian system may be recognized in the vertical and contorted slates and olive sandstones of the Hudson river, extending from Newburgh to Glen's Falls.

Organic remains, other than obscure Fucoids, are very rare, except in particular localities, where Fucoides serra, of Brongniart, abounds, and is very characteristic from its numbers, for in the Silurian rocks it is almost unknown. Several other species of the genus to which the serra belongs, have also been found in the same localities. The F. dentatus Brong. also occurs, but is not nearly so numerous as in the Silurian slates. This species has been referred to Graptolites Linn, and is supposed to bear no analogy to marine plants; indeed, all the members of the group are very unlike the true fucoids of the Transition. These are nearly all the organic remains which occur in the slates, but fragments of the trilobite, Cryptolithus tersellatus have been very rarely found, a species common in the Trenton limestone at Fonda, on the Mohawk, and at Glen's Falls. Over the highly inclined strata of the

Cambrian or Hudson system, rest in a nearly horizontal position the Silurian strata, with the limestones and slates of which series commenced the first condition of the seas, favorable to the existence of myriads of shells, corals, and trilobites, whose exuviæ have very materially added to the thickness of the strata.

In the report of the geologist of Pennsylvania, the olive sandstone of the Cambrian or Hudson strata, has been confounded with the fourth rock of the Silurian system, known by the name of Salmon river sandstone, which formation is admirably characterized in New-York, Pennsylvania and Ohio, by the Pterinea carinata of Goldfuss.

There is strange misunderstanding of the method of applying organic remains in the division of series of strata into formations, and the identification of widely separated rocks by the Zoological characters of each. In the January number of the New-York Review, the opinion is advanced, that the "Calymene Blumenbachii ought to be carefully sought for in the rocks which are said to correspond to the Dudley period. Unless it is found, or some other consideration is introduced, can it be believed that fossils are a satisfactory evidence of the age and place of rocks?" The line of demarkation between rocks of different age has never yet been drawn with any accuracy by the aid of Palæontology, except by the consideration of groups of species, one, or even a few species, having no weight whatever in the determination. Thus the shell termed Terebratula Schlotheimii, dates its existence with the Trenton limestone, and reappears in three of the latter formations of the Silurian system. Orthis testudinaria, Dalm. is peculiarly characteristic of the Trenton limestone, by its almost invariable presence and extreme abundance, and yet it is also found in the limestone of the Helderberg a formation of a far more recent origin. But, although a few species may have been continued through a succession of geological eras, the groups are widely distinct, and their value in determining the comparative age and identity of formations, can never again be called in question by a geologist who deserves the name.

"Excepting two trilobites, I have always found the organic remains of the Dudley limestone to correspond with those of rocks far above the Trenton limestone, and therefore it was natural to suppose that the Calymene Blumenbachii had escaped from the catastrophe in remote seas, which destroyed it here. But that trilobite has lately been found in the Rochester shale, in company with Asaphus caudatus, in this place it occupies the same position in the scale of formations which it holds at

Dudley, above the Trenton limestone, but in this country it is characteristic only of the latter formation, for there it abounds, whilst in the Rochester shales it is very rare. Occasionally the relative position of two formations may be so obscured, or the mineral character so similar, that the amount of difference will not be always estimated by those who describe them. It is just so in Ohio and Kentucky, where no observer has yet drawn the line of distinction between the Trenton and the newer limestone superimposed upon it, because the similarity in mineral character and color is so perfect, and the formations thin out into mere seams and layers, that a critical knowledge of the fossils is necessary to determine the difference in age. It is possible, therefore, the Calymene Blumenbachii and Asaphus tuberculatus are most abundant in a limestone at the base of the Dudley series, which corresponds in age, not only with the Trenton limestone, but also with the Llandeile flags of Murchison, whose observations, when published more in detail than they have yet been given to the world, will probably clear up all this difficulty.

The catalogues of organic remains of the Silurian system, hitherto published in Europe, are only calculated to mislead and confound the geological enquirer, as they are far too vague; not only the species peculiar to certain formations being indiscriminately mingled, but even the groups of the Silurian and Carboniferous systems are strangely confounded. This is the case in "De la Bache's manual," "Thomson's outlines of Geology," Phillips' Treatise on Geology in the Encyclopedia Metropolitana, and in the Lethea Geognostica of Bronn. The last named author has published a plate of numerous species of organic remains as characteristic of the mountain limestone, among which it is difficult to detect one belonging to that system, for they are nearly all characteristic of the Silurian strata. There are also importanterrors in his figures, such as the round perforation in the beak of Atrypa prisca, an imperforate shell. Excepting Lingula, no bivalve with a *perforated apex* occurs either in the Silurian or Carboniferous systems. The genus Terabratula is wholly unknown, and the shells usually referred to that genus I propose to group under the generic name of Stenoscisma, derived from two Greek words signifying narrow fissure, a character these shells possess under the imperforate apex of the larger valve, and which serves to connect the genus with Delthyris, from which it differs in having no cardinal area. This last named character on the other hand connects it with the genus Strygocephalus. I refer to it the common Silurian bivalve, Terebratula Schlotheimii, (Von Buch.) The genus Producta of Sowerby is unknown in all the rocks of the Silurian sys-

tem, except in the highest or the Ludlow strata, where two species occur; here on the contrary, the genus Strophomena of Rafinisque is unknown, as well as in the Carboniferous system, whilst it abounds in the Helderberg and Trenton limestones. The following table will show some of the characteristic genera of the two systems and subdivisions.

SILURIAN SYSTEM.	CARBONIFEROUS SYSTEM.
Brachiopoda.	*Brachiopoda.*
Strophomena, (lower and medial strata.)	Producta.
Crustacea.	*Crustacea.*
Dipleura, Eurypterus, (upper strata.)	Very rare, and the genera undetermined.
Platynotus, Trimerus, (medial strata.)	Polyparia?
Isotelus, Triarthrus, Ceraurus, (lower strata.)	Amplexus.
Polyparia.	
Catenipora, (medial strata.)	

Among the curious and interesting organic remains of the Transition, the fucoids are not the least worthy of notice, and they seem to have been much neglected by naturalists. They are even more characteristic than the testacea, so far as the species have been determined, for particular species are more absolutely limited to the respective rocks in which they originated. They assume a variety of forms, no doubt corresponding to various as yet undetermined genera. Some of them have been of a fibrous reticulated structure, having vescicular appendages, often lobed and imitating on the sandstones the forms of tracks of reptiles and birds which some writers have believed them to be. On plate 26, in Buckland's Bridgewater treatise, these foot shaped vesicular fucoids may be seen attached to the net-work, and no doubt they performed the office of floats to support the fibrous structure to which they were appended. Some naturalists have doubted the vegetable origin of these singular remains, but they could neither have been polyps nor radiated animals, since no trace of organic structure other than the mere general form is ever exhibited. Besides, like the Fuci, they were very partial to a sandy bottom, being comparatively rare in limestones, whilst the corals and radiated animals are chiefly found in the latter. Fucoides Harlani is extremely abundant in the red shales of Medina and Rochester, and in the equivalent sandstones and shales of Pennsyl-

vania and Virginia, and is more generally known than any other species. It is absolutely limited to this peculiar formation, serving to identify it in every locality. It appears to have formed a net-work, like the Dictuolites, but terminating in some of its ramifications unlike the latter, in fasciculi, somewhat resembling the human fingers. It is very difficult to ascertain with certainty whether the branches really anastomose, but such is the opinion derived from a careful examination of some very perfect specimens.

It is doubtful whether a more perfect series of Transition strata than that of New-York can be found in any part of the world, and certainly no group or system is more perfectly characterized by peculiar forms of organic remains. Nine distinct groups occur within the limits of the State, all below the great coal formation and Carboniferous or mountain limestone strata, which lie in the bordering counties of Pennsylvania. To show the order of superposition of some of the transition rocks, and the distinctive nature of the organic remains, I have drawn up the following table, chiefly from observations made during the first year of the survey, and confirmed by subsequent examinations.

Table of formations, showing the order of superposition, and some characteristic fossils of the Transition strata.

10.	Carboniferous strata, (in Pennsylvania,).....	Euomphalus catillus; Delthyris trigonalis, D. cuspidatus, Producta scotica, P. sulcata, P. scabricula, P. hemispherica, Goniatites minuta, G. Henslowi, calamopora polymorpha, Amplexus coralloides.

ROCKS OF NEW-YORK.

Old Red Sandstone Group, (*Murchison.*)

	Old Red Sandstone?	
9.	Olive sandstone, (organic remains undetermined, except a few land plants, very rare.)	
8.	Dark coloured shales,.....	Dipleura Dekayi, Cryphæus Boothii, Calymene Rowi, Pterinea fasciculata, P. concentrica, Posidonia lirata, Delthyris distans, (Sow.) Lima macroptera, Cyrtoceras maximum.
	Black slate, ...	Posidonia.

Medial Silurian strata.

7.	Gray Brachiopodous sandstone,.....	Atrypa elongata, Delthyris arenosa.
	Helderberg sandstones, ...	Fucoides cauda-galli.
	Helderberg limestones,.....	Asaphus micrurus, A. selenurus, Calymene bufo, Cryphæus calliteles, Calymene anchiops, Atrypa prisca, A. aspera, A. Wilsoni, Pileopsis tubifer, Strophomena rugosa, S. tuberulifera, Atrypa concentrica, Calamopora fibrosa, Cyathophyllum ceratites, C. helianthoides.
	Second Pentamerus limestone,.....	Pentamerus Knightii, Euomphalus profundus.

6.	Gypseous shales, ...	Eurypterus remipes.
	Rochester shales, ...	Asaphus caudatus, Platynotus Boltoni, Trimerus delphinocephalus, Orthis elegans, strophomena elliptica, Delthyris lineatus, Caryocrinus loricatus, C. ornatus.
	Pentamerus limestone,.....	Pentamerus elongatus, (P. oblongus?)
5.	Green slate, lenticular iron ore, &c.....	Undetermined.
4.	Niagara sandstone, (red,).....	Fucoides Harlani, Dictuolites Beckii, Lingula cuneata.
	LOWER SILURIAN STRATA.	
3.	Salmon river sandstone, (olive;)	Pterinea carinata, (Gold.) P. planulata, P. modiolaris, Cyrtolites ornatus.
	* Green slate,.....	Agnostis pisiformis.
2.	Gray crinoideal limestone,.....	Group of the Trenton limestone.
	Trenton limestone and slate,.....	Cryptolithus tesellatus, Triarthrus, Asaphus tuberculatus, Calymene Blumenbachii, Isotelus, Ceraurus, Orthis testudinaria, strophomena alternata, Pleurotomaria cirriformis, Orthoceras striatum, Trocholites ammonius, Columnaria sulcata, Trianisites, Fucoides dentatus, (Graptolites.)
	Mohawk limestone, ...	Orthostoma communis.
	Gray limestone with sparry veins, ...	Fucoides demissus.
	Gray calcareous sandstone, ...	Lingula acuminata.
	CAMBRIAN SYSTEM, (*Sedgwick.*)	
1.	Olive sandstone and slate, ...	Fucoides serra, (Brong.)
	Variegated sandstone, (Potsdam sandstone of Emmons,)	Dictuolites radians.
	Primary.	
	Gneiss, &c.	

* The position of this rock with Agnostus was determined by Mr. Vanuxem.

Descriptions of new species of organic remains.

Strophomena, *Raf.*

1. *S. eliptica.* Shell elliptical; inferior valve ventricose, gibbous in the middle, radiating striæ acute, remote; umbo elevated, ventricose, summit rounded; beak much incurved; superior valve striated; lateral extremities angulated, prominent. Length, ½ inch. *Locality*, Rochester, in formation No. 6. See table.

2. *S. deltoidea.* Shell deltoid, with numerous radiating striæ and concentric rugose undulations, obsolete on the inferior half of the valves; inferior valve slightly convex above, gibbous, abruptly rounded and flattened at the base; striæ small and crowded; one or two lines in the middle of the valve larger and more prominent than the others; angles of the cardinal line slightly prominent. Length, 1 inch. *Locality*, Trenton-Falls.

3. *S. lineata.* Shell suboval, length greater than the height, inferior valve convex; lateral margins rounded, and forming, with the basal margin, a nearly regular arch. Length, ⅝ inch. *Locality*, Cayuga lake.

4. *S. carinata.* Shell suborbicular, with from 16 to 18 angular radiating ribs; superior valve with a sinus in the middle; inferior valve angulated in the middle, slightly flattened on the sides; base prominent and subangulated in the middle; basal margin sinuous. Length, ½ inch. *Localities*, Helderberg mountain, in limestone; Ludlowville.

5. *S. modesta.* Shell alated, compressed, with obsolete radiating striæ; inferior valve slightly convex; extremeties of the cardinal line acutely angulated; within punctate. Length, ½ inch. *Locality*, Rochester, Mr. Hall.

Lingula.

1. *L. cuneata.* Shell cuneiform; lateral margins subrectilinear; beaks acute; valves convex towards the apex, flattened on the inferior half; base slightly arcuate. Length, ½ inch. *Locality*, Medina, Orleans co.

2. *L. acuminata.* Shell acute, acuminated at the apex; somewhat gibbous on the umbo and compressed laterally; basal margin rounded. Length, ½ inch. *Locality*, uncertain; in "calciferous sand rock."

3. *L. concentrica.* Shell ovate-acute, with very regular numerous concentric raised striæ; lateral margins subrectilinear in the middle. Length, ½ inch. *Locality*, Helderberg mountain, in limestone.

4. *L. oblonga.*—Shell oblong, sides nearly straight and parallel, regularly arcuated above, and abruptly rounded at base. Length, ¾ inch. *Locality*, Martville, Cayuga county, in sandstone.

ATRYPA.

A. elongata. Shell narrow elliptical, with numerous radiating striæ; lateral margins truncated in the middle; inferior valve gibbous in the middle, and somewhat depressed on the sides. Length, 3 inches. *Locality*, Helderberg, in sandstone.

DELTHYRIS.

1. *D. acuminata.* Shell subcordate, dilated transversely; valves with radiating sulci; superior valve, very prominent and carinated in the middle, carina not sulcated, slightly arcuate in length; lateral extremities rounded; base emarginate; inferior valve profoundly bilobed, sulci not deeply impressed; beaks approximate. Length 2½ inches. *Locality.* Helderberg, in limestone. It resembles Atrypa acuminata, (Sow.)

2. *D. granulosa.* Shell trigonal, ventricose, with very numerous minute elevated punctæ; ribs numerous, convex, the interstices not deeply impressed; inferior valve bilobed; beak elevated, incurved, foramen large; superior valve with a wide medeal convex depressed rib, with a narrow groove down the middle; umbo prominent, summit rounded. Length 1¾ inches. *Locality:* uncertain, but belongs to the shales of No. 7.

3. *D. arenosa.* Shell trigonal, with radiating sulci; superior valve with a rounded elevation in the middle, having about 4 sulci upon it, or 5 ribs; inferior valve, with a corresponding furrow; basal margin undulated, prominent and angulated in the middle. Length 2½ inches. *Locality.* Helderberg, in sandstone.

Fresh Water Shells.

CYCLOSTOMA.

C. pervetusta. Shell orbiculato-conical; volutions 3 or 4; base with a profound umbilicus, exhibiting the volutions to the apex. Length ¾ inch.

PLANORBIS.

P. trilobatus. Shell orbicular, with three nearly equal rounded prominent lobes; the large volution rapidly enlarging towards the aperture. Length ¾ inch.

UNIO.

1. *U. primigenius.* Shell ovate, ventricose; anterior side narrowed, sinuous or contracted; posterior side profoundly dilated; dorsal margin elevated, rectilinear, subalated, beaks prominent, acute; posterior extremity rounded; cardinal teeth compressed, very oblique; lateral teeth lamellar, rectilinear. Length 1¼ inch.

2. *U. orthonotus.* Shell oblongo-ovate, slightly furrowed or contracted obliquely from beak to base; anterior side very short; posterior side elongated; dorsal margin rectilinear and declining; umbonial slope angulated; basal margin straight; cardinal teeth oblique. Length 1 inch.

These fresh water shells occur in the red sandstone at Medina, beneath the layers of Fucoides Harlani, the Unios and Planorbis not very common, but the cyclostoma in great abundance.

CRUSTACEA.

CRYPHÆUS, Green.

C. greenii. Body ..... tail with the margin rather obtusely rounded; surface granulated; lobes obtuse or truncated at the extremity, end of the middle lobe somewhat expanded; groove on the ribs short and terminating abruptly in an angle.

Observations. When the crust of this trilobite is removed it exhibits very narrow prominent articulations, and no sudden depression at the termination of the ribs which is so marked a characteristic in the callitedes. I have named it in honor of Professor Green to whom we are indebted for the name and illustration of the genus. *Locality.* Moravia Cayuga county, in shale with Dipleura.

CALYMENE.

C. marginalis. Buckler with a broad margin; eyes large, semi-oval; middle lobe entire, convex, smooth, abdomen .....

Locality, near Ithaca, in a boulder. This has a much less prominent front than the Rowi, a deeper groove between the eye and middle lobe, and the tubercle which nearly joins the lower angle of the eye is much smaller.

T. A. CONRAD, *Palæontologist.*

Frankfort, Jan. 23, 1839.

To His Excellency W. H. SEWARD,

Governor of New-York.

SIR:—

I have the honor to enclose herewith my report on the First Geological District of New-York. It contains my report on the economical geology of New-York, Westchester, Putnam, Rockland and Orange counties, marked (A,) and an appendix in two parts marked (B) and (C.)

The document marked (B,) is on the descriptive geology of Orange county, by Dr. Horton; the other, marked (C,) is on that of New-York county, by Dr. Gale.

I have the honor to be,

Sir, your ob't serv't,

W. W. MATHER,

Geologist First District, New-York.

THIRD ANNUAL REPORT

Of W. W. Mather, Geologist of the First Geological District of the State of New-York.

To His Excellency WILLIAM H. SEWARD,
Governor of the State of New-York.

SIR:—

As an introduction it may not be improper to state what progress has been made thus far in the Geological Survey of the First District of New-York.

During the first season, viz. in 1836, I completed the reconnoisance of the first district, and made the detailed surveys of Suffolk county, the economical results of which may be found in the first annual report. Assembly document No. 9, pp. 61, 96, 1836.

The second season was devoted to the detailed surveys of Queens, Kings, Richmond, Dutchess and Columbia counties. The economical results may be found in the second annual report, pp. 121, 184, Assembly document No. 200, 1838.

The third season, or 1838, has been devoted to investigating the geology of New-York, Westchester, Putnam, Rockland and Orange counties, the economical results of which will be found in the present report.

The *details* of geology that are not of *direct* practical utility, have been retained, with a view to their publication in the final report of the survey, since the sole object in making the annual reports, is to enable the people to profit by the discoveries made, while the survey is still in progress.

In addition to the geological investigations, a large collection of specimens has been made to illustrate the geology and mineralogy of those counties that have been examined. Specimens, corresponding nearly

with the numbers given below, have been collected from the several counties, viz:

Suffolk, about		800
Queens, Kings, Richmond,		450
New-York, say		400*
Westchester,		712
Putnam,		423
Dutchess, Columbia,	1,352	
Rockland,		465
Orange,	3,029	
		7,631 specimens.

About one-third of this number has been collected for the geologists of the different districts, and mineralogist, so as to give to each a suite to illustrate the geology of the first district, leaving about 5,088 specimens, which are deposited in the State cases in the Geological Rooms of the first geological district. These cases are in the room over the State Library, (Miscellaneous Library.) They are all labelled and arranged in eight distinct sets. One of these sets is displayed in the glass show cases, while the seven duplicate sets are contained in seven horizontal layers of drawers, and placed in the same relative order of position as those in the show cases above.

The manuscript geological notes of my surveys in the form of a diary, are bound into nine duodecimo volumes of 400 to 700 pages each, each of which has a table of contents, and an alphabetical index to facilitate reference.

I have made topographical maps of Columbia and Dutchess counties, and partly completed the drawings of those of Putnam, Westchester, Rockland and Orange. Topographical maps had been published of the counties of Suffolk, Queens, Kings, Richmond and New-York, which rendered this labor for those counties unnecessary. Numerous local maps, diagrams, sections, &c. &c. are contained in the volumes of the diary.

* The specimens from the island of New-York have not been received and placed in the cases, but it is supposed that there are about 400. Feb. 4, 1839. The New-York specimens are now in the cases. W. Horton.

During the next season it is my intention to make the detailed surveys of Ulster, Delaware, Greene, Schoharie and Schenectady counties.

This intimation of what counties it is contemplated to examine during the next season, is given at this time, in order that persons owning property in those counties and wishing examinations made, may give notice in due season. Letters, *post paid*, addressed to W. W. Mather, Geologist of the First District, Albany, and requesting him to examine the mineral resources of property in those counties, will be attended to in the course of the season.

In discussing the geology of the counties examined during the past year, we will consider first, that of New-York, Westchester and Putnam, and afterwards, that of Rockland and Orange counties.

The general geological features of these groups of counties, except the ranges of mountains called the Highlands, are widely different. Although I have spent twelve years of my life in the midst of the region explored the past season, and although in the habit of spending most of my leisure during that time in unravelling its complicated geological phenomena, I feel that I have but *begun* to develop those facts that are of high importance, not only in scientific, but in economical geology. The general geology is very simple, but when we come to examine particular strata, veins and beds of useful minerals, and trace out the connection of the different localities, it is found to require much time and an intimate practical knowledge of the subject. The strata, in many places, are transverse to the general direction of the strike of the rocks, in consequence of transverse upheaves, of which there are several striking examples. Again, faults are numerous, and in many of these the heaves are not only vertical but lateral, and sometimes to a distance of 1,000 to 6,000 feet. These counties present one of the finest fields in our country for the investigations of physical geology. A life-time might be well spent, and with advantage to the community from its economical results alone, in developing the geology of the counties explored this season. The time for the completion of the survey is so limited, that to do equal justice to all the counties, superficial and slight examinations only can be made. These, however, have been sufficient to develop a vast amount of mineral treasures that were unknown before or not appreciated.

New-York, Westchester and Putnam Counties.

General Remarks.

In their topographical character, these counties are hilly, with broken rocky ridges on the western side, while the aspect of the eastern is that of heavy undulating swells of land. The soil is derived from the disintegration of the contiguous rocks, and from the pebbles and boulders of materials transported from a greater or less distance from the NNW, by some natural cause. The soils resulting from such a variety of rocks, contain all the *mineral* elements of fertility, while the careful husbandman supplies artificially those *organic* elements which are necessary as food for plants.

Nature has deposited almost inexhaustible quantities of manure in the bog meadows of the interior, in the salt marshes along the coast, in the mud flats of the river, and in the limestone hills; while on the other hand, great quantities are annually taken from the city of New-York, and distributed over the country. This feeding of the soil, if it may be so termed, is as necessary to its productiveness as feeding our cattle and horses, if we would have them efficient. The mineral manures, as lime, gypsum, bone earth, &c. are the seasoning, while the animal and vegetable matter supplied to the soil are the proper food for the growth of plants.*

ECONOMICAL GEOLOGY OF NEW-YORK, WESTCHESTER, AND PUTNAM COUNTIES.

Fluviatile or River Alluvions.

These alluvions in the district under consideration are not extensive. The streams flow through a rocky region, from which there is little wash. The waters are limpid and pure, and little sediment is deposited from them, even in time of floods or freshets. There are no alluvions of this class of considerable extent in those counties that might not be classed with salt marshes. The Hudson river to Albany may be considered an estuary, in which the tide ebbs and flows, and the water is always brackish to the Highlands, and frequently as far as Poughkeepsie and Hudson. The most important of the fluviatile alluvions in the

* Prof. Hitchcock, in his report of last year to the Legislature of Massachusetts on the geological re-survey of that State, has made many valuable and judicious remarks upon agriculture, upon soils and manures, and the office that these latter perform in supplying food to plants. The investigations of Prof. Hitchcock and Dana are considered the most important that have been brought before the public for a long time. They give a new aspect to agriculture as a science, and many facts that have been long known to intelligent and observing farmers, are there explained on philosophical principles. I would earnestly recommend that every farmer should peruse that part of Prof. Hitchcock's report of the geological re-survey of Massachusetts in 1838, which refers to agriculture, soils and manures.

Hudson in the counties under consideration, are the silt and mud banks forming in Tappan bay between Sing-Sing and Dobbs' ferry; the meadows near Gen. Van Cortland, at the mouth of the Croton river; the mud and silt banks extending from the above mentioned meadows to Teller's Point on one side and Sing-Sing on the other, and which occupy most of the bay between Teller's Point and Sing-Sing; the flats in Haverstraw bay between Teller's point and Verplanck; the meadows east of Verplanck; the flats between Verplanck and Royd Hook in Peekskill Bay; the meadows between Anthony's Nose and Marble Point, and the meadows and flats that lie SE, E, NE and N of Consti tution Island, below Cold Springs. The last meadow is the only one that has been dyked out to prevent its being overflowed by the tides. Two or three hundred acres are enclosed, and good hay is produced upon these meadows. The meadow east of Verplanck may be said to be dyked out. A fine road has been built across the marsh near its south end within the last two years, and the tide may now be excluded. The amount of drainage water flowing into it is very trifling.

This meadow is filled with peat to a great depth. While the road was in progress of construction across this quaking bog, the weight of gravel was so great as to cause the turf to yield, and the road sunk, while a mass of peat was forced up on each side, rising above the general level of the marsh. Several thousand loads of gravel were necessary to fill the small portion of the road way that sunk, and it was estimated that the depth of the peat must have been about 40 feet. The peat seen at this place, and which had been raised above the surface by the sinking of the road-way, was of inferior quality, coarse and fibrous, but that which is good may be below. This marsh is so convenient to water transport, that the peat may be considered valuable.

Peat is probably abundant in the meadows near Constitution Island, though it has not been particularly examined.

The mud flats that have been mentioned in Tappan Bay, Haverstraw Bay, Peekskill Bay, and near Constitution Island, are all increasing slowly, and from a variety of causes, such as vegetable decomposition, the silt and mud deposited from the water, and the growth and decay of molluscous and other animals. They have increased more rapidly during the last twenty years than before, in consequence of the greater amount of cultivated land causing a greater amount of earthy materials to be transported by the rains and surface waters into the Hudson. These flats will eventually become meadows, but the time may be far distant. Should land continue to increase in value near the Hudson as

	Cords.
Brought forward,.....	
Another east of Stewart's iron mine at the base of the hill,	20,000
Another half a mile south of do. in Phillipston,.....	10,000
Another near Davenport's corners, five miles northeast of Cold-Springs, ...	100,000
Another half a mile west of Saxon Smith's, in the SSE part of Phillipston, ...	25,000
	1,161,000

Marl.

This alluvion, although sought with care, was not found in New-York, Westchester or Putnam counties. It seems to be confined to the slate and graywacke regions of the First Geological District, as far as we can judge from the observations made thus far on the Geological Survey.

Terrains de Transport.

This, as a descriptive term, is meant to include all those materials which, as a mantle, cover the proper rock formations over a considerable area in the counties under consideration.

They bear undoubted evidences of having been transported by, and deposited from water. They are found as gravel and pebble beds, boulders and erratic blocks, and as sand and clay beds, in the main valleys of the streams. They are all of high scientific interest; but in the present report only those of economical value will be discussed.

Clays and Sands.

These materials form numerous and extensive beds along the banks of the Hudson, varying in elevation from the level of the river to a height of near 100 feet. The general order of superposition where all the beds occur, is as follows:

1. Gravel and pebble beds of variable thickness.
2. Sands stratified with water lines oblique to the strata.
3. Gray or yellowish clay.
4. Blue clay.

The blue clay generally rests on the subjacent rock, or on beds of gravel. The sand is extensively used for brick making, for lime-mortar, for casting sand and for moulding sand, and in brick making. Materials suitable for this purpose are found in many places, but the brick

yards generally supply themselves from localities long used. The price paid for moulding sand is, in some places, 25 cents per bushel, so that a bank of it is of great value. It is composed of grains of quartz with some of feldspar, garnet, hornblende and magnetic oxide of iron. The water lines oblique to the strata, indicate the directions of the currents that deposited the beds and strata of this material. Near our cities and large towns, where much sand is required for mortar, the sand and gravel beds of this formation are of great value, and their proprietors realize a large amount per acre for materials that are usually considered almost worthless.

Clays.

Both the blue and gray clays are plastic and are used in the manufacture of bricks, stone ware and coarse pottery. Both these clays contain carbonate of lime, and they may without impropriety, be called marly clays, and are well adapted for use on light soils.

They will not only improve the texture of such soils, but they will supply some mineral substances which are necessary for the production of certain crops. They have already been used to some extent on such soils with advantage, and it is believed that they may be made more extensively useful as a mineral manure. The uses of these clays for stone ware and pottery, are scarcely worth mentioning as statistical facts, as the amount of industry, capital and production is so limited.

It is different with the brick manufacture, which employs a great amount of industry and capital. The gross number of bricks made in the counties under consideration, may be estimated at 42,900,000 per annum, with a value of $225,225, as the average sale prices at the kiln is about $5 to $5.50 per thousand.

Local Details of the Brick Manufacture.

There are three brick yards in Dutchess county, that ought to have been mentioned in the geological report of last year, but were omitted through mistake. One is located near Break-neck Hill, and two others are in operation near the mouth of Fish Kill creek. They make about 5,000,000 of bricks per annum. The estimated number of last year makes an aggregate of 17,000,000.

I. GRANITE.

This rock occurs abundantly in New-York, Westchester and Putnam counties.

It presents all varieties of texture, from a very coarse grained rock, to one almost perfectly compact. In colour it varies as much as in texture. It is white, red, gray, yellowish and bluish-gray, according to the colour of the minerals forming it. The colour of the feldspar usually determines that of the mass. It occurs in beds, in veins, in interstratified masses, and in knots, knobs, and protruding masses, in which no connection with veins or beds have been traced. The more common mode of its occurrence is in beds, 10 to 100 feet thick, interstratified with gneiss. Some of the granite is too coarse for use as a building material. Some is too compact and hard, being in fact, eurite; others are well adapted for building. Different localities show a great variety in strength, and in the ease or difficulty of dressing, as well as in the ease of quarrying and the magnitude of the blocks that can be procured. In the geological report of last year, it was mentioned that many places would undoubtedly be found in the Highlands, where fine quarries would be opened, and furnish "building materials of the best quality, and which would endure the changes of our variable climate for ages, without decay or disintegration." The investigations of the past season, have verified the prediction, that such localities might be found. The materials are of the best quality, easily quarried in large blocks, suitable for columns, cornices, &c. easily dressed, enduring as time, as the naked crags themselves will testify; and several of the localities, which were unknown to their owners, are so convenient to water transport that the blocks can be swung directly on board vessels in the Hudson, by means of cranes. When we consider the value attached to the quarries in Maine, Massachusetts and Connecticut, where, in most places, it is necessary to haul the stone, either on a common road, or construct a rail-way to navigable water, a distance from half a mile to six or seven miles, and observe that notwithstanding all these disadvantages, the great outlay of capital, and the distance to a market, that they make it a profitable business, we may begin to appreciate the importance of having inexhaustible quantities of materials, as good, as beautiful, as durable, and as easily quarried and dressed, on our own waters, within forty or sixty miles of the city of New-York, and so convenient to shipment, that no rail-roads and hauling are required. In order that the reader may be able to judge of the value attached to the quarries in Maine, I may be permitted to quote a portion of Dr. Jackson's Second Annual Report, on the Geology of Maine. "Many of the Maine quarries can furnish regular dimension

stones, of excellent granite, on board ship, at $1.12 per ton, and the expense of transportation to New-York is rarely more than $2.50 per ton. Now there are but few cities where this article will not sell for at least $7 per ton, which will give a profit of $3.38 for each ton of granite.

"At the base of Mosquito mountain, beside a hugh pile of rocks that have fallen from the mountain's side and exposed a steep precipice of naked rock, the Frankfort Granite Company have begun extensive operations for obtaining building stones. Thus far they have wrought only those detached blocks, that lie in confused heaps at the base of the mountain, by which much expense is saved in quarrying.

"This quarry was first wrought in the month of May, 1836; since that time more than $50,000 worth of granite has been sold. It has been mostly sent to New-York, and is there used in constructing the Albany Exchange.

"A considerable sum, no less than $20,000, has been expended in digging a large sloop canal from the river to the base of the mountain, and that work must have consumed a considerable share of the proceeds from their sales; but when the work is complete, it will so favor the shipments as to make ample returns to the company.

"The whole mass of Musquito mountain is composed entirely of granite, and its height is 527 feet above high water mark, while the diameter of the mountain is at least twice the measure of its height, and it must contain at least five hundred millions of cubic feet, equal to 30,000,000 tons.

"Rough split granite sells for $5 per ton, of 14 cubic feet, on the wharf at Kennebunk port. The price remains uniform up to the dimensions of 26 cubic feet; and above that measure, two cents per foot is charged for every additional foot.

"Stones for store fronts, hammered, sell for 75 cents per superficial foot. Where two sides of a stone are fine dressed, and two rough hammered, three sides are charged, and nothing is demanded for the ends. Where three sides are fine dressed, and one rough hammered, they charge four sides and not for the ends."

which have a slight inclination to the west, while the grain of the rock is nearly vertical. It splits easily, both in the direction of the grain and across it. It may be procured in the form of blocks of 5 to 10 or more feet square, and of the thickness of the plates of rock, which are from 1 to 4 feet thick. Some masses were seen which had been split off for columns, for store fronts, 12 to 14 feet long, by 1½, 1¾, and 2 feet square.

The rock at this quarry is of a light gray colour, almost white, and is a beautiful material for building. It is durable, of sufficient strength, easily dressed, and easily quarried, and the stone can be transported to the banks of the Hudson, for three to four cents per cubic foot.

The extent of this rock was not ascertained; but there is an area of at least 10 acres, with a mean depth of 60 feet, or 26,136,000 cubic feet, or 968,000 cubic yards of this granitic gneiss, or about 1,900,000 tons.

There is a location suitable for quarrying, in Putnam county, about three and a half miles below West-Point, and near the Cotton Rock.* The granite or granitic gneiss is of good quality, of a light gray colour and durable. This locality was not examined closely, but from the general aspect of the rock, it is believed to be a good location for a quarry.

There are two locations for fine granite quarries on the estate of Gen. Van Cortland, on the shore of the Hudson, in Westchester county, between Anthony's Nose and Peekskill. The granite has the appearance of stone of superior quality, perfectly indestructible, and has every external aspect of quarrying easily in large blocks. It is inexhaustible in quantity, and lies upon the shore of the Hudson river, with deep water along side, so that the facilities for shipment are almost unrivalled.

It is estimated that several millions of dollars are annually paid out of the city of New-York, and the towns on the Hudson river, for building stone, brought from beyond the limits of the State, while we have within our own boundaries and near the markets, inexhaustible supplies, of

* The Cotton Rock is a noted place in the Highlands. It is on the shore of the Hudson, in Philipstown, between high and low water mark, about three and a half miles below West-Point. The rocks here are impure verd antique, (composed of limestone and serpentine, with brucite and other minerals imbedded,) serpentine, with diallage and veins of asbestus and delicate silky amianthus, diallage rock, augite rock, and granite. The amianthus which comes from the veins in the serpentine, has the appearance of cotton or of raw silk, and has given rise to the name "Cotton Rock."

equally good quality, which can be quarried, shipped and hauled at less expense than the stone we now import from Maine, New-Hampshire, Massachusetts and Connecticut. The granites of the Hudson river *must* then, soon be wrought and sent to market, and the quarries will become very valuable.

II. GNEISS.

Gneiss is the predominant rock in New-York, Westchester and Putnam counties. It varies greatly in external aspect and in composition in different parts of the tract under investigation. Its colour is dependent upon the relative abundance of its constituents, which are variously coloured in different localities. The feldspar is white, reddish, or of a bluish gray; the mica is black, brown, yellow, copper coloured, and white; the quartz is white, gray or smoky. In some places mica abounds in the rock, and it approaches to mica slate, but more commonly the feldspar is most abundant, and gives character to the rock.

Much of the gneiss in the Highlands of the counties under consideration, is a hornblendic gneiss, in which the mica is wholly or in part replaced by hornblende.

A range of granitic gneiss, of a light colour, passes through Putnam and a part of Westchester county. It extends through Carmel, near Pine pond, by Mahopack pond, thence southwardly, and crosses the turnpike from Peekskill to Danbury. Another bed extends from Boyd's corners in Putnam county and crosses the Peekskill and Danbury turnpike about five or six miles from the former place. These beds are quarried to a small extent, for use in the vicinity; but they are too remote from water transport, for quarrying at present, for a more distant market. It is durable, of a light gray colour, easily split from the quarry, and easily dressed. If these strata reach the Hudson river, they are believed to have changed so much in aspect and quality as building stone, as not to have been recognized as the same beds. The bluish gneiss is quarried at Gen. Van Cortland's quarry, near Royd Hook, two miles west of Peekskill. Another quarry is opened near Peekskill Landing, half a mile northwest.

A range of reddish gneiss extends NNE from the point above Tarrytown. In many places excellent quarries may be opened, where the stone quarries well, dresses easily, and is beautiful and durable for architectural purposes. One quarry is already worked to some extent in this range, for the New-York market, on Mrs. Beekman's farm, about one and a half miles from Tarrytown. Large quantities of stone are taken

V. TALCOSE SLATE.

This rock is limited in extent. It occurs in Westchester and Putnam counties, forming a range of hills several miles in length. It forms Blue Rock Point, on the post road, between the crossing of Peekskill creek and Annville. The slaty laminæ are parallel in direction to the limestone, and granular quartz rock on the east, which dip at an angle of from 75° to 85° to the ESE. This rock forms the principal mass of the hills to the NNE of Blue Rock Point for several miles. Gallows hill, a place celebrated during the Revolution, (in consequence of the public executions,) is a part of this range of rock. The rock is generally covered by soil, except where it has been denuded by water, or excavations for roads, &c. The soil is of good quality and produces fine crops. Farther northeast, this rock is rarely seen, but it passes up Peekskill hollow, and up a valley two or three miles west of Boyd's corners in Putnam county. It is very refractory in the fire, and is used for the in-walls of furnaces. Localities may, perhaps, be found, where slates for roofing may be quarried with advantage. The rock is very fissile, and splits in thin laminæ of some magnitude.

Diluvial scratches were observed on the out cropping edges, in many places, where the surface was exposed by uncovering the rock in making and repairing the roads. They are very distinct on the road that passes from Gen. Van Cortland's mansion over Gallows hill, on the western declivity. Like hundreds of similar localities observed last year in Columbia and Dutchess counties, the general direction is from north 20° to 30° west, to south 20° to 30° east. Veins of quartz were occasionally seen traversing the talcose slate. In some places, the quartz was loaded with pyrites, and where the slate had decayed and the masses of this mineral were scattered about on the ground, they had the spongy texture similar to the quartz from the veins and nests in the slates of Columbia and Dutchess counties. The cavities are also frequently filled with oxide of iron, like the quartz in the gold region of Virginia and North-Carolina. No gold was however seen, and it is hoped that a sufficient number of fruitless researches for *gold*, *silver* and *coal* have been made in this vicinity to deter others from future enterprises of such a nature, where the *expense is certain*, and the returns so very, *very uncertain*.

The talcose slate, at its junction with the gray and whitish limestones, is highly loaded with carbon and with pyrites. The one has given origin to the reports and stories of valuable coal beds in this region, and the other to the existence of gold and silver mines.

The slate and limestone glazed with anthracite, and presenting many points of resemblance to anthracite coal, are sufficient to excuse the conclusions of those who have supposed the existence of workable coal beds, and who did not know that such deposits have not been found in primitive rocks.

VI. LIMESTONE.

This rock is abundant, and extensively distributed in the counties of New-York, Westchester and Putnam. It is all associated with primitive rocks, such as gneiss, mica and talcose slates, and with granite, and is interstratified or embraced as beds in these rocks. In colour it varies through white, gray and clouded to black; in texture it is coarsely crystalline, granular, and perfectly compact: in composition, it varies from pure carbonate of lime to magnesian and ferromagnesian carbonate of lime, with variable quantities of earthy impurities: in hardness, from a very strong stone to one so friable as to be capable of being crushed to sand by pressure in the hand.

This rock is of greater present as well as prospective value in the region of country where it is found, than any other, unless it be the granite, which may, in progress of time, become equally valuable.

Limestone of New-York County.

This rock abounds in the north part of the island, and has been quarried to a considerable extent for marble, building stone, and for lime. The details of this rock in New-York county will be found in the descriptive geology of that county by Prof. Gale, in the appendix to this report.

Limestone of Westchester and Putnam Counties.

The limestone of these counties has the same dip and line of bearing as the contiguous gneiss and gneissoid rocks, and like them, is distinctly stratified. They all dip to the ESE, (as a general rule, but there are local exceptions,) at a high angle, varying from 45° to 90°. The limestone forms several nearly parallel ranges at intervals of to three or four miles apart, ranging in a NNE and SSW direction.

1st. The most eastwardly deposit of this kind, and of any great magnitude, is seen on Gouverneur Morris's farm, opposite Harlaem, where it is quarried for making the piers for the rail-road bridge and for other purposes. It is generally gray, and in some places is much intermixed with mica. Many of the blocks, and even the rocks in place in the

ther, and Mr. C. thinks it adapted for use as a marble. It was opened a few years ago for making lime, and it is said to have made lime of good quality. This limestone locality belongs to a Mr. Frost.

The limestone of Cross Pond in Westchester county, was examined by Prof. Cassels. It alternates several times with gneiss in the breadth of one-fourth of a mile. He states the strike of the rock at N 30° E, and the dip at 80° westward.

Limestone interstratified with gneiss was also seen by Mr. C. on the banks of Long pond, and between Long and South ponds.

The strike of these beds is about north 70° east, and dip 60° eastwardly.

Good lime was made here twenty years ago, but the expense of wood has stopped the operations.

Limestone occurs at Bedford village, opposite the boarding school, where it was examined by Prof. Cassels.

Granular limestone occurs four miles northeast of Sing-Sing at Sarlis' Hotel, where it was observed by Prof. Cassels.

Limestone crops out on the hill ESE of Peekskill. It is much contorted and variously clouded, and some of it may, perhaps, be used for an ornamental marble. It also crops out near the lower dock at Peekskill, and is bounded on the east by hornblende rock.

A bed of limestone occurs five miles from Peekskill, on the road to Crum ponds. It is a dolomitic limestone that is used for marble, for making lime and for sand. For the latter purpose, the crumbling rock is crushed by a stone roller, and the mortar is said to set well in which it is used. Similar sand in some other parts of the country will *not* form a strong mortar.

Limestone of good quality occurs on Abra'm Miller's farm, on Mill creek, which is the outlet of Crum ponds. The locality is stated by Prof. Cassels, who examined it, to be five and a half miles southwest of Somerset plain, and three miles SSE of Crum Ponds village. The strike is north 30° east, and dip 75° eastwardly. Mr. Miller has made lime from the stone of his quarry for four years. He makes five kilns of lime per annum, each of 600 bushels, the average price of which is 50 cents per bushel at the kiln. Twenty cords of wood at $3 per cord, are used to a kiln, and six days are required for the burning. The lime-

stone lies in high knobs, and can be easily opened on the northeast side, and Prof. Cassels thinks good marble may here be obtained. This locality is about two miles west of Whitlock village, through which it is supposed the New-York and Albany rail-road will pass.

Limestone was seen by Prof. Cassels on Plumb creek, about a mile west of Somerstown plains, on the Peekskill road. It occurs along the road for about half a mile.

Limestone occurs about two miles north of Phittlockville. It is also said to occur on Mr. Todd's farm, about a mile east of the locality above, where it has been used for making lime. Prof. Cassels saw it again about three-fourths of a mile south of the crossing of Titicus river. It is here abundant, and fine quarries might be opened. It crops out on the road side occasionally all the way to North Salem, where it is abundant and highly crystalline. A stratum of limestone was seen by Prof. Cassells about a mile north of Owenville, and again about a mile and a half west of Peach pond.

A marble quarry is opened nearly opposite Harlaem, in Westchester township, one-fourth of a mile north of Harlaem bridge. It is gray and white, and more or less mixed with mica. It is quarried for the piers of the rail-road bridge. The strike is north 25° to 30° east, and dip 80° WNW. It is associated with gneiss, with which it was seen in contact on the east side.

A bed of *dolomitic limestone* occurs near the county poor-house of Westchester county. It is called sandstone by the people, because it crumbles to sand by exposure to the weather. The same bed was seen at intervals to Dobbs' ferry. It crosses the valley of a small stream near the church on the hill at Dobbs' ferry. It forms the shore below Dobbs' ferry. A quarry is opened in this bed one-eighth of a mile from the shore of the Hudson, a mile below Dobbs' ferry, and a rail-road and wharf have been constructed to facilitate the transport and embarkation of the marble. Lime has been burnt from this stone on the shore, and some of the rock has been transported to New-York and burnt.

The *Sing-Sing marble quarries* are extensively wrought by the convicts of the State prison. Almost all of the limestone of these quarries crumbles by exposure to wet and frost, though it frequently requires many years to disintegrate. Near the surface the rock is perfect dolomite, covered by calcareous sand from the crumbling of the rock. At a greater depth the rock is sound, hard and tough. The bluish

Some estimate of the value of these limestone beds may be formed from the fact that the blocks can be swung on board sloops by means of cranes without any land transport, and that each acre may be made to yield from 100,000 to 500,000 barrels of lime, or for shipment; each acre will on an average yield about 100,000 tons of stone suitable for burning.

Limestone, variegated and clouded, occurs one-fourth of a mile south or southeast of Annville, across the marsh from the village near the mouth of Peekskill creek. It may, perhaps, be used for a marble, but in places it is intermixed with mineral substances which might be an injury to it in polishing and sawing. Its thickness could not be ascertained, as it was mostly covered by the tertiary formation that forms the high steep banks of 60 to 100 feet deep. Its range is NNE and SSW, and its dip about 70° to the ESE.

The same bed of limestone is again seen on the right bank of Peekskill creek, one-fourth of a mile above Blue-Rock Point. It is on land belonging to Gen. Van Courtland, and has been quarried to some extent. It is gray, bluish and variegated, in some places white, and makes good lime. Its range or strike is NNE, and its dip nearly vertical. On the west it is bounded by the talcose slate, and at the contact the rock is black, in some places glazed with anthracite, or a substance like it, and it is loaded with cubic crystals of iron pyrites.

This limestone reappears near Gen. Van Courtland's mill, one mile north of the locality just mentioned.

Limestone makes its appearance as knobs or hills, fifty to one hundred feet high, about two or three miles north of Annville, in the valley west of Gallows hill.

Limestone was observed about one and a half miles south of Putnam Court-House, on the farm of a Mr. Townsend, at two old mine holes, where some have supposed that silver, and others that marble was the object of exploration. It is scarcely necessary to add that no traces of silver ore could be distinguished. Both these excavations are in a bed of limestone about thirty rods apart. The bed is narrow, perhaps twenty feet wide, and is bounded by gneiss on each side; the strata are highly inclined to the east-southeast. Brucite and some coccolite were observed in the limestone of the northwardly excavation. At the other locality the limestone is very white, coarse grained, and contains imperfect crystals of phosphate of lime or green augite.

A bed of limestone containing brucite, serpentine and asbestus, is associated with the bed of magnetic oxide of iron on Mr. Tilly Foster's farm, two and a half miles southeast of Putnam Court-House.

Above Patterson in Putnam county, is an extensive bed of limestone. Many hundred acres in this valley are underlayed by limestone. It is quarried for lime, and forms a superior article. Sixty cords of wood are consumed in burning a kiln of 2,000 bushels. The price of this lime is 50 cents per bushel. Much of this stone seems well adapted for a building stone. Some of the rock contains beautiful tremolite.

A bed of impure limestone crosses the Cold Spring turnpike near Haight's tavern, in Phillipstown, five miles northeast of Cold spring; another bed is supposed to cross the road one-half mile north of Warren's tavern in Phillipstown; another bed crosses the road on the hill near Indian brook, between the Highland school and Warren's tavern; another near Mr. Ardens, two miles south-southeast of West Point; another near Philips' mill, one and a quarter miles east of West-Point; another at Cotton Rock, three miles south-southeast of West-Point; another still below, on the shore of the Hudson; two others on the shore, and a quarter of a mile east, near the old silver mine; another at the White mine on Anthony's Nose mountain; another three miles east-southeast of West-Point, near the Post road; another near Davenport's tavern, five miles northeast of Cold Spring; and another on Mr. Theodore Hustis' farm, one mile north-northeast of Davenport. All these localities are supposed to be in the same bed of limestone which is exposed in these various points, and probably in many others. Hustis' quarry is in the limestone bed above mentioned. Some parts of the hill are granular limestone, and a part is nearly compact magnesian limestone or miemite. Serpentine is frequently intermixed, forming a verd antique marble, which may, perhaps, at some future time be applied to use. Several fine minerals occur at this locality, which was discovered by Dr. Barratt in 1822. The precious serpentine of this locality is perhaps not surpassed in beauty by that of Newburyport or Easton, or even any locality known. It occurs crystallized distinctly with various modified forms. White coccolite, white augite, diopside, sahlite, phosphate of lime, amianthus, asbestus, pearl spar, pyrites, chromate of iron, magnetic oxide of iron, and various other minerals occur at this locality. The bed of limestone at this place forms a bed twenty to fifty feet thick, resting against granite or scinite on the west, while a stream flows at the base of the hill. It is difficult to determine whether it can be quarried with advantage, but it lies in nearly vertical strata on the

The locality where the quarrying operations were carried on, was at high water mark, and they dug perhaps too near the level of low water. Good blocks of this rock could scarcely be expected free from cracks, where they had been exposed to the beating surf and the winter's frosts for ages. A large portion of the hill south of the beach, and of the locality at the southeast end of the beach, is composed of serpentine rock, and it is not impossible that quarries of some value may be opened there.

Another locality of serpentine rock, with radiating fibres of anthophyllite,? occurs in a southeasterly direction from White Plains three or four miles. I did not see it, but was informed of it, after I had left that part of the country. I had inferred the existence of such a locality from the boulders of this rock, which I saw scattered over the fields. Another locality is in Philipstown, Putnam county, about ten or eleven miles NNE of Peekskill, and about half or three quarters of a mile east of Horton's pond. The rock is of a blackish green, fine grained, and sometimes coarsely crystalline. It is yellowish on the weathered surfaces, and is associated with steatite. Ten to eleven acres seem to be underlaid by this rock, which might be quarried for an ornamental marble. It is about eight miles from water transport.

Another locality, one that has already attracted much notice, is Brown's quarry near Pine pond in Putnam county, four or five miles from Putnam Court-House, and one and a quarter miles NNW of the county poor-house. It is dark coloured, dark green to black, and from compact to a coarse crystalline, like coarse grained hornblende rock. It is granularly foliated like common white marble, polishes well, and is perfectly black when polished. It may be obtained in large blocks for sawing into slabs. Large blocks lie on the surface in Brown's lot, and the rock is seen in place all around the hill. In the mine lot adjacent, good blocks may probably be obtained by quarrying.

Twenty-five to thirty acres of ground are underlaid by this rock on the hill side, west of the brook, which is the outlet of Pine pond. It is easily accessible, and about 100 feet above the water level of the adjacent valley. Blocks of many tons weight can be easily procured; in fact many of this size are now lying on the surface, and require no blasting or splitting before they are put in the saw-mill. Magnetic oxide of iron, or chromate of iron, is disseminated through the serpentine in some parts of the serpentine bed, and this variety of the rock will not be suitable to work, as it can neither be sawed nor polished easily.

The quarry seems to be sufficient to supply the market, not only of our own country, but the world, with this kind of ornamental marble for a long time. It is really a beautiful material when polished, and it is hoped that it will be extensively used. I have seen no other locality where such a material can be obtained in so large blocks, sound and free from seams and cracks. A marble of this kind was used in ancient times in some of the old Spanish palaces, but it is exceedingly rare in Europe. Twenty acres of this rock belong to Mr. Ferry H. Brown,* one acre to Mr. J. W. Brinkruff, and the remainder to Mr. Fary, as the agent of the Hudson River Mining Company.

IX. STEATITE.

This rock is rare in the counties under discussion. It occurs on the island of New-York at the serpentine bed, but it is believed not to be of good quality. It is there mixed with anthophyllite. Vide Dr. Gale's Report in the Appendix.

Another locality was seen this year near Peckville, a little north of the line of Putnam county, and within Dutchess county. It is there intermixed with serpentine, and although abundant, and quarried in large blocks, it was found difficult to saw it well, in consequence of the different degrees of hardness of the steatite and serpentine. It is beautifully spotted and clouded, and a steatite indurates by heat, it is possible that it may at some future time be wrought as an ornamental stone.

Some of the masses of steatite are very pure, soft and easily wrought. In some parts of the bed the rock is granular, or scaly talc, either pure, or traversed in every direction by crystals of actynolite.

Another locality was seen in Philipstown, Putnam county, on a Mr. McCabe's farm. It is near the serpentine rock before described as eight or nine miles NNE of Peekskill, and half to three-quarters of a mile east of Horton's pond. The rock here graduates through every variety of aspect, from talc, through steatite to serpentine. I did not see proper soapstone or steatite rock adapted for useful purposes, *in place*, but was assured that large blocks had been dug there, and that there was an abundance of it. I saw slaty steatitic rock *in place*, and small masses of beautiful steatite scattered over the ground. Good quarries of this rock are well known to be very valuable. The blocks are worth $20 per ton in market. This bed graduates on the east into serpentine rock.

* Mr. Brown sold his twenty acres a day or two after I had examined the locality, and had informed him of its value, for $10,000. He had, a short time before offered it for sale for $100.

taining augite and some magnetic sulphuret of iron, and when carefully tested by cupellation, gave no traces of silver.

Copper ore has been found in several places in Putnam and Westchester counties, but not in such quantities as to justify exploration.

Pyritous copper and green carbonate of copper are found in small quantities in the gneiss rocks at Phillips' mills, one mile and a quarter east of West-Point; also at Phillips' iron mine eight miles northeast of Cold-Spring landing. Pyritous copper, black sulphuret of copper, and green and blue carbonates of copper are found at Sparta, near Sing-Sing, and the surface indications were considered so favorable, that a mining company was formed, and chartered with a capital of $100,000. It was sold by the company for $1,000 to some persons in New-York, who incurred some expense in sinking a shaft and making an adit level from high water mark on the shore of the river to intersect the shaft. This adit level was to drain the mine as low as was practicable without the aid of machinery. Little ore was obtained, not enough, it is said by one of the old miners, to pay the expense of the candles used in driving the adit level. The ore is stated to contain some silver. A beautiful specimen of the ore was presented me for the State collection, by Mr. Cartwright, who discovered the mine and had the superintendence of it. The specimen is in the public cases in the geological rooms of the First District, in the capitol. Copper ore is found also in the marble quarries at Sing-Sing in a small vein. It occurs there as pyritous copper, black sulphuret of copper, and as the blue carbonate of copper. It occurs also in small quantities in the cliffs near the shore, about 100 yards southeast of the brick kiln at Sparta. It has also been found in small quantities in several places in the township of Mount-Pleasant, farther from the river. As it occurs in so many places in this vicinity in small strings and nests, it is not improbable that workable quantities of the ore may exist there, but I would advise persons to be cautious in investing capital for mining explorations. The working of metalliferous veins, with the exception of iron, has thus far in this country, been like a lottery, whether for gold, silver, lead or copper. There are some that have proved to be good investments, and have yielded permanent profits, but on an average, at least nine-tenths of them have cost far more than they have produced.

Titanium ore has been found in several places in Putnam county. At almost every locality where augite and scapolite are found associated, (and the localities are numerous) sphene or the silico-calcareous oxide of titanium is also found associated. Sphene, beautifully crystallized,

was discovered by Dr. Barrett, at Cold Spring landing in 1822, during the excavations for the foundation of the long block of buildings next the shore, on the north side of the village. Specimens were obtained at that place in abundance by Dr. Barrett, and more beautiful than any that I have seen from any other part of the country. Titanium has, however, been applied to but one useful purpose, and that of comparatively trifling importance, viz: for tinging the enamel of artificial teeth of a slight yellowish colour, like the natural teeth.

Arsenical Ores.

Arsenical iron occurs in several places in Putnam county, but the only locality known in that county to which any practical importance is attached, is about four or five miles northwest from Putnam Court-House, and about half a mile southwest of Pine pond, in the township of Kent, near the serpentine marble quarry. This is one of the old mine holes from which silver is reported to have been obtained. The mine is now owned or leased by a mining company, called the Hudson River Mining Company. It had been cleaned out when I saw it. The shaft is forty feet deep. Yellow pulverulent sulphuret of arsenic covered the sides of the shaft and the timbers, wherever they had been covered by water, resulting from the decomposition of the arsenical sulphuret of iron. This latter mineral abounds there. It forms a bed or mass in hornblendic gneiss rock above the shaft, and is there undergoing decomposition, forming arseniate of iron. The ore does not, so far as I could perceive, form a vein, but is a mass, and from the surface indications, and from what I saw in the mine, there is a probability of the existence of a great quantity of this ore. The mine goes by the name of the silver mine, and it is stated that silver has been obtained from it, but the individual who is said to have analyzed it, has no public name as a chemist, and until it shall be analyzed by a disinterested person of reputation as an analytical chemist, confidence ought not to be reposed in the statement that it is a silver ore. This kind of ore is wrought as a silver ore in Germany, where it contains some of the precious metal. It is possible this may also contain it, and even should it be argentiferous, it may not contain enough silver to make it worth separating.

The ore contains much arsenic, and it may perhaps be profitably wrought to furnish the common white arsenic of the shops. It is well known that large quantities of this material are consumed for various purposes in this country, such as the manufacture of shot, flint glass, medicinal preparations, &c. and the supply is at present derived from Germany. This mine would probably supply the demands of commerce

The ore is associated with granular quartz on the east, and probably with limestone on the west, but this latter rock was not seen near the ore beds. These rocks are associated in the above order at the mouth of Peekskill creek.

A bed of hematite, of excellent quality, as far as the eye can judge, occurs on James Ackerman's farm, about one and a half miles north of the county poor-house, and four or five miles ENE of Tarrytown, in Westchester county: thirty tons of the ore were dug in 1837, and carried to the furnace at Cold Spring, Putnam county. It had not been used in September last, but it will undoubtedly make good iron. There is, probabably, an extensive bed of the ore. It is associated with white limestone, and this range of rock reaches the banks of the Hudson, a little below Dobbs' ferry. It is possible that beds of similar ore may be found connected with the limestone near the river. Should this be, the ore beds would be valuable, as there would be but little cartage to water transport. An acre of iron ore, only three feet thick, ought to yield the owner at least $4,000 if he leases it to those who dig it for fifty cents per ton.

Bog ore was seen on Judge Kemey's farm, one and a half miles south of Sing-Sing. It was about eight inches thick, but it seemed to occupy an area of only a few square rods, and in an economical point of view is scarcely worth notice. As a mineral, it is well characterized, and makes beautiful cabinet specimens.

Red ochre and *red chalk* occur on H. I. Cruger's farm, in Cortlandtown. It is presumed to be abundant from the appearances at the locality. It has been opened a little, by persons who wished to obtain small quantities of these materials. Specimens are deposited in the State collection.

Magnetic Oxide of Iron.

This ore abounds in Putnam county. Several mines are already wrought, and many more are capable of exploration They form masses in gneiss and hornblendic gneiss rocks, which, by casual examination would be called beds; but after a careful investigation of the facts, I think they may be called veins. Their course is parallel to the line of bearing of the strata, and they lie parallel to the layers of rock, but by close examination, it is found that in several instances, after continuing with this parallism for a certain distance, the ore crosses a stratum of rock, and then resumes its parallism, then crosses, obliquely, another, and so on. In other places, where a great bed of the ore occurs at

some depth, only a few small stripes of ore penetrate through the superincumbent mass to the surface, as if the rocks had been cracked asunder, and these small seams of ore had been forced up from the main mass below. The beds or veins of magnetic iron ore lie either vertical, or dipping to the ESE, at an angle corresponding nearly to the dip of the strata. One example, only, was observed where its dip was to the WNW, viz: at the Stewart mine. The ore is very variable in quality. In some it is nearly pure magnetic oxide of iron; in others it is intermixed more or less with the materials of the contiguous rocks; in others, it is mingled with pyrites and with other minerals. Two main veins of this ore will be described under the names of the Philips vein and the Simewog vein. Numerous localities are known where this ore occurs, and where it has been dug in small quantities. They will be mentioned under the head of local details.

LOCAL DETAILS.

A bed of magnetic oxide of iron has been opened on Break-neck mountain, and several tons taken from it. The extent of the bed is not known, and the ore has not, it is believed, been smelted.

Another bed has been opened on the northeast part of Constitution Island, opposite the West-Point foundry.

Another was opened in the middle of the island. The ore occurs, disseminated in granite near the redoubt, above the Target rock on Constitution Island. Magnetic oxide of iron is thickly desseminated in limestone, near Philips' mill, one and a fourth miles east of West-Point; and it is found in that stratum of limestone in many places, from the above locality to near half a mile south of the "Cotton Rock," a distance of three miles.

It also occurs in the granite rock that is associated with the augite and limestone rocks near the old "silver mine"* three quarters of a mile southeast of Consook Island, and one mile northeast of Anthony's Nose mountain.

A bed was opened many years ago on Anthony's Nose mountain, but it contained much pyrites and crystallized phosphate of lime, both of which injure the ore for the manufacture of iron.

* This mine was opened in ancient times, for what purpose is not known. Stalactites are found in the adit level, which is 200 yards long, and old tools with the handles rotted out have been found in it. It was reopened some years ago with the hope of getting silver—the man who worked it having been told that the scales of plumbago in the rock were sulphuret of silver. He is said to have spent all his property, and to have died in a mad-house.

Farther down the hill are the two main openings, which go by the name of Philips' mine. The ore in some parts of the upper mine is more or less intermixed with copper pyrites, which injures the quality of the iron. The mine has been wrought badly, timbers being used to prop the overhanging rock, and great masses have crushed in and filled most of the mine.

The lower mine, where the whim is placed, has a solid rock roof, a part of the ore bed having been left in the top of the hill, while the mine has been worked below. The ore bed is here 15 to 20 feet wide, and has been wrought 30 to 40 feet in depth, over a length of — yards. The ore here is nearly a pure magnetic oxide of iron, and 20,000 to 30,000 tons of ore have probably been taken from these two mines.* Other openings have been made along the line of the vein for about half a mile farther to the SSW, and some 3,000 to 5,000 tons of ore probably removed. The rock in which this part of the vein thus far described, is contained, is mostly feldspar, with some bluish quartz.— Hornblende is also common. The feldspar is sometimes pearly in lustre and gray in colour, with wrinkled and bent faces, as if it had been soft and subjected to forces acting in different directions.

The next mine that is worked to any extent on this vein is the Stewart mine.. It is about twelve feet thick of pure ore, and four feet more of lean ore. The former is much used in forges, the latter in the blast furnace. The ore at this mine is purer than that of any other mine I have seen, and is easily worked in the forge. It is granular, and easily broken and crumbled into grains about the size of BB shot, and is called by the miners "shot ore." The vein lies between strata of feldspathic gneiss, which dip to the WNW about 70°. This mine is on the east side of the mountain crest, and about 100 to 200 feet above a marsh, with a steep declivity, and might easily be wrought to that depth without drainage, by driving an adit level to intersect the vein.

About half a mile SSW is another opening by the road side, where some ore has been dug, but it is lean, and much intermixed with the gneiss rock.

About three-fourths of a mile SSW of this is the Denney mine. It is about two and a half miles ENE of Warren's tavern in Philipstown, in a straight line, on one of the crests of the eastern ridge of the High-

* *Green hornblende, actynolite, green hyalite, green and blue carbonate of copper, pyritous copper,* crystallized *magnetic oxide of iron* in the form of the acute rhomboid, *common pyrites,* and *acicular gypsum* (efflorescent,) were seen in small quantities at these mines.

lands. The ore seems to have been injected among the rocks. In some places it forms regular stripes on the surface of the rock, parallel to the line of bearing, in others, there are scarcely any indications on the surface, while extensive masses exist a short distance below. This cap of rock over the ore is frequently called by the miners a rider, and the ore below, the horse. The mine now at work north of the house, is about 30 feet deep, and the vein of solid ore 25 feet wide, overlaid by a cap or rider of rock which contains but little ore.

Most of the ore is very compact and pure, but some contains hornblende. Much of the feldspathic rock contiguous to the vein is injected with thin veins of ore from one-eighth to one inch thick. 200 yards SSW is another opening from which much ore has been taken. This place has been excavated to a depth of 60 feet, and the vein is 20 to 30 feet wide. 20,000 to 30,000 tons of ore at least have been removed.

Contiguous to this opening is another 30 feet deep to the water, with a sheet of rock 5 or 6 feet thick, between two divisions of the vein. The rocks on each side of the vein are more or less injected with thin veins of ore; from examining the locality, many suppose that the ore has been injected into the cracks and crevices of the rock when broken up by some upheave.

This ore is delivered at the Cold Spring furnace, and at the wharf at Cold Spring, for $3 per ton, and mined as it is, scarcely any profit can be realized at this price. The quantity mined here is 600 tons per annum.

The Coal Grove mine is about one or one and a half miles SSW of the Denney mine. It is in gneiss. The vein is narrow at the surface, but at the depth of 12 feet it is 4 feet wide. The ore is of an excellent quality, very rich, and well adapted for the forge, and will, undoubtedly, make an excellent iron. The distance from this mine to the furnace and Cold Spring landing, is less than from the other mines.*

The Gouverneur mine is about one and a half miles SSW of the Coal Grove mine, and four miles east of the Philips manor house, at the southeast corner of the water lot. The ore is much intermixed in the rock, but would perhaps work well, mixed with other ores to flux out the feldspar and other minerals. It may probably be purer farther down. It has been opened in several places along the crest of the mountain to a depth from 3 to 12 feet.

* The Kemble mine is a short distance NNE of the Coal Grove mine, and on Philips' vein.

and Smith's clove is a noted example. It is the one through which the New-York and Newburgh turnpike passes, without ascending more than a few hundred feet.

The Ramapo river flows through this to the south, while another stream, a branch of Murderer's creek, flows in the opposite direction. For local details on the rocks of the Highlands of Orange county, except those near the Hudson, the reader is referred to the descriptive geology of that county, by Dr. Wm. Horton, in the appendix to this report. The land of this region produces tolerable crops where it is capable of tillage. It is good grass land. The principal portions of the mountain region are used for growing timber and fire wood for the New-York market, for furnaces and forges.

The slate and graywacke region of Orange county is accurately described by Dr. Horton in the appendix to this report. In the general direction of dip, it corresponds with the primitive rocks of the Highlands, pitching to the southeast, and apparently passing under them.

The slate rocks lap around the terminating ridges of the primitive rocks of gneiss, granite, &c. and continue a greater or less distance up the valleys between the ridges, like water in the bays and re-enterings of a coast, but the dip of the strata, with the exception of some local contortions and transverse upheaves, continues parallel to the general directions of the lines of bearing and of dip. This is a rich agricultural region, celebrated for its fine grazing and grain farms.

The red sandstone region of Rockland county is a fine agricultural district. The land is in some parts much broken and stony, but in general it is rolling, with a rich sandy loam, resulting from the disintegration of the subjacent sandstone and its associated shales, marls and limestones. The strata are in general slightly inclined (1° to 3°) to the westward, but near the granitic rocks, near Grassy Point, they dip southwardly at a considerable angle, ranging from 15° to 45°. This rock occupies that portion of Rockland county from Grassy Point along the base of the Highlands to New-Jersey, and eastward to the Hudson river, but a portion of its area is covered over by trap rocks.

The trap region of Rockland occupies much less of the surface of this county than one would suppose in passing up the Hudson river. It forms a narrow belt along the shore of the Hudson, from the New-Jersey line, to near Haverstraw, where it ranges off to the northwest and then west, and finally southwest near the base of the Highlands, where

it disappears. A branch of it strikes off about two miles north of Nyack in a westerly direction, and extends, with perhaps some interruptions, to near the Highlands. These ranges of trap rock are narrow, from one-fourth to one mile, and in some places perhaps one and a half to two miles broad. Along the Hudson, and on the north front of the range extending west from Haverstraw, the trap rock forms high mural columnar escarpments, of 300 to 800 feet in height, with a steep slope of debris, which have been crumbled off from the cliffs above by the action of the weather and the frost.* On the western and southern sides of this range, the trap rock generally slopes off more gradually, but in a few places it is precipitous. It can scarcely be considered otherwise than an enormous projecting trap dyke. Dykes were observed in several places cutting through the sandstone, some of which were very large. Occasionally it was seen spreading laterally from the dykes between the strata of sandstone. Many facts of high scientific interest were observed. They will be detailed in the final report on the Geological Survey of the State.

ALLUVIAL DEPOSITS.

Fluviatile Alluvions.

There are no alluvions of importance of this kind above water, that may not be classed as salt marshes. Tappan, Haverstraw and Peekskill bays are becoming more shoal by the deposition of alluvial matter in many places, and the larger steam-boats cannot go in to Dobbs' ferry, Tappan Slote, Nyack or Haverstraw, in consequence of the shoal water over these mud flats. There is a broad channel through these bays of considerable depth, but in many places the water is shoal nearer the shore, and large areas are becoming gradually more shallow, so that we may reasonably anticipate the time when they shall become land. The flats along the right bank of the Hudson, opposite West-Point, both below Gee's Point and near Camp-Town, have grown sensibly more shallow within the last fifteen years, during which time they have been under my observation. The same may be said of the flats between Constitution island and Gouverneur's landing, opposite West-Point, and between Constitution island and Cold-Spring.†

* There are several places where valleys pass through the trap range above described, but it is believed there are none where this rock is discontinued. The valley west of Nyack is perhaps the lowest, but even here the trap is seen at the summit of the valley.

† In 1822, sloops used to come in at the foundry dock, about half way between Cold-Spring and the West-Point foundry, to take in their freight of cannon and other castings from the foundry, but the water has become so shoal that for some years past it has not been possible, and they now load at Cold-Spring.

A peat meadow occurs on the mountain, half a mile west of Round pond, five miles southwest of West-Point, on land of Mr. Wilkins, and contains 10,000 cords.

A small peat bog was seen between the limestone ledge and Duck-Cedar pond, in Warwick, and may contain 4,000 cords. A peat bog was seen near the Patterson mine, containing probably 5,000 cords.

Another near the Crossway mine, containing 30,000 cords.

Another east of the Sterling mine, containing 50,000 cords.

Another, of 60 to 100 acres, was seen in the valley of Smith's clove, between Wike's and Galloway's. It contains probably 200,000 cords.

A peat bog lies west of Townsend's ore bed in Canterbury, and contains 10,000 cords.

In the slate and graywacke region of Orange county, peat is every where abundant, and the localities are so numerous that it would be tedious to enumerate them. The drowned lands, the Graycourt meadows and the Black meadows are the most extensive of these deposits. The former marsh is most extensive, and contains 17,000 acres. At a low estimate, there must be 25,000 acres of peat bogs in Orange and Rockland counties, that have not been estimated, and we may calculate, in round numbers, that they contain 25,000,000 cords of peat.

The aggregate cords of peat before enumerated, is 1,140,000 cords, and the total estimated amount of the peat in Orange and Rockland counties may be put at 26,140,000 cords, or about 72,000,000 chaldrons.

MARL.

No fresh water shell marl was observed in Rockland county: Dr. Horton found it abundantly in the peat bogs in the slate formation of Orange county, but the quantity has not been estimated, from the want of sufficient data. It is hoped that our farmers will make a proper trial of this material on their lands. The reader is referred to Dr. Horton's report on Orange county, in the appendix to this report, where the use of this material as a stimulant manure, is discussed.

TERTIARY DEPOSITS.

The tertiary deposits of Rockland and Orange are similar in composition, texture and superposition, to those of Putnam and Westchester counties, and which have been described. One of these deposits ex-

tends from Verdrietje Hook, below Haverstraw, to Stony Point; another lines the shore from Dunderberg Point, above Caldwell's Landing, to one and a half miles below; others of the pebbly and gravelly varieties, at an elevation from 100 to 200 feet above the river, overlaying the gneiss and granitic rock, extend at short intervals from Fort Montgomery to two miles above West-Point. A clay deposit lies in the valley, and near the shore between the Crow's Nest and Butter Hill mountains; and another extends from one mile west of Butter Hill Point, by Cornwall and New-Windsor, to Newburgh.

The tertiary deposits extend up the valleys of the streams, and are spread more or less extensively over the interior. They attain an elevation of 300 to 500 feet above the Hudson. Those on the banks of the Hudson are nearly uniform in height, and their surface is from 150 to 200 feet above tide water. Pottery of a coarse kind is made in Canterbury, and perhaps in some other towns in Orange county, but the principal econominical use of the clay beds of the tertiary deposits of Orange and Rockland counties, is for the manufacture of bricks. In Rockland county, bricks are made as follows:

At Hodge's yard, at Grassy Point, they made in		1838,	2,500,000
Wm Holmes'	do	do	2,000,000
Mumer's,	do	do	3,500,000
Mackay's, at Haverstraw,		do	2,500,000
Churchill's, below Caldwell's Landing,		do	1,000,000
Lent's,	do	do	500,000
			12,000,000

In Orange county, bricks are made as follows:

At F. Clark's yard, in Cornwall, in		1838,	1,260,000
Cronkites,	do	do say	1,500,000
W. Stringham's,	do	do	1,000,000
N. Audam's,	do	do	3,000,000
M. L. Sproat's, Walkill,		do	300,000
S. C. Wood's, Goshen,		do	300,000
Norris', Newburgh,		do	2,100,000
Anderson's,	do	do	300,000
Total bricks made in Orange county in		1838,	9,760,000

nace hearths, and was opened about fifty years ago. It has not been worked during the last thirty years until within a few months. Mr. Joseph Bird has reopened it, and pays Mr. Van Houten $10 rent for every set of furnace hearths he quarries.* The quarry is two and a half miles from the landing, and a set of stones for a furnace hearth delivered there, is worth $100. One stratum only is quarried for this purpose, and that is three feet thick. Another stratum above might be used, but it is stated to be too tender. This, and most of the quarries of sandstone were examined by Prof. Cassels. The stone is very porous, and filled with rounded quartz pebbles. It is tender when first quarried, but becomes harder by exposure to the weather. The furnace men prefer that the stones should "season" one year before they are put into the furnace.

Another quarry, owned by Mr. Cornelius Depew, is about half a mile north of Van Houten's. Here the stone is gray at the surface, but red two feet below, so that the blocks contain both colours. The stone is stronger, finer grained, and not so tender as Van Houten's, but in other respects similar. One stratum only is worked at this quarry. The grandson of Mr. Depew works this quarry, and pays $15 rent per set of blocks for a hearth. The hearths now in the Greenwood, Woodbury, and Cold Spring furnaces, are from this quarry.

Blauvelt's quarry, three miles northwest of the New City, is worked by Isaac Springstein. It is opened near the summit of the hill. The face exposed is about 20 feet high. The uppermost layer is 5 feet thick. The stone is soft and friable, and is used for furnace hearths, glass works, and for jambs. The proprietor receives $13.20 per set.

Another quarry has been opened three miles north of the New City by Richard Coe. It is the coarse gray sandstone, and near the junction of the trap and sandstone.

Another quarry, one-fourth of a mile west of Coe's quarry, has been opened by Levi Smith. This stone is also the gray sandstone from near its junction with the trap rock. A locality was observed on the shore two or two and a half miles below Haverstraw where the conglomerate looks like a good fire stone. The stratum is 4 or 5 feet thick.

Numerous quarries have been opened along the south base of the mountain on each side of the road, among which are those of John

* A common hearth requires 14 blocks of stone, 10 of which contain each about 20 cubic feet, and 4 each about 10 cubic feet, or in the whole, 240 cubic feet.

Smith, Jacob Green and Jonas Conklin. It is not known how many sets of stones are obtained at these quarries, but the probable receipts are from $4,000 to $10,000 per annum.

Red Sandstone or Freestone.

This rock is extensively worked for cutstone, for flagging stone, and rough stone for basements along the shore of Tappan bay. The shore is skirted by quarries from two miles below Nyack to two miles above that place. Some of these quarries have been worked for more than fifty years.

Gesner's quarry is at the ship yard, about half a mile below Nyack. It is not much worked.

Westervelt's quarry is one mile north of Nyack. It was visited by Mr. Cassels. The flagging stone 1½ feet wide, and 2 to 3 inches thick, are delivered in New-York at 15 cents per foot. Rubble stone of this sandstone sells in New-York for 62½ cents per cart load of 15 cwt. The transport costs about one-fifth of this amount. The proprietors receive one-fifth of the proceeds of sales for rent from those who work the quarries. 2,000 feet of slabs besides rubble have been quarried this year. Clark's quarry is one and a half miles north of Nyack. Specimens of the sandstone of this and several other quarries are in the State collection.

Wilkin's quarry is one mile south of Nyack. 5,000 to 6,000 feet of slabs have been quarried here this year, and 500 cart loads of rubble stone.

The two quarries of Daniel Onderdonk and his brother are near each other below Nyack. 2,500 feet of slabs or flags have been quarried the past season from each.

Richard Clark's quarry is near Onderdonk's.

There are sixteen quarries in operation below, and fifteen above Nyack, within two miles from that place, which will average about 2,000 feet of slabs, (as Mr. Cassels was informed,) and 500 loads of rubble stones each, per annum.

This would give the product of the 31 quarries the last year as 62,000 feet of slabs, valued at..... $9,300 00
and 15,500 cart loads of rubble, at..... 9,687 50
$18,987 50

These quarries may all be opened directly on the shore, and blocks of large size may apparently be quarried with ease, and swung directly on board vessels by means of cranes. Should these stones prove as good as their external aspect would seem to indicate, it would be difficult to estimate their value, which would be very great.

A valuable quarry may be opened on Stony Point, a little west of the light-house. This part of Stony Point next the United States' land, belongs to Mr. Brewster. There are about 10 acres of granite of good quality, and which may be worked to a mean depth of 60 feet to high water mark. This place ought to be able to furnish one million cubic yards of granite, or 27,000,000 cubic feet. This rock is the proper granite, composed of quartz, feldspar and mica. It is darker or as dark coloured as the Quincy stone; is as durable, and as easily dressed. This quarry ought in the course of working to yield a nett profit of $7,000,000, if the stone should prove as sound and easily quarried as its appearance would seem to indicate. The aggregate amount of workable granite in locations just described on the right bank of the Hudson in the Highlands, is estimated at 100,000,000 cubic yards, or 2,700,000,000 cubic feet, a quantity that may be considered inexhaustible.

GNEISS.

This rock is predominant in every part of the Highlands of Rockland and Orange counties. Its modifications have already been described, as well as its stratification, and allusion has been made to some of the transverse upheaves that have changed the dip and line of bearing, to a direction nearly perpendicular to the general ones.

This rock has been quarried in many places, but the quarries can scarcely be said to be fairly opened. Many fine locations for quarries exist which have not yet been opened.

Local Details.

Gneiss, and granitic gneiss, have been quarried from the loose blocks at the base of Butter Hill and of the Crow's Nest, on the shore. There is a great abundance of durable stone here, which can be easily obtained. It is rather hard to dress, but is beautiful and indestructible.

At West-Point two fine quarries of gneiss have been opened, and worked occasionally for many years. Most of the buildings at West-Point are constructed of stones from these quarries. They are of a

beautiful bluish gray colour. The quarries are about half a mile north of Fort Putnam.

A quarry has been opened at Block-House Point, about half a mile below West-Point, or three-fourths of a mile below Gee's Point.

Another quarry may be opened about one-fourth of a mile above Block-House Point, on the shore, northeast of the Hospital.

Another quarry has been opened on the shore, about half way between Block-House Point and Mrs. Kingsley's. Much of the rock along the shore to near Mrs. Kingsley's landing, may be quarried with advantage.

Cozzens' quarry is one-fourth of a mile below Mrs. Kingsley's.

A quarry has been wrought on the shore, about one-fourth of a mile above Buttermilk falls.

Another extensive one might be opened between that and Buttermilk falls.

Another quarry is at Buttermilk falls.

Mearn's quarry is half a mile below the falls.

Two other quarries are within one mile below the falls.

Faurot's quarries are half a mile and one mile below Consook island. Capt. F. has sold 1,200 tons of stone in New-York this year at $1.75 per ton.

Another may be opened near Fort Montgomery.

Many other quarries might be opened along the shore at intermediate points, where the stone is of good quality; but much care is necessary in selecting judiciously, since a large portion of the mass of gneiss rock is not of a good quality. Little of the rock from Faurot's quarries to Mearn's quarry is good.

Several fine gneiss quarries might be opened on Waggon's islands, and between these and Caldwell's Landing.

Talcose Slate.

This rock is seen on the shore of the Hudson, about one mile and a half or two miles below Caldwell's Landing. It passes on the west side of the limestone in which Tompkin's quarries are located, and crops out again in the bay beyond the first quarry, and is seen on the shore west

It is on the immediate shore of the Hudson river, about 1 or 1½ miles below Caldwell's Landing, and above Tompkins' quarries. Prof. Cassels describes it as four or five rods wide, measured across the strata, which are rather thick layers and blocks than strata. It is stated that blocks of any reasonable size can be quarried here, free from cracks and flaws. It is of various shades of colour, from a deep spotted green to a beautiful bluish white. It is generally free from pyrites, but some blocks contain crystals of this mineral. The occurrence of this mineral would injure it for sawing and polishing, but Mr. C. reports that most of the quarry is free from this mineral, and that the verd-antique marble from this place takes a high polish. The quarry is on the shore, and vessels can come directly along side. The quarry belongs to Sampson Marks, Esq.

Ores.

Silver ore is said to have been found in several places in Rockland and Orange counties, and many wonderful stories are told about the mines once discovered, and which the discoverers have not been able to find again. I have seen no silver ore or any thing to justify the conclusion that it exists there.

The same remarks may be applied to *lead ores.*

Copper ore is found in several localities in the trap and sandstone region of Rockland county. The strongest indications of copper ore were seen about two miles from Sadenton, by the road side, between that place and Ramapo works. Thin seams and scales of green carbonate and the red oxide, were seen in abundance on and through the trap rock. These minerals were first discovered in the loose masses of the rock, and were traced up to their source in the ledges of trap rock in the hill on the east side of the road. No veins of copper ore were seen, but veins of silicious matter one-fourth of an inch thick traversed the greenstone trap, and the sides of these veins were frequently invested with a thin scale of the ore. It is not improbable that workable veins of this ore may be found in this vicinity. It is well known that copper ore has been found in some quantity associated with sandstone and trap rocks like those in New-Jersey, Pennsylvania, Connecticut, Massachusetts, Nova Scotia, and on the shore of Lake Superior. Many mines have been opened in these various parts of the country, and considerable quantities of copper ore mined and sent to England to be smelted.

The arsenical ores of Orange county are discussed by Dr. Horton in the appendix to this report.

Iron Ore.

Magnetic oxide of iron ore abounds in the mountain region of Rockland and Orange counties. Most of the localities of this ore are on three or four lines which extend across these counties from northeast to southwest. Sometimes the lines are not continuous, but are dislocated by lateral heaves. Their continuity has not been traced throughout, and much time and minute observation would be necessary for a perfect development of these veins.

One of these veins ranges along the northwest faces of the Highlands, and the mines on Butter hill, Deer hill, and probably those of the Clove mine, O'Neil mine, and Forshee mine may be on this vein.

The other ranges from the Forest or Dean mine NNE to Kronkite's mine, Meek's mine, and the ore bed near West-Point. The ore beds on Constitution Island are believed to be a continuation of this vein.

The same vein is supposed to range from the Forest of Dean mine southwestwardly by the Greenwood mine, or else the Hassenclever mine, Patterson mine, Mountain mine, Long mine, Crossway mine, Sterling mine, and mine to the New-Jersey line.

Another range of ore seems to extend from the north side of the Crow's Nest, where a mine has been opened by Round pond and so on towards New-Jersey.

Another still probably ranges from Fort Montgomery by Queensbury mine, and Rich mine, to New-Jersey.

Local Details.

A bed of magnetic oxide of iron occurs about one or two hundred yards east of the reservoir at West-Point. Its quantity is not known, as no explorations have been made. The indications there are as promising as at many productive mines. The ore is associated with hornblende. It has been traced at short intervals for some distance in a southerly direction towards Meek's mine on the west part of Bear hill, southwest of Buttermilk falls.

At *Meek's mine* the ore is titaniferous.

Kronkite's mine on the farm of Richard Kronkite, Esq. is about half or three-fourths of a mile southeast of his house, and four and a half miles SSW of West-Point. There are two veins of ore separated by a sheet of rock. Mr. K. has traced it 50 to 80 rods to the NNE. 800

The northwestern border of the primitive is very irregular, extending obliquely across the county near its middle, in a direction about east and west. It embraces a large portion of the town of Warwick, most of the town of Monroe, the south corner of Goshen, part of Blooming-Grove, nearly all Cornwall, and parts of New-Windsor and Newburgh. By far the greatest part of this primitive region is composed of gneiss. In many places it is regularly stratified, the line of bearing being on an average south 45° to 50° west, and north 45° to 50° east; and the dip to the south and east at an angle varying from 45° to nearly vertical. There are, however, many variations, both in the direction and the dip, but they are local. This rock, in some of its variaties, forms the great mass of the Highlands. For exhibitions of the stratification and dip, many fine examples are seen on the Orange turnpike, and on the turnpike from Canterbury to the New-Jersey line. The local variations may be observed at Sterling mine, and on the road from Canterbury to West-Point, and many other places. It is presumed that the variations in the dip, to be seen on the last mentioned route, induced Prof. Eaton to believe that all the primitive rocks of the Highlands in this county dipped to the northwest.* *In general*, the primitive rocks of the county are less regular in stratification and dip along the banks of the Hudson, and at their western margin, than in their centre. Among the varieties of gneiss in the county, may be mentioned that in which the mica predominates, and that in which the feldspar predominates, as being most abundant; these occur every where. Next in abundance is that which is called hornblendic gneiss and gneissoid hornblende, the hornblende and mica forming the larger proportion of the rock. It is very abundant at Long and Sterling mines, and in all the short ridges and elevations forming the western border of the Highlands. Granite is abundant in the primitive region of the county, constituting beds and veins. It is coarse and crystalline, on the road from Buttermilk falls to Fort Montgomery, and on the turnpike from Monroe works to Haverstraw. It is graphic on Rocky hill in Warwick, and other places. It is sienitic in Mount Eve, at Sterling iron mine, and many other places. It is compact in Butter hill, fine grained and compact in many places on the road from Warwick to the Ramapo river. All the varieties of colour are abundant. The red is particularly so in several of the ridges east of Long pond. While it is not positively asserted that granite, in this county, is a rock regularly stratified like the gneiss, the careful attention of geologists is invited to a locality on the northeast side of the turnpike from Haverstraw to

* See Journal of Science, vol. , page

Monroe works, about three miles from the latter place; also to many places on the turnpike from the saw works to Bellvale, in Warwick.

Immense quantities of rock are found every where in the Highlands of Orange, which are neither perfect granite or gneiss, but partake of the character of both, or is intermediate between the two; and it is this *granitic* gneiss or *gneissoid* granite, which embraces a large number of the metalliferous deposits found in the county.

HORNBLENDE ROCK.

Extensive strata of this are found in the Highlands, which are well characterized. The most extensive one observed forms the middle of the southeastern face of the mountain first east of the valley of Long pond, in Warwick. This stratum is, perhaps, twenty-five rods wide. An extensive stratum also runs through the Forest of Dean, along the western margin of the white primitive limestone. Magnetic iron ore is associated with this stratum in many places.

In addition to what has already been remarked of the foregoing granitic rocks, it should be further stated that the feldspar is generally in a larger proportion than the quartz. The colour of the quartz is white and bluish, or reddish white. The mica is black, green or intermediate shades of these colours, and the feldspar white, yellow, red and greenish. The hornblende black, gray or greenish.

The minerals embraced in the foregoing rocks are numerous and important.

First are the ores of iron; all the magnetic oxides are found in them. They also contain adularia, fibrolite, kyanite, manganesian, garnet, serpentine, mica, plumbago, sphene, red oxide of titanium, crystallized hornblende, epidote, tremolite, zircon, crystallized augite, tourmaline, coccolite, sahlite.

Beds of other mineral substances are also embraced in the granitic rocks. In the town of Monroe is a bed of quartz. It is two and a half miles southeast of Greenwood furnace. Its northeast end only is visible. At this place it is four rods wide, and rises fifteen feet above the gneiss on each side. It is visible for more than twenty rods, and gradually disappears beneath the surface. The quartz is white and nearly opake, containing in many places pale green coccolite.

Augite rocks exist in many localities; the surfaces are often covered with fine crystals. This may be seen at Greenwood furnace, Monroe,

From this point, it may be traced northeast by the way of Little Round pond, northeast corner of Bog Meadow pond, southwest by the way of Popelo's pond, and the brook from the Two ponds to Greenwood furnace; thence, with some interruption where it crosses the Ramapo, by the east side of Duck Cedar pond, to the New-Jersey line.

In all this extent, it frequently disappears and again reappears, after having apparently been cut off by the granitic rocks. It is seen in some places only a rod, or even less, in breadth. In many places it is seen in contact with the granite, the gneiss and hornblende rock; sometimes *between* them, sometimes *above* them, and sometimes *beneath* them. It is *not* stratified; in all this extent, which is about twenty miles in a straight line, it is confined between certain limits, and never appearing northwest or southeast of given lines, which may be about a mile distant from each other. It is generally quite narrow, and occasionally it is *cavernous*. Its bearing is southwest and northeast. Its prevailing colours are white and red; much of the red is flesh red, and coarsely crystalline, forming a handsome calcareous spar. It every where contains imbedded minerals; those which particularly distinguish it in almost every locality, are what is believed to be the boltonite of Shepard, and small black spinells. What I suppose to be boltonite, has hitherto been called brucite, which it resembles in some respects. The Mineralogist of the Survey will determine to which species it belongs. This rock also contains beautiful pargasite, sahlite and coccolite; also crystallized augite, scapotite, zircon and sphene; also serpentine and plumbago.

A few trap dykes are seen cutting obliquely across this rock, one of them is partially exposed at the Two ponds in Monroe, and contains imbedded crystals of hornblende.

Three others are visible at the Duck Cedar pond, one of them finely exposed. It is here seen cutting the limestone precipice perpendicularly downwards fifty feet, and running nearly east and west. The trap rock is perfect green stone. A few rods from the southwest end of Popelo's pond where the stream enters it, this rock forms a perfect natural bridge. It is used as such, and one might cross it without being aware, unless the noise of the brook aroused his attention. The breadth of this bridge across the stream is fifty feet, and its length up and down the stream seventy-five or eighty feet. Hornblende rock supports the arch on one side, the other is covered by soil, but it is believed to be granite. This space is spanned by the lime rock. The water, at present,

fills the concavity below so that I could not see through; but in times of drought, people pass through it.

This limestone is also met with half a mile southwest of the Queensborough forge, very much resembling that at Fort Montgomery, and containing the same substances imbedded in it. It is here of very limited extent, being confined to a few small elevations of a few rods in extent.

White primitive limestone is also found in the town of Warwick. It exists here on a more extensive scale. Its northern limit is near the line of the town of Goshen. It passes along the east side of Mount Eve. Its southeastern limit is very straight and well defined until it enters New-Jersey. Its western is irregular, passing along the side of Pochunck mountain, thence near the margin of the Drowned lands across the Pochunck creek to Mount Adam. It also passes some distance between Mounts Adam and Eve. At its widest part its extent is more than three miles. It contains every where beds of granite, quartz, hornblende rock and augite rock. It is not stratified, or if so, it is very irregular and confused. True, there are localities where there are appearances of stratification, and a dip to the southeast, but they are very limited in extent.

Its colour is generally white, having the character of calcareous spar. In some localities it is snow white, translucent and compact like Parian marble. Plumbago and mica are very generally disseminated through it. It also contains a great variety of fine minerals imbedded, which will be enumerated in another place. It does not rise into ridges of much elevation.

TRANSITION ARGILLITE.

This rock occupies a large extent of surface in this county. Its general direction is NNE and SSW, varying to northeast and southwest. Some ridges and elevations differ considerably from this course; but these are partial, and extend only short distances. Its colour differs from light ash grey through all shades to black. Its hardness, in some localities, being the softest kind of clay slate; in others, hard and silicious; while others still possess this property in all intermediate degrees. It is every where regularly *stratified*, although the strata, in many places, are singularly bent and contorted.

Its *dip* is uniformly to the southeast, differing considerably in its amount in different places. In some localities its position is nearly ver-

True it is, however, that carbon is abundantly diffused through this argillite, and that thin seams of anthracite can be exhibited in many places.

Anthracite is also disseminated in the graywacke in masses from the size of a pin head to that of a pea, so as to give the rock quite a handsome appearance. This is strikingly the case at Walden, on the northwest bank of the Walkill.

The argillite, and its associated graywacke and graywacke slate, no where rise into lofty mountains. When this circumstance is recollected and taken in connection with what has been stated of the extent of this rock forming the great valley of the Walkill, it will be perceived at once how greatly it modifies the surface of the country. There is another remark should be made in this place, in relation to the rock of which we have been speaking. The argillite portion of the county of Orange embraces an unusual *number* and extent of swamps, or as they are called, bog meadows. They are *all* formed by bars of argillite rock across their outlets; this is true from the great drowned lands down to those which cover only an acre or two of surface. *The useful* purposes to which this rock is applied, are not numerous. The most important one at present, is in the construction of fire places and the lining of furnaces. When placed with the edges of the laminæ to the fire, it remains for a long time uninjured. Some varieties in this county, which are not silicious, are excelled by no stone, for this purpose. The quarries of Mr. Bulmer, at Sugar Loaf, furnish excellent stone in abundance; they are sold at from $2 to $5 per load, at the quarry. It is also quarried to some extent on the western shore of Big Long pond, as a fire stone. Roof slate might be obtained abundantly, very similar to the Welch slate, but none is wrought for this purpose.

The argillite is also employed to some extent in the construction and repair of roads; it is, however, but a poor material for this purpose. The surface edges of the rock are generally employed, and these of the variety containing the largest proportion of clay. The wheels soon reduce it to powder so fine that the wind drifts it when dry, and the water washes it away when wet.

Beds of silicious slate and Lydian stone are embraced in this argillite. I have also seen graphic slate, but it is not abundant. In some places, the graywacke associated with the argillite forms a tolerably good building stone. It quarries very well, and works well under the hammer, but it requires great experience in selecting the layers, to avoid those

which crack and crumble to pieces when exposed to the weather; this tendency renders it unsafe for masonry of importance. It is employed to great extent in the construction of field walls; a large portion of the county is enclosed by walls of this stone.

GRAYWACKE.

This rock has the widest distribution of any in the county. It occupies all the town of Deerpark, laying northwest of the Basher's kill. In this region, it assumes all the various forms usually called by this name, including the wacke slate. In some of the ridges of mountains, it is in thick massive layers, dark coloured and compact. In others, it is in layers of but a few inches in thickness, light gray colour, very hard and sonorous, when a blow of the hammer is applied. In others, still, it is soft; colour, dark and dull, with a strong tendency to decomposition; and finally it passes into wacke slate, which is sometimes the colour of the rock, and at others nearly brick red. Between the Neversink and Mongaup rivers, the redwacke runs nearly across the town. The direction of the mountain ridges in this section of the county, coincide very nearly with most others to the east, that is, northeast and southwest nearly. There are, however, some variations. Some of the strata lay quite flat, approaching a horizontal position; others are much more inclined. The general angle of dip may be included between 15° and 25° to the northwest and north. The Delaware river occasionally runs a short distance between these ridges, but generally crosses them obliquely. At low water, the hardest layers of the rock may be seen in many places forming a reef across the stream. From a little below the mouth of the Mongaup, the Delaware takes the direction of the strata for near three miles before it finds an exit to the south and east. In this distance, the mountain attains an elevation of 800 or 1,000 feet; in some places, it is almost perpendicular. Here nearly all varieties of this rock may be seen, except the red. Most of these three miles, the Delaware and Hudson canal is built in the river, the mountain forming one bank, and a wall of stone from fifteen to twenty-five feet high, on which is the tow-path, forming the other bank. The strata of graywacke extend from the Delaware river into Sullivan county. In this stratum, west of the Shawangunk mountain, I have not been able to detect a single fossil in place, although faint arborescent appearances are discoverable on the surfaces of some layers. The Shawangunk mountain extends in a single unbroken ridge from the New-Jersey line to Sullivan county. Near or at the summit of this ridge, the graywacke appears again, but here its position, at first nearly ver-

very white incrustation, which forms handsome specimens. It has the appearance and hardness of arragonite. Veins of white quartz and nodules of black hornstone are common in some of the layers. This stratum is employed extensively for burning into lime.

Another stratum of sparry lime rock, farther to the south and east makes its appearance about a mile east of Salisbury mills, in Cornwall.

It is here but a few rods in width, and not far distant from Skunemunk mountain. It is visible, with a few interruptions, across Blooming-Grove and Warwick, to the State of New-Jersey. It is seldom more than a mile in width. It resembles closely the stratum near Newburgh, but at no point rises so high above the surface. In the village of Warwick, it affords good specimens of crystallized quartz, and crystallized brown spar. Fifty or sixty rods west of the Presbyterian church, in the same village, some of the layers are a light red colour, very close and compact in structure, and gives the argillaceous odour when moistened. The lustre is quite dull, and it breaks with a flat conchoidal fracture. There is evidently much clay in the composition. It has been supposed to be the water lime, but there are more glimmering particles in it than in the hydraulic lime of standard localities. It has also been examined in reference to its fitness for a lithographic stone, but does not prove good. It is called red marl in that vicinity.

The minerals noticed in this rock, are quartz crystals, crystals of brown spar, crystals of oxide of titanium, and magnetic iron ore, so strong as to have given it the name of native magnet.

In Hamptonburgh, limstone exists as a bed in the argillite. This bed is about two and a half miles long, and fifty or sixty rods in breadth. The contact of the two rocks is no where visible, although they are within a few rods, and in some places but a few feet distant. This bed has the same direction and inclination as the argillite. It is all fetid, and contains cubic crystals of sulphuret of iron, which are of a bright yellow colour. Most of the layers are the usual colour of sparry lime rock; some however are very dark coloured, so much so that it was supposed to contain coal; an excavation was accordingly made for this mineral; it need scarcely be observed that no coal was found. The surfaces of some layers are full of the fossil shells of the very early periods of animal life. The stone of this bed has been long used for lime, but the quality is not very good. The argillite closes round both ends of this bed. It is called the Neelytown limestone in the neighborhood where it lies. Limestone exists abundantly in the town of Monroe,

particularly in the north and northwest part of it. It is abundant about two miles north of Greenwood furnace, near the point where the Ramapo river enters the Highlands. It is here spread out to a breadth of near two miles, and a part of it extends southwesterly to the neighborhood of Long pond.

It is much used as a flux in the iron furnaces, and but very little for lime.

A small bed of similar limestone is found in the town of Cornwall, half a mile southwest of Ketcham's mill. It is stratified and dips to the southeast. Limestone is also found in great abundance in Goshen. It begins two and a half miles southwest of the village, and extends from the Walkill southeast to Thompson's pond, a breadth of six or seven miles, and in length to the south and west, it extends into New-Jersey, across the town of Warwick, west of the stratum already mentioned. The western edge of this limestone underlays the drowned lands and most of the islands in them, and passes along the northwestern margin of the white primitive limestone of Warwick. Another part of the same rock passes along the whole southeastern margin of the same primitive limestone, and crosses the line of New-Jersey with it; in other words, when this limestone meets the primitive rock, it divides into two branches; one proceeding along the northwestern, and the other along the southeastern margin of the primitive until they all enter New-Jersey. I have not seen them in contact, but they are every where in close proximity; no other rock intervening. At the line of New-Jersey, this rock, with the included primitive, occupies a breadth of nearly eight miles. The northern terminations of the ridges of this limestone interlock with the southern terminations of the argillite ridges. This singular interlocking of the two rocks can be finely seen three and a half miles from Goshen, and a half a mile southeast from Mapes' tavern; also, a little farther southeast, at the limekiln of Mr. H. W. Thompson. I have been able to detect no fossils in this limestone, except near the limekiln first mentioned, and these are in the upper layers, associated with the conglomerate limestone on the land of Mr. Thompson. The pebbles, of which the conglomerate is composed, are all smooth and apparently water-worn; all sizes, from that of a pea to several pounds weight; all shades; of light-gray to dark-brown, and nearly black, firmly cemented, and all burn into excellent lime. The dip is here to the southeast from 3° to 10°.

A mile west of this is a lofty hill called Mount Lookout. It is composed entirely of limestone; its southern, western and northwestern

cisely similar to that from which so much and such superior lime is burned in Newburgh. All that is required are care and experience in selecting and burning. This statement is necessary since the belief has become common, that there is little if any good limestone in the county, except at Newburgh, and as a consequence, the Newburgh lime has comparatively excluded all other from use.

It is a common belief in the county, that the limestone from beneath the surface requires less fuel to reduce it to lime than that taken from the surface.

As a building material, some of our limestones are not surpassed by any found in the State. Those of Neelytown in Hamptonburgh, and Mount Lookout in Goshen, are peculiarly fine. That of Mount Lookout is a handsome dove colour, and perfectly durable. It can readily be obtained of any length and thickness required.

MILLSTONE GRIT, (*of Eaton.*)

All the northwestern side of the Shawangunk mountain is composed of this rock. It is regularly stratified. The line of bearing being about north 50° east, or south 50° west. The dip to the northwest, at an angle of 30°. This rock extends, without interruption, from the New-Jersey line to Sullivan county, and from the base of the Shawangunk* mountain to the top; in some places it caps the top of the mountain, and in others the slate of the eastern side is the highest. I have not seen the two rocks in actual contact, although they are close to each other the whole length of the county.

The structure and composition of this rock varies in different layers from fine grained, nearly compact, to that which is composed of pebbles the size of filberts. Most of the layers are very hard, some are sandy, and others even slaty. Its colours are white, gray, grayish and reddish white, and brick red.

About one-third of the distance from the bottom of the mountain is a belt of the red coloured rock; it is about two rods wide, the layers corresponding with the layers of the other colours, and it extends quite across the country. In many places hard specimens could not be distinguished from the New-Jersey sandstone.

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* Shawangunk, pronounced by the Indians Shong-gum, meaning white stone, is very appropriate. People now living, have had this explanation from the lips of the Indians.

The same rock is found in the town of Blooming-Grove, but in a different situation and position. It is first found in this town on the southeast side of the Round hill.

Round hill, like the Highland ranges, is primitive, and here the grit rock inclines against and rests upon it. The grit rock is regularly stratified, line of bearing same as in Shawangunk mountain, but it dips to southeast. It passes through all kinds of composition, from compact to soft and slaty on one hand to a coarse conglomerate on the other; and all shades of colour, from milk white to brick red. From the point mentioned, it extends northeast nearly four miles, until intercepted in its line of bearing by a part of Woodcock mountain, which is primitive.

A similar rock is again found in the southeastern face of Skunemunk mountain, and at its base. But here it is interstratified with the graywacke and graywacke slate, and while all the colours already mentioned exist here also, there are some layers which are different. The pebbles of which these layers are composed are much larger, and about half of them are very white, and the remainder very red. All the pebbles are smooth, as if water worn.

These layers extend as far south as Skunemunk mountain, and about two miles farther north than the mountain itself does. The Hematite mine of Mr. Thomas Townsend, is connected with this rock, two and a half miles west of Canterbury.

Pine hill, a ridge next southeast of Skunemunk, is composed of this rock; it is near three miles long, narrow, and somewhat elevated. In this hill the rock is almost entirely red, and can be quarried in handsome blocks for building. Woodbury furnace is built of stone from Pine hill; it has all the appearance of freestone, except that it is rather more variegated than most American sandstones. It bears a high temperature very well. No fossils have been seen in this rock any where.

CLAYS.

Kaolin is found in a few places in the Highlands. One locality, a mile north of Southfield furnace, on the Orange turnpike, affords indications of its existence in some quantity. It has not been tested as to its value in the manufacture of Porcelain.

The blue and gray clays form an extensive stratum, underlaying the soil over a large portion of the county, particularly all that portion

is lessened by the use of coal and peat, there can be no doubt it will be extensively used as a manure.

The amount of lime burned in the county this season is as follows:

Goshen,	10,650 bushels
Hamptonburgh,	1,400
Minisink,	1,400
Warwick,	4,200
Newburgh,	165,000
Total,	182,650

This at an average price of 25 cents per bushel, yields the sum of $45,662.50, as the product of this branch of our industry, per annum.

WATER.

Orange is abundantly supplied with springs and streams; on one side is the Hudson, on the other, the Delaware. The Neversink river and Basher's kill enter this county from Sullivan, and empty into the Delaware. On these there is considerable fall. Part of the summit level of the Delaware and Hudson canal is in the county; the last mentioned streams are used as feeders.

Three or four miles from the New-Jersey line, at the eastern base of the Shawangunk mountain, rises the Shawangunk kill. It pursues a northeasterly course at the foot of this mountain, to near Bloomingburgh; thence it separates Sullivan and Ulster counties from Orange, and finally falls into the Walkill, in Ulster.

The Walkill enters the county from New-Jersey, and pursues a very serpentine course without any fall, through the drowned lands, to the outlet. From this point to Ulster county, northeast of Walden, there are occasional falls and sites for water power.

The great marsh, or as it is called, the drowned land, covers an extent of 17,000 acres in this county, and 3,500 in New-Jersey. At high water, this surface is covered, and again laid bare by drainage and evaporation. Many parts of the shore have been annually visited by fevers; since the partial draining has been effected, these have measurably disappeared. This tract appears once to have been a lake, and has been gradually filled to its present level by vegetable matter. It is now a vast body of peat of different qualities. Much of it is very good, covered only with undecomposed vegetable matter. In some places, the

peat is underlaid by shell marl. Several islands are scattered within this tract; they are all limestone land of the best quality, and afford many facilities for burning lime, particularly on account of the abundance of wood in the marshes which surround them. The drainage of this marsh has long been an object of great interest, not only to the proprietors, but to others in the vicinity. Many years since, a large sum was expended for this purpose, in cutting down the bed of the river at the outlet, four miles west of Goshen. This trial partially reclaimed many acres at the shores. The proprietors are now employed in making a new channel for the stream, or at least for the surplus water, near two miles in length; the water now flows in this new channel, and is gradually wearing it broader and deeper. By this channel, it is proposed and expected to render available nearly 30 feet fall. This amount is deemed sufficient to lay the whole tract dry.

If this effort to drain succeeds, and there appears no good reason to doubt it, 20,000 acres of the richest land will be reclaimed, and the surrounding country made healthy.

The Otter kill rises near Thompson's pond; runs through Goshen and Hamptonburgh northeasterly, and falls into Murderer's creek, near Washingtonville. Graycourt creek rises from Little Long pond in Monroe, runs through Blooming-Grove, receives the Otter kill, takes the name of Murderer's creek, and falls into the Hudson, near Cornwall landing.

The Ramapo river has its origin from the Two ponds in Monroe. The Long pond gives rise to part of this river. Its waters run easterly until they enter the Highlands, near Greenwood furnace. The other branch of the Ramapo issues from Mount Basha's pond, winds around and between the mountains, passing Southfield furnace, unites with the other branch at Monroe works; the stream thence pursues a southerly course into Rockland county.

Numerous small streams intersect the county in all directions. A stream called Fallbrook discharges its waters into the Neversink in the town of Deerpark. About a quarter of a mile before it meets the Neversink, it falls over the face of the mountain, forming a beautiful cascade; the whole fall, within the first mile, is said to have been ascertained by Col. Clinton, and found to be 600 feet. About 200 feet of this fall is almost perpendicular.

Our natural ponds or lakes are numerous, and some of them of considerable dimensions. Thompson's pond, in Warwick, covers nearly

100 acres. It gives rise to Quaker creek, a branch of the Walkill. Wickham's pond, lies in Sugar Loaf valley, and discharges its water into Warwick creek. It is surrounded by marsh which is filled with peat, and in some places underlaid with shell marl.

Long pond, or Big Long pond is partly in Orange, and partly in New-Jersey. It is ten miles long and from one to two broad. It is used as a reservoir for the Morris canal.

Round pond and Long pond in Monroe have been mentioned already. Mount Basha's, or as it is called Mombasha, is in Monroe, a mile southeast of the two last mentioned. It is two and a half miles long, and a half to one broad. Sterling pond or lake is a beautiful sheet of water in the corner of Monroe and Warwick, about two miles in circumference, and entirely surrounded by mountains. Its water is finely transparent, and said to be the deepest of any in the Highland mountains. It is the last to freeze in winter. Its waters pass into New-Jersey by way of Ringwood.

Duck Cedar pond in Monroe is narrow, but about two miles long, discharging its waters into the Ramapo, at the saw works. The waters of this pond are so near the level of Ringwood and Sterling valleys, that during the war of the revolution, when operations on the Ramapo were too near the British lines, a dam was erected across the north end and its waters thrown to the southwest to supply the furnace and forges at Ringwood.

In the southeast part of Monroe, are the Cedar pond, Long pond, Green pond, Carr pond, Island pond, Slaughter pond and Two ponds.

In Cornwall, are Round pond, Long pond, Reservoir or Bog Meadow pond, Cranberry pond, Bull's pond, Popelo's pond, and others; these however, are the largest; all are used more or less as reservoirs to supply deficiencies of water in seasons of drought. In Newburgh, about six miles north of the village, is Big pond; a mile wide and nearly three long.

In New-Windsor, a mile west of Snake hill, is Little pond. The water from this pond sinks into a cavern in the limestone and disappears; three quarters of a mile distant, a stream, believed to be the same, emerges from the ground. At times the stream can be heard beneath the ground, 30 or 40 rods, before it bursts out at the surface.

Several of these lakes, in the purity of their waters, and in the beauty and magnificence of their mountain scenery, vie with the celebrated waters of the north of England.

Our springs are numerous; a few are believed to be medicinal waters; some of them will be presented to the analyst of the survey.

The spring and well waters of the county are considered good; but in all parts underlaid by graywacke and slate rocks; much of the water is *hard* from containing a salt of lime in solution. This is probably derived from the rocks, or the stratum of blue marly clay so extensively spread on them.

PEAT.

In the drowned lands, several thousand acres are covered with this substance; it is from three feet to several yards in depth, and on trial proves a good fuel.

The Greycourt meadows, lying in Goshen and Blooming-Grove, contain 500 acres of peat, several feet in depth. It exists in great abundance in Warwick, Minisink, Goshen, Monroe, Cornwall, Blooming-Grove, New-Windsor, Newburgh, Montgomery, Hamptonburgh, Crawford, Walkill and Mount Hope; all the towns in the county except Deerpark. In this latter town the quantity is small. The quantity in the county is unusually large in proportion to its extent, perhaps as much or more so than any other county in the State. It would require a great amount of time to ascertain the number of acres. It is perfectly inexhaustible. If its consumption for fuel ever becomes as general as it is in some parts of Europe, the Greycourt meadows and drowned lands would prove a source of immediate revenue to their proprietors.

ERRATIC BLOCKS—BOULDERS.

These are found in the county in the greatest profusion. Most of the surface is thickly dotted by them, and in many places they are so numerous as to prevent cultivation. Under this term, however, it is not intended to comprehend any rocks or stones, except such as have been removed to considerable distances from the place of their formation. Over the whole surface, from the Highlands on the southeast, to the Shawangunk mountain on the northwest, perhaps nine-tenths of the loose stones are graywacke. Many of them are unlike any rock of this description in the county, while others resemble and no doubt were broken up from the layers upon and near which they now lie. The parent

rock of the former is to be sought for beyond the bounds of the county, but where, has not fallen under my observation.

The next most common and widely spread boulder, is what is called Esopus millstone, and white flint rock, or the millstone grit of Prof. Eaton. These are found abundantly over all that part of the county between the mountains. They are, almost without exception, completely rounded—none are flat or angular. They are evidently more numerous, and much larger in the northern than in the southern towns. In Montgomery and Crawford, they are often too large to be removed by the efforts and industry of man, even when aided by gunpowder; some may there be seen of five hundred tons weight, and probably much more. As we proceed south, they gradually diminish in size and frequency. How far they extend, I am unable to say, but I have seen them near the New-Jersey line. These boulders are pretty uniform in appearance; their colour is white, bluish, or reddish-white. It is seldom compact, but generally composed of grains and pebbles from the size of small peas to that of white walnuts, and sometimes much larger; some of the pebbles are smooth and rounded, others are angular—nearly all are united by a silicious cement. In a few, iron pyrites exist as the cementing substance, or disseminated through the mass; this decomposes when exposed by a fresh fracture, and gives the rock a greenish appearance.

From what has been stated, I think these masses have been brought into the county from the north by the agency of water. A rock stratum is seen in Blooming-Grove, precisely similar to the boulders just described, but this is shut in by two elevated primitive ridges, and its fragments have had a limited distribution, and can be readily traced to its limit within the county. Boulders of the same millstone grit, and of the same appearance and character, are also found in the valleys of the Neversink and Delaware, but these can also be traced to a stratum in that vicinity, whose fragments have taken a direction not to be mistaken. Another stone which has attracted some attention in the county, is the *labradorite*. Its existence was first noticed by Dr. Heron, of Warwick, several years since. In addition to Warwick, I have seen it the present season in Goshen, Minisink, Walkill, Hamptonburgh and Blooming-Grove. No doubt if sought for, it might be found in many other places; it is found in pieces weighing from a few pounds up to three or four tons. They are all rounded, and very much worn, having the appearance of travellers from afar. No rock formation of this kind is now known to exist nearer than Essex county. Some pieces of these boulders have

been polished, and prove very fine. They usually reflect only the green and blue colours. The best I have seen is in Warwick; also in Walkill, upon the farm of Dr. Shaw; and in Blooming-Grove, upon the farm of Joseph Moffat.

Many other erratic stones are found, not deserving particular notice, but it should be remarked, that wherever transported fragments of a rock are seen in the county, they are always to the southward of the parent rock. Thus, from the south end of Mount Eve, a chain of blocks can be traced for miles, even into New-Jersey, of a character so peculiar as to render mistake impossible. Another stone found in rolled masses, in the county, is jasper. They are yellow, striped, red and black. Many of them contain cavities, lined with small but beautiful quartz crystals, and coatings of white, blue and yellow chalcedony. Some of the jasper boulders are coarse, some fine and compact, some slaty, and some ferruginous. They have but a limited distribution, being found only at the foot and on the northwestern declivity of Bellevale mountain, in Warwick.

IRON ORE.

This valuable mineral substance is found in Orange in great abundance. With a few exceptions to be noticed hereafter, it is associated with our primitive rocks. The most abundant as well as most valuable ore, is the magnetic oxide. It is generally found in that species of primitive rock so common in the highlands of the county, and often called granitic gneiss or gneissoid granite It lies in beds and layers in this rock, having its line of bearing and its dip. Where it exists in layers, they are from one inch to twenty feet in thickness, in some places alternating several times with the layers of rock. Where it is found in beds, the magnitude of the largest has never been ascertained. In the line of bearing, the extent of our deposits of this ore is not yet well ascertained.

On the southeast side of Butter hill it is traced from the river, and from nearly opposite the village of Canterbury, by way of Monroe, quite into New-Jersey, a distance of about twenty-five miles.

The most westerly of the great ore deposits now wrought, is called the *Clove mine.* It is the property of George Wilks, Esq. situated about a mile south of the village of Monroe. It has been open many years, and much ore has been used. The ore is the magnetic oxide. It is compact and granular. The latter is called shot ore. The pyrites is more or less disseminated through it. It makes *red* or *hot* short iron.

Vast quantities of ore have been taken from this mine without any appearance of its failing. It belongs to the Messrs. Townsend. Only one dyke has ever occurred in this mine; it was one foot thick, and made no change in the direction of the ore. It cannot now be seen—is worked 70 feet deep.

The *Patterson mine* is half a mile southwest of Long mine—ore very similar in all respects—makes excellent *red* short iron—is in the granitic rock. The ore is twenty feet thick—opened 150 feet long. About 10,000 tons of this ore have been used. It is strongly magnetic, and has polarity.

About the middle of the mine, as now open, is a transverse slip or *heave;* the mine and its walls appearing as if they had slid downwards and forwards to the southeast, causing an angle in their line of bearing. It is the property of the Messrs. Townsend.

Mountain mine, *Antone mine*, *Conklin mine* and *New mine*, are a group from twenty-five to fifty rods northwest and north from the Patterson mine, belonging to the same proprietors. They lie in nearly parallel beds; the ore of all apparently similar—a rich black magnetic oxide, possessing polarity. Ore to the amount of 5,000 tons has been used from these mines; the ore and walls nearly vertical; layers of ore from four to eight feet thick. The new mine has a cap of rock lying nearly horizontal; associated minerals, sahlite, hornblende, and feldspar. The sahlite is laminated and very beautiful; iron red short.

Crossway mine, upon the same estate, is 400 or 500 yards southwest of Mountain mine. This bed is 14 feet thick, and has been wrought 65 feet deep and 150 yards in length; ore and iron very similar to those of Patterson mine; moderately *red short;* ore and walls nearly vertical; 28,000 tons are supposed to have been used from this mine; associated minerals, hornblende, epidote, mica and adularia.

Sterling mines, belonging to the same gentlemen, are about a mile southwest from Crossway mine, at the south end of Sterling pond. These mines, or *this vast mine*, is in the northern end of a mountain of moderate elevation; its length is about three miles. The ore is *rich*, granular and compact; its product, *cold short* iron; is one of the earliest known iron mines in the United States. The minerals connected with this ore are crystallized green hornblende, sahlite, green mica, flesh-coloured feldspar, and the ore in octohedral crystals. The rocks are granite, and a coarse showy sienite. There is abundant evidence of great

disturbance in the stratification in this mountain, and in all the vicinity. The rocks dip to the northeast and east, with the ore conformable to this arrangement; at least such is the general arrangements, so far as can be ascertained in this mass of confusion. The ore alternates with the rock; how often, cannot of course be ascertained. The ore lies naked about fifty rods wide by 150 yards in length. In many places its surface is even and polished as if it had been ground off by the sliding of the rocks.

The *Belcher mine* is upon the same property, and very similar ore to that of Sterling; it makes *cold short* iron. It is one and a half miles southwest of Sterling mines, and at the southern termination of the same mountain. The ore has been worked about 115 feet wide without finding a rock wall on either side. It is believed to be a prolongation of Sterling mine.

Red mine or *Spruce Swamp mine* is nearly three miles south of Long mine. All the ores of this mine are magnetic and full of pyrites, so much so that only a moderate amount has been used. They decompose rapidly when dug up and exposed to the open air. In this manner the surface of this mine has all been reduced to powder of an iron-rust colour; like several other mines the ore alternates with the rock.

Magnetic oxide of iron is also found of good quality in many places in Cornwall; but these have not been opened to much extent. Near the foot of Butter hill, on the land of Mr. Clarke, on Deer hill, on the land of Mr. Luke Wood, and that of Thomas Titus, are indications of valuable deposits of this ore.

Two and a half miles west of the village of Canterbury, in Cornwall, is the *hematite* or *limonite* mine of Mr. Thomas Townsend. For the last two years this ore has been considerably used, and although a lean ore it makes excellent iron. It is mostly in powder, or very small fragments, mixed with balls and pieces of the hematite, of a few pounds weight. It lies in limestone rock, and between the limestone and the grit rock. These rocks, where connected with the ore, are decomposed to great extent, and mixed in the state of powder with the ore; hence the ore requires washing.

This stratum of limestone and hematite can be traced across this town into Monroe, until we reach the magnetic oxides already noticed. It is seen a quarter of a mile north of the Clove mine, and at many places intermediate between this and the Townsend mine in Cornwall. The distance between these extreme points is full ten miles.

Hematite is also found along the whole western side of Bellvale mountain, and in places along the Warwick valley, to the New-Jersey line.

Thus it appears, that in Orange, one great iron region extends from the Hudson river on the east side of Butter hill quite across to Rockland county.

Another on the west side of Butter hill follows the valley across Cornwall, east of Skunemunk mountain, through Monroe, and by way of Sterling into New-Jersey, and far across that State.

The amount of ore in these deposits, which is of easy access, and has the most perfect facilities for cheap mining, is perfectly inexhaustible.

The amount of iron to be made in the county in all time to come, can only be limited by the supply of coal necessary for the reduction of the ores.

List of minerals observed in making the examination of the county of Orange, by W. Horton,

Magnetic iron ore,	crystallized,		O'Neal mine,	Monroe.
do	do	do	Sterling	do
do	do	massive,		
do	do	do	O'Neil	do
do	do	do	Forshee	do
do	do	do	Sterling	do
do	do	do	Belcher	do
do	do	do	Crossway	do
do	do	do	Spruce swamp	do
do	do	do	Mountain	do
do	do	do	Patterson	do
do	do	do	Long	do
do	do	do	Greenwood	do
do	do	do	Rich iron	do
do	do	do	Horsen clever	do
do	do	do	Forest of dean	do
do	do	do	Clove	do
do	do	do	Green's mine,	Deer hill, Cornwall.
do	do	do	Titus'	do do
do	do	do	2 miles east of	Warwick,
do	do	do		Amity,
do	do	do	4 miles SE	Woodbury furnace, Monroe

Magnetic pyrites, O'Neil mine, Monroe.
do do Rich iron do
Iron do in cubes, 2 miles southeast of Warwick.
do do cubic, Carpenter's point.
do do do 4 miles north of Newburgh.
do do massive Clove mine, Monroe.
do do do O'Neil do
do do do Greenwood do
do do do Rich iron do
do do do Forshee do
do do do Spruce swamp do
do do 2 miles south east of Warwick.
do do Sugar loaf and Snakehill, Goshen.
White do in crystals, Rocky hill, Warwick.
Skorodite drusy, Edenville.
Arsenical iron, massive, Edenville and Amity.
Brown and red hematite or limonite, in a bed 2½ m. W. of Canterbury.
do do do ¼ m. N. of Clove mine, Monroe.
do do do Bellvale, 4 m. E. of Warwick.
do do do near New-Milford, 3 m. SW do
Bog ore, Blooming-Grove.
do Goshen,
do New-Windsor.
Arsenical iron, Edenville,
do Amity.
Arragonite, Edenville.
do 1½ miles west of Newburgh.
do O'Neil mine, Monroe.
Satin spar, Blooming-Grove.
do 5 miles south of Goshen.
Brown spar, village of Warwick.
do 1 mile southeast of Warwick.
do Hampton 6 miles northeast of Newburgh.
Calc or rhomb spar, white, Amity.
do do red, do
do do white, O'Neil mine.
do do red and white, 2 m. E. Greenwood furnace Monroe.
do do 4 miles SE of Woodbury furnace.
do do do Two ponds, Monroe.
Iceland, 1 mile SW of Amity.

Quartz, crystals, Blooming-Grove.
do do Warwick.
do do Goshen.
Sulphate of lime, 1 mile NE of Edenville.
Phosphate of lime, crystalized, Amity and Edenville.
Hornblende, do Sterling, Monroe.
do do Two ponds, do
do do Amity.
do do Mount Eve.
do do 1 mile north of Edenville.
do do 1 mile NW do
do do 1 mile SE of Amity.
do do 1 mile south of do
do do 1 mile SW of do
Augite, crystals, Two ponds, Monroe,
do do Greenwood furnace, Monroe.
do do 2 miles SE of Greenwood furnace.
do do Fort Montgomery.
do do Edenville.
do do Amity.
Coccolite, 4 miles west of West-Point.
do Forest of Dean, Monroe.
do beautiful black, Forest of Dean, Monroe.
do Greenwood furnace, Monroe.
do 2 miles east of Greenwood furnace.
do 2 miles SE of do
do 1 mile west of Monroe works.
do Forshee mines.
do Amity.
do O'Neil mine, Monroe.
do Rocky hill, Warwick.
Sahlite, Forest of Dean, Monroe.
do " " mine, Monroe.
do Rich iron mine, do
do 3 miles SE Greenwood furnace, Monroe.
do Long mine, Monroe.
do Mountain mine, Monroe.
do Patterson do
do Sterling do
do O'Neil do
Scapolite, crystallized and massive, Two ponds, Monroe.

Scapolite, crystallized and massive, Greenwood furnace, Monroe.
do do 1½ miles north of Edenville.
do do Amity.
Meionite, Two ponds, Monroe.
do Forest of Dean, do
Boltonite, 2½ miles SE of Monroe works.
do Two ponds, Monroe.
do Forest of Dean, do
do 4 miles west of West Point, Cornwall.
do fine, 4 miles SE of Woodbury furnace, do
Mica, greenish white, Forshee mines.
do green, Clove mine.
do do Sterling mine.
do black, Greenwood Furnace.
do red, Mount Eve.
Zircon, brown, do
do red, Deer hill, Cornwall.
do do Amity.
do red and white, McGee's hill.
do black, Rocky hill, Warwick.
do do 1 mile NE Amity.
do red, 1 mile north of Edenville.
do black enclosed with white, Rocky hill.
Tremolite, green, 1 mile north of Edenville.
do brown, do do
do white, do do
do gray, do SW of Amity.
do white, do do
do " do do
do brown, do SE do
Pargasite, Amity,
do 2 miles NE Greenwood.
do Two ponds, Monroe.
do Forest of Dean mine, Monroe.
do 4 miles west of West-Point, Cornwall.
do do SE Woodbury Furnace, do
Idocrase, Amity.
do 1 mile SE of Amity.
do do south do
do do north of Edenville.
Sapphire, do east of Amity.

Galena, Fallbrook, Deerpark.
Pseudolite, 1 mile SW of Amity.
do do south do
Kyanite, Rocky hill, Warwick.
do 2 miles SE of Warwick.
do Queensborough, do
Fibrolite, do do
Talc, 1 mile SW of Amity.
do ½ do SE do
Cinnamon stone, 1 mile SW of Amity.
Garnet, 1 mile SW of Amity.
do O'Neil mine, Monroe.
do Two ponds. do
do 2 miles east of Warwick.
Asbestos, Mount Eve.
do Forshee mines.
do Clove mines.
Amianthus, Amity.
do O'Neil mine.
do Greenwood furnace, Monroe.
do Clove mine. do
Diallage, 1 mile south of Amity.
Chrome, crystallized in octohedrons Clove mine, Monroe.

The statements here subjoined are from Peter Townsend, Esq. one of the oldest iron masters of our country; he was born in the vicinity of an iron furnace, and has been engaged in this business during a long life, has introduced many improvements, and by his enterprize and industry has done much to benefit his country in time of need. He cast the first cannon in this country; he also put steel works in operation, and has long been a highly useful citizen.

Sterling mine—discovered in 1750, by whom unknown; named after Lord Sterling, the then proprietor of the soil; he sold, and a blast furnace was immediately put in operation by Messrs. Ward and Colton, that is, in 1751; cost of mining is 37½ cents per ton. Its yield is always 50 per cent in the blast furnace. Amount of this ore used has ranged from 500 to 2,000 tons annually; the medium of this gives 137,000 tons as the amount of ore used from this mine. At present the amount used is 2,000 tons; the ore always fuses easily; its iron is between *cold* and *hot* short; very sound and strong. It has been largely used for casting cannon and for making bar iron; no proper dykes in

the mine, it lays on the side of a mountain. The ore, in different places where opened, is from 10 to 20 feet thick, inclining at an average angle of 30°. The floor is smooth granitic rock, a little over three feet thick; rests on another bed of soft rich ore, and the little used proves free of sulphur. (I may add from my own knowledge *positively*, that another immense bed underlays the last mentioned.—*Wm. Horton.*) Sterling mine covers a surface of more than 30 acres, by survey; part of this the ore is bare, part is covered by soil from one to five feet in depth, and part by rock, from six inches to a yard, or more, in thickness.

Long mine—discovered in 1761, by David Jones, has never been bottomed in any place. It is traced over a mile in length; is wrought 40 rods in length, general width 16 feet, consisting of two parallel layers, with a waving *slab* of rock between them from 4 to 12 inches thick. In this 40 rods a dyke has been found, of what Mr. Townsend calls an imperfect flint, 2 feet thick, standing perpendicularly, and crossing the ore at right angles, (it is now covered.) All the ore similar; yield always 62 per cent. Average amount of ore used 500 tons; this in 75 years gives 37,500 tons taken from this mine. Its iron is remarkably tough clean, and strong; cost of mining from 50 cents to $1 per ton. The iron of Long mine has been much used for cannon steel, muskets, wire and fine malleable iron. It has also been cast into harness buckles, and after annealing, proves exceedingly tough and strong.

Patterson mine—discovered in 1831 by John Patterson. 1,000 tons of this ore are used annually, which in 7 years gives 7,000 tons as the amount. Cost of mining from 50 cents to $1 per ton; yields 56 per cent. Its ore chiefly used to correct infusible and bad ores, such as O'Neil and lean hematite ores. Iron good.

Red mine, or *Spruce swamp mine*—discovered in 1780, by J. Stuperfell; cost of mining 50 cents per ton; ore sulphurous; being remote, not much used; iron sound; has been generally used as a flux, mixed with hard black oxides and refractory *cold short* ores; it assists fusion, and improves the quality of the iron.

Mountain mine—Discovered in 1758, by a hunter, in consequence of a tree being blown up by the roots; yield 45 per cent; iron remarkable for strength and *fine polish*; cost of mining $1 per ton. Two dykes cross this mine at an angle of 45°, each 15 inches thick. Before the revolution, when this mine was chiefly worked, the iron was sent to England to be used for tinning.

Signed, W. HORTON.

(C.)

REPORT

Of L. D. Gale, to W. W. Mather, on the Geology of New-York county.

GEOLOGICAL SURVEY OF THE ISLAND OF NEW-YORK.

This island is about twelve miles long, and from a half of a mile to two miles and a quarter broad.

To give a clear view of the geology of the island, it will be necessary to state in general terms the character of the neighboring rocks, boulders of which there is good evidence to believe are found on almost every part of the island.

Taking the Hudson river as the dividing line, we have on the east, the island of New-York, and the southern portions of Westchester county, consisting of gneiss and its subordinate rocks, as *serpentine*, *hornblende*, *primary limestone*, *anthophyllite rock*, and perhaps a few others; while on the west in the contiguous State of New-Jersey, we have *red sandstone* in all its varieties; *serpentine*, *greenstone* in all its varieties, with the minerals usually accompanying these rocks.

The basis rock of the island is *gneiss*, if we except about one mile in length of the northern extremity, which is limestone. The middle and northern portions are rough and broken from the almost constant exposure of the rock above the surface; while the southern, although consisting of the same material, is every where covered, and in some places to great depths, with alluvial* and diluvial deposits.

The gneiss varies considerably in character in different portions of the island. For example, the northern part abounds largely in lime-

* Whether some of these alluvial deposits referred to, especially the beds of sand found under the diluvium, are as old as the tertiary or not, I will not pretend now to determine.

The excavations for the above avenues have rendered Geology an essential service by exposing the rocks of the island, and exhibiting their surfaces, their stratification, their mineral ingredients, and included minerals. The strata of the rock, as before stated, (page 178) follows more generally the direction of the avenues, which run north 35° east. Of about seventy-five observations on this section, to ascertain the strike of the strata, more than fifty gave results varying from north 25° east, to north 35° east, making the medium strike north 30° east. Two extremes were north 45° east, and north 45° west.

The dip of the strata was taken in eighty-four different places on this section. Of these, twenty-nine were vertical, thirty-eight were to the west, and eight to the east. Of the thirty-eight which dip westward, twenty-four are between 80° west and vertical, seven between 70° west and 80° west, and three between 45° west and 70° west. Of the eight which dip eastward, six are from 80° east to vertical, and two are 45° east. Of the eighty-four observations, fifty-eight were within 10° of vertical, and only six gave an eastward dip. The result is, therefore, that the medium dip of all the rocks of this section is westward about 85°.

The quality of the rock which forms the substratum of this section, does not differ much from that of other parts, whether north or south of it; therefore, with some few exceptions, a proper description of the rock as it occurs here, will answer for the whole.

As to its components, it contains a large proportion of mica, a small proportion of quartz, and still less of feldspar; but generally an abundance of iron pyrites, (sulphur and iron) in very minute crystals, which on exposure, are decomposed. The sulphur and the iron both take oxygen from the air, and the result is free sulphuric acid, copperas and iron rust. The first two combine in their agency to hasten the disintegration of the rock, and the third gives it a permanent ferruginous cast. In consequence of these ingredients, it is generally fissile, tender, and soon disintegrated on exposure, rendering it unfit for the purposes of building.

In some cases, the rock is so highly charged with pyrites, that on exposure for a few days in a dry season, it becomes covered with copperas in the state of an efflorescent powder, exhibiting the appearance of white frost in an autumnal morning. This phenomenon I have repeatedly seen on the rocks at the Hell-Gate ferry.

Besides the regular ingredients of gneiss, it occasionally happens that the mica is replaced, either wholly or in part, by hornblende; in which case its colour is rendered darker, it is more compact in texture, and columnar in its structure. This occurs on the 4th avenue, in the rail-road cut at the south opening of the tunnel.

As before stated, (page 177) the gneiss on the western side of the island so abounds with veins of granite parallel with the strata, that in many places they constitute the chief material of the rock; and will, I doubt not, at a future day, be wrought for useful purposes. This has indeed been the case to some extent; many sloop loads of stone cut for culverts and other faced work on the Croton aqueduct, have been prepared from the material furnished in opening the 10th avenue, and delivered. It is a fair granite, specimens of which I have furnished and labelled "granite from 10th avenue, near 48th-street." The granite prevails more or less from 31st-street on the west side, and from 24th-street in the middle, to 60th-street on the north, and most of it runs out southwest of Bloomingdale road. I am fully convinced that in cutting through the streets and levelling the lots, a large amount of excellent building material will be furnished, and will be a source of profit at a future day.

The stone furnished for the aqueduct was delivered at the dock near the place of consumption, at $1 or $1.12½ per cubic foot, dressed for the work, which, I was informed by one of the contractors, was about the same as it would cost to get them out and put them in shape when equally good materials could be furnished on the spot. This circumstance is explained by the fact that those who furnish it were contractors with the corporation of the city for opening the avenues on the island, where they are paid a certain amount not exceeding $1 or $1.10 per cubic yard, for removing the stone out of the way, and are at liberty to make such use of it as they please. The cutting of the stone, therefore, after it is removed from the quarry, is the chief expense to the furnisher; this shows why it can be furnished at so low a rate. The amount paid by the corporation for removing loose earth, varies from 12 to 30 cents per cubic yard, according to the nature of the earth to be removed, and the distance to be carried to get it out of the way; the most common price is 18 cents, and the same price is paid for filling in valleys, whether with stone or earth; and if it is done by the load, as is frequently the case, nine cubic feet make a load for one horse.

Where rough stone are furnished for basements and other rough work, they are delivered at $1.00 a load, so that contractors sometimes get

ridge of limestone, and varied from north 25° east, to north 45° east, and the dip from 50° east to vertical. From Mr. Dykeman's house, which is near the southern line of the limestone, to the old tide-mill, (which is nearly opposite to Tubby-Hook,) at distance half a mile or a little more, is a line of abandoned quarries, which many years ago were extensively wrought for burning into lime; but as the lime was of inferior quality, other varieties at length superseded it. This limestone has been called dolomite, but whether from its granular structure, or from its composition, I am unable to determine. I have not met with any analysis of it, nor do I think there is any on record.

The individual minerals, and the diluvial furrows, will be considered in another place.

The extreme eastern part of this section lies east of the three divisions already considered, and is bounded east and north by the Harlem river, west by the valley of the 8th avenue, and on the south by Harlem and Manhattanville valley. It terminates on the north at McComb's dam, about one mile north of the Harlem bridge, and consists of a low ridge of gneiss, following the line of the 7th avenue. It is from 200 to 400 feet wide, and from 50 to 80 feet above the contiguous plains. The valley through which the 8th avenue passes, is throughout its course a perfect level, and but a few feet above the waters of the river. The strike of the strata of this ridge at 142nd-street is north 25° east, and the dip vertical. In the extreme north, at McComb's dam, the gneiss crops out. It has the strike north 35° east, and the dip vertical; and is covered in many places to the depth of 15 or 20 feet with diluvium, consisting of loam, sand, gravel and pebbles, with boulders of white limestone, like that of Kingsbridge, greenstone like that of the Palissades, sandstone and granite. The granite is generally rough and angular; while most of the others, especially greenstone, are rounded and smooth. In this vicinity the general course of the river, as well as the valley through which it runs, is SSE, so that any current from the northwest would be likely to accumulate any materials swept along in its course on such prominences as that at McComb's dam.

III.

General remarks on the transported materials of the island, both alluvial and diluvial.

The island contains in every part abundant evidence of a current having swept over it from northwest to southeast, both from the grooves and scratches still visible on the solid rocks of the island itself and its

vicinity, and from the materials themselves being traceable to the original rocks, whence they have been transported. The southern part of the island contains the largest amount of these materials. In the south-eastern extremity of it, usually denominated Corlear's hook, the surface has been graded in some places 70 or even 80 feet below the natural level, and shafts have been sunk 75 or 80 feet more without reaching the rock. The diluvium and alluvium together are therefore in this vicinity at least 150 feet, the streets having been graded in some places half that depth below the original soil. It is proper to state that the whole of Corlear's hook and its vicinity originally consisted of a series of conical hills of diluvial sand, gravel and pebbles, with masses of all sizes, from pebbles to boulders 15 or 20 feet in diameter; all of which have been removed and deposited in the neighboring valleys and low grounds. Here were collected, not only the largest quantity, but the greatest variety of rocks that were found in any part of the island.

We will now enumerate the different depths at which the rock has been reached by borings for water, or for other purposes, in different parts of the island which are covered by alluvium or diluvium. Most of these borings were commenced in this city many years ago by Mr. Levi Disbrow; and the same business is successfully conducted by his son, Mr. John Disbrow, from whom most of the subjoined facts were obtained.

Commencing at Corlear's hook, we find a shaft was sunk at Mr. James P. Allaire's works, in Cherry-street, about 80 feet through diluvium, stratified sands, clays, or gravel, without reaching the rock. Again to the westward about half a mile, at the foot of Jefferson-street, the rock was reached through 10 feet of diluvium, and 40 feet of stratified sands, and gravel alternating with clays.

At Fulton market a shaft was sunk through 15 feet of artificial ground, then 115 feet of stratified sands, blue clay and river mud alternating, and the rock was struck at the depth of 130 feet.

At Holt's Hotel, a few rods north of the last mentioned place, a shaft was sunk through 126 feet of strata like those at the market, and the rock reached through a bed of gravel, and the shaft sunk 500 feet into the rock, which is gneiss with veins of quartz and granite; 200 feet of the upper part of the bore is a three inch hole, and the remainder two and a half inch. The water obtained from this well was at first tolerably good, and promised to be very serviceable, but since has

very much deteriorated, and is now said to be even more saline than that of the neighboring river.

On the west side of the island, at Washington market, which is on the west side of Washington-street, between Fulton and Vesey-streets, a shaft was sunk 10 feet through artificial earth, 50 feet through river mud containing decayed vegetable matter, sands, clays, &c. in thin alternating strata, 10 feet of sands and gravel, when the rock was reached at 70 feet from the surface.

Again, at the corner of Grand and Wooster-streets, a shaft was sunk 40 feet through artificial earth, then 20 feet of mud, clays, and sands highly charged with decaying vegetable matter; then 6 feet of fine blue clay; and lastly, 6 feet more of coarse sand and gravel, when good water being obtained, the borings were discontinued at the depth of 72 feet from the surface. This depth was considered as at, or at least as very near, the surface of the rock, from the fact that in almost all cases where the rock was reached at great depths through similar strata, it was found covered with a bed of gravel or sands, like that above mentioned.

In College place, directly north of Columbia College, which is on more elevated ground than the market, the rock was reached at the depth of 80 feet, through 20 feet of diluvium and 60 feet of stratified sand and gravel alternating. If we follow the high range of grounds in a longitudinal direction, as in the neighborhood of Broadway, though we have fewer data from which to judge, yet it is believed that the rock here approaches nearer the surface than in the places above mentioned. This is inferred from the fact that the direction of Broadway corresponds with that of the strike of the strata, and is generally more elevated than the grounds on either side of it, and the contour of the rock follows, it is believed, that of the loose earth which covers it.

At the old rock well near Trinity church, the shaft was sunk 26 feet through diluvial gravel and sands, where the rock was reached, though not penetrated, and good and permanent springs of water obtained. At the City Hall the shaft was sunk 90 feet to the rock, but is in the district of the Collect, (see vertical section No. 1.) The celebrated well, corner of Bleecker-street and Broadway, is 448 feet deep; 42 feet through stratified sands and gravel, and 406 feet in solid rock, having the usual character of the gneiss of the island. The bore of the shaft is 7 inches diameter, and yields 120,000 gallons in 24 hours, according

to the statement of Mr. D. senior, who made the borings, and who also states that the water rose within 30 feet of the surface.

The shaft of the city reservoir in 13th-street, a few feet east of Broadway, is 113 feet deep and 17 in diameter, with 2 adits at bottom, one 75, the other 100 feet long. The rock was reached at about 20 feet.

In the same street, a few rods west of Broadway, the rock was reached at the depth of about 3 feet, approaching in one place very near the level of grading. At 16th-street, corner of 2nd, 3rd, and 4th avenues, the rock appears, and the soil as we go northward continues to grow thinner and thinner.

As we approach the East river from any point in the middle of the island, between 1st and 20th-streets, the rock dips down to a depth of 90 or 100 feet below grading, as evinced in the shaft sunk in this part of the city. In conclusion, the diluvium and stratified sand and gravel, it appears, extends on the west side of the island as far as 31st-street, and on the east side to 16th-street; and notwithstanding this formation is found in every other section of the island, it is in comparatively small quantities and needs not a particular description. The mineral character of these materials will be noticed in the description of the boulders.

IV.

Allvial Beds and Valleys on the Island.

There are three principal beds or valleys of alluvium that demand particular description. The first lying in the very centre of the city, includes nearly the whole length of Centre-street with Elm, on the west, and Orange and Mulberry-streets on the east, to the neighborhood of Canal-street. This valley was formerly called the Collect, as it was a receptacle for the draining of the adjoining higher grounds. In some portions it was a mere quagmire, and in others a collection of stagnant water 50 or 60 feet deep, and is said by some of the oldest citizens to have had an outlet communicating with the East river along what is now called Roosevelt-street; and another, with the Hudson across the Lispenard meadows, crossing Broadway at what was then called the stone bridge, (now corner of Broadway and Canal-street.) The Lispenard meadows extended from Broadway to the Hudson, and from the vicinity of St. John's church to Spring-street on the north, including the range of Thompson, Laurens and Wooster-streets.

This first valley being a fresh water alluvion, and a quagmire originally, was of great depth, as has been recently proved by soundings made by Mr. Disbrow, in the place now occupied by the Halls of Justice in Centre-street, between Franklin and Leonard-streets, where iron rods were sunk 40 feet through artificial earth, 30 feet through black mud, 5 to 10 feet of blue clay, then a bed of gravel resting on the rock. Still farther south, at the Manhattan water works, on Centre, between Reade and Duane-streets, seven shafts were sunk 30 feet each in coarse diluvial gravel without reaching the rock. The water supplied by the Manhattan company is by no means the best in quality, but is used for want of better in culinary operations in a considerable portion of the southern part of the city.

The black mud brought up from the lower part of the strata of the Collect was as salt as the waters of the river, though very good water was obtained at a higher level on the outskirts of this valley. This fact is generally explained by considering the water from the gravel beds bordering on the valley as that drained from the surface of higher grounds; while that from lower strata, as from the black mud above mentioned, was derived from the river either directly or indirectly, and being heavier retained its place at the bottom.

The second alluvial valley lies on the east side of the island, and includes what was formerly called the Stuyvesant meadows, and all the low ground extending southward to the vicinity of Corlear's hook, or from 21st street on the north to Delancy-street on the south, and from the river on the east to about half a mile westward; this last boundary varying somewhat in its distance from the river in different portions of it. This region is throughout a salt marsh, and was formerly to a considerable extent covered by the tide at every flow, but is now shut out by dykes and filling in of the streets. The strata composing this alluvion are mostly alternations of sands, clays and mud, and beds of sand or gravel resting on the rock, which last is from 90 to 100 feet below the grade level surface.

The following are some of the results of borings made in this alluvial district. At the corner of Fifth-street and Avenue D, a shaft was sunk which reached the rock at the depth of 109 feet.

At the Dry Dock another was sunk, which came in contact with the rock at the depth of 130 feet, and penetrated it 200 feet.

At the corner of Houston and Lewis-streets the rock was reached at 94 feet. At the corner of Houston and Avenue D, at 96 feet, and at

the corner of Seventh and Lewis-streets the rock was reached at 93 feet. And at the corner of Seventh-street and Avenue D, it was reached at the depth of 100 feet. In these borings it is evident that the rock dips down on the east side of the island to about 100 feet below the grade level of the streets, and that about the same depth of alluvial deposits have accumulated, and most of them below tidewater mark.

The third bed of alluvium is that already referred to under the name of the Harlem and Manhattanville valley; the form of which approaches that of a scalene triangle, having the longest side on its southern borders, and extending from the village of Manhattanville on the Hudson to the termination of 94th-street on the East river; its shortest side from Manhattanville to the northern limit of Harlem village, near 130th-street; and the remaining side from the last named point on the north to the termination of 94th-street on the south. The width of the island at this place is about two and a half miles, and the length of the valley east and west the same, while its extent north and south is about two miles. The strata throughout the valley are alternations of sands, loam and gravel, generally in strata, but sometimes in conical hills thrown together in great confusion; and when this is the case, it is gravel and pebbles rather than sand or loam. The gravel and pebbles predominate towards the western portion of the valley; sand and loam in the eastern. Boulders are less abundant in this than in most other portions of the island.

Comparatively few excavations or borings have been made in this valley, consequently we have fewer data for determining the depth of earth covering the rock. In the northern part of Harlem village at the corner of 4th avenue and 129th-street the rock appears, and has been removed by blasting; and in a number of other places in the vicinity it approaches the surface or within a few feet of it; indeed it is inferred that the whole valley is a bed of alluvium comparatively shallow, inasmuch as the rock appears from 10 to 20 feet above the surface, both to the north and south of the valley, and immediately on its borders.

The extreme eastern portions, and especially the southeastern parts, are a salt marsh, which, along the borders of Harlem creek, approaches the 3rd avenue; but as few, if any, excavations have been made in it, little can be said of its geology.

Besides the above mentioned alluvial beds, others are found in different portions of the island, but they are so inconsiderable as to require no particular description.

There is, however, a prolongation of the Harlem and Manhattanville valley, which extends northward and embracing the 8th avenue till it strikes the Harlem river at McComb's dam. It consists generally of sand and diluvial loam, and is almost a perfect level; few boulders are to be seen on its surface, except on its northernmost part, where they are found in great abundance.

V.

Boulders—their sources and abundance in different parts of the island.

The following are the principal varieties of rock:

1. Greenstone in all its varieties.
2. Red and gray sandstone, and their varieties.
3. Serpentine like that at Hoboken.
4. White primary limestone like that at Kingsbridge.
5. Granite and gneiss like that found on the island.
6. Hydrous anthophyllite like that found in place on the west side of the island.
7. Greywacke like that found in the valley of the Hudson above the Highlands.
8. Limestone like that of the Catskill mountains.
9. Ferruginous sandstone or jasper rock, like the sandstone underlying the Palissades near Fort Lee.
10. Clay stone, supposed to be from the same source as the last.
11. Actynolite, supposed from the anthophyllite locality.
12. Kyanite—this has been found in small fragments, but I am not aware that it has been traced to its locality.

The abundance of the several varieties of rock above enumerated, is very different in different parts of the island. While some are common to every section, others are confined to a particular part; thus, greenstone is found in boulders every where from north to south, and from east to west, while serpentine, like that at Hoboken, is confined to the southern limits. The details of these facts will be found below.

1. *Greenstone.* This in all varieties is perhaps the most abundant rock that is not found in place on the island, yet in boulders is common to every part of it. In almost every instance, they are worn to a rounded form, though it is one of the hardest and toughest rocks known. They are among the largest transported rocks on the island, being from 10 to 15 feet in diameter, and often covered with grooves and scratches indi-

cating the mechanical violence to which they have been exposed. This rock is not found in place on the east side of the Hudson, but is the chief rock on the western shore, from Tappan bay on the north to Bergen hill on the south; and as all the varieties found in place there can be selected amongst the boulders here, the necessary inference is, that this locality is also the source of the greenstone. Specimens forwarded.

2. *Red sandstone*, like the greenstone, is common to every part of the island, being found from Corlear's hook to Kingsbridge, but most abundant towards the former place. These boulders vary considerably in appearance, as well as in size. Though occasionally consisting of coarse pebbles, they are generally fine grained, of a red or grayish red colour, and distinctly stratified. I have found some that measured 9 or 10 feet in diameter. This rock, like the greenstone which it accompanies along the Jersey shore, is not found on the island, nor on the east side of the Hudson nearer than the valley of the Connecticut.

There are two other varieties which I have referred to the red sandstone formation, but on account of their peculiar character as boulders, I will describe them by themselves under the name of ferruginous sandstone and claystone. Specimens forwarded.

3. *Serpentine*, like that at Hoboken, is common in the southern, but rare in the northern parts of the island. In speaking of serpentine, we shall make a distiction between that variety found in place at Hoboken, and that found at the anthophyllite locality on the island, which approximates to serpentine in character, but is harder and is mixed with limestone. These boulders are much more common in Brooklyn than in this city, except perhaps the region of Corlear's hook. This might be expected, taking for granted that they were transported from Hoboken, which seems to be a necessary conclusion, as no other locality of this variety is known in the vicinity. Besides, the direction of the diluvial grooves being from northwest to southeast is such as would carry the materials from Hoboken to Corlear's hook, and the east part of Brooklyn.

4. *White or Primary Limestone.* Boulders of this material were found some years ago in cutting away the hills at Corlear's hook, and in a number of places on the east side of the island, between the city and Kingsbridge; but I have neither seen nor heard of any being found on the western side. The principal places where I have found this rock, are on the 4th avenue near 120th-street; at the 7th avenue, north of the village of Harlem, near 142nd-street; at McComb's dam, at the

northern termination of the 7th avenue; and in a number of places in the valley of the Harlem river, between McComb's dam and Kingsbridge. Now the nearest locality where this rock is found in place, is at Kingsbridge, and I have no doubt the boulders in question came from this place; but had they been transported in the general direction of the current shown to be northwest and southeast, instead of reaching their present location, they would have been carried across the Harlem river, and have been deposited in the range of grounds lying about midway between Harlem and Westfarms. Specimens are forwarded.

5. *Granite and gneiss*, especially the latter, being abundant in every part of the island except the northern extremity, boulders of these might be expected to be more numerous than of any other materials; yet I think greenstone boulders are quite as numerous, take the whole island together, as granite and gneiss. The largest boulders I have seen of the latter kind, measured in diameter 12 and 18 feet, and are equally common in all parts south of the Harlem and Manhattanville valley. The granite, which exists in veins in the gneiss, is mostly on the west side of the island; and this when torn from its place and transported by a northwest current would naturally have been distributed over the eastern parts, and even as far as Long-Island. A number of very large ones were excavated between 1825 and 1830, in the vicinity of Corlear's hook, some of which were peculiar in character. One I well remember lay many years on the south side of East-Broadway, near its junction with Grand-street. It was a gray granite of coarse texture, with tabular crystals of black hornblende 3 or 4 inches in diameter interspersed throughout. It was 18 feet long, 16 broad, 8½ high. This is the largest boulder I have seen on the island, but those from 10 to 12 feet diameter are very common.

A large boulder of granite, 11 feet in diameter, and though somewhat rotund, has a rough and angular surface, as though it had suffered little from mechanical violence, rests on the gneiss rock on the east side of Bloomingdale road, from a quarter to half a mile south of the village of Manhattanville, and at the southwest corner of a Mr. Stevens' house, between it and the road. The whole rock on which it rests is covered with diluvial grooves, and a very large one 3 inches deep and 18 wide between the road and the boulder, and terminating at the latter, seems to have been the result of the movement of this huge mass. Specimens are forwarded.

6. *Hydrous Anthophyllite.* This rock has been familiarly known for many years in this vicinity under the name of *radiated asbestos rock*, but was known only as a boulder found in considerable abundance in various parts of the city, and as far north as 15th or 20th-street. Its geological place was not, however, known at that time; and as its true mineralogical character was somewhat doubtful, Dr. Torrey sent specimens of it to Professor Thomson, of Glasgow, who analyzed and pronounced it anthophyllite; but as it contained a much larger proportion of water than had usually been found in this mineral, Dr. Torrey proposed to prefix the term *hydrous*, which has been generally adopted. This rock has been found in place on the west side of the island, between 10th avenue and the Hudson, and between 57th-street on the south, and 63rd-street on the north. Here the strata are nearly vertical; the strike is NNE; the width of the bed at right angles to the strike varies from 3 to 30 rods. It commences at 57th-street, within 30 or 40 feet of the avenue, and runs obliquely to the streets crossing the 11th avenue near 60th-street, and runs out at the river on 63rd-street. It is remarkable that the granite lying on the west, and the gneiss on the east of the rock in question come in complete contact with it without intermixing. So remarkable is the line of separation on the side next to the gneiss, where there is the best opportunity to examine the two, that within the space of three inches each rock possesses all of its own peculiarities, with none of those of its neighbor. The mineral character of this rock varies much in different parts of the bed. In the southeast portion where it approaches nearest to 10th avenue it exhibits little or no stratification, is very dark coloured, and has a tabular structure. In the same vicinity are found masses of serpentine and limestone intermixed, exhibiting a porphyritic appearance, the serpentine appearing green and the limestone white. Again near the middle of its course, or near where it crosses the 11th avenue, it becomes lighter in colour, more fibrous and scopiform in structure; but the fibres are large, and in some instances approach the character of actynolite. Still lower down, following the strike towards the river, the same mineral character continues, except that the fibres are still finer, and the whole texture becomes softer and more like steatite; so that many years ago, before the rock was known to geologists, it was attempted to work this bed for a soapstone quarry, to be applied for similar useful purposes; but the material being too hard, the project failed. This rock has been found in boulders in all of the southern part of the island, and some are very large. On the west side they extend from the rock in place to 15th-street. In the middle division they have been found

from 48th-street on the north to 14th-street on the south, and on the east side from 24th-street to Corlear's hook.

On the south side of 14th-street, between Bowery and 3d avenue, is a boulder of this rock 15 feet long, 12 broad, and 6 high, containing on its surface abundance of diluvial scratches running longitudinally.

Again, 30 feet west of 3d avenue, on the south side of 16th-street, and 40 feet distant from it, is another boulder, 13 feet long, 8 broad, 7 high. It is uniform in texture, like that on 63d-street, in place, and is covered with scratches running longitudinally.

Another 12 feet long, 8 broad, and 8 high, is lying in 25th-street, about 20 rods west of 4th avenue, covered with scratches in every respect like those of the last.

Now had these boulders (which, I doubt not, have all been derived from the same rock,) followed strictly the course of the current indicated by the diluvial grooves on the island, they would have been found along the Bloomingdale road, near the 8th avenue, and from thence eastward to Kipp's bay and the alms-house, and possibly somewhat lower down; instead of which, they have been carried much farther south, to Corlear's hook, and even on Long-Island.

I will here remark, that I strongly suspect there are other localities of this rock eastward of this island; for boulders of the same character resembling most perfectly specimens of this island, have been found at West Farms, New Rochelle, and Sawpits, which could scarcely have been transported from the locality on this island.

7. *Graywacke*—Which is common in the valley of the Hudson. I have seen specimens found many years ago, in grading the streets at Corlear's hook. These specimens closely resemble the rock brought to this city for the purpose of flagging the sidewalks, from Coeymans and Coxsackie, also from Esopus creek, but as no specimens have come to my observation recently, or since about 1830, I cannot speak from personal knowledge.

8. *Limestone, like that of the Catskill or Helderbergh mountains*, abounding in *productus*, has been found at Corlear's hook, and in other places in the southern part of the island. I have a single specimen in my cabinet, obtained at that place in 1826, at the depth of 40 feet below the natural surface. It was then a boulder 2 or 3 feet in diameter, and has been distributed so that but a small fragment now remains. I

discovered it, and removed it to my cabinet, and considered it as bearing such strong evidence of its source, that I shall forward it to be preserved in the State cabinet at Albany.

9. *Ferruginous Sandstone or Jasper rock*, like that found in place underlying the Palissades, near Fort Lee.

This rock which is one of the most abundant next to greenstone and granite, in the south part of the island, I have not found north of the Harlem and Manhattanville valley. It is most abundant between 13th and 20th-streets, and between 2d and 4th avenues. This rock, when first noticed, was supposed to be a ferruginous quartz in a state of disintegration; but on a closer inspection, an obscure appearance of stratification was observed, and the component grains were found rounded and often transparent, and cemented together by a large amount of oxide of iron. In some specimens it is difficult to identify the granular structure on account of the abundance of the cement, and the advanced stage of decomposition in which it is found; in others, there is so intimate a union between the parts, that the whole seems to be one entire mass. There are others, again, where the cement puts on the appearance of jasper, and hence the name of jasper rock, which has frequently been applied to it.

In searching for the geological place of this rock, I am satisfied I have found it underlying the Palissades in the neighborhood of Fort Lee, where the red sandstone comes out under the Palissades very near the water's edge, and exhibits a great variety of character. Specimens of this rock are forwarded.

10. *Claystone*, supposed from the same formation as the last; they are distinctly stratified, and have a clay colour. They are often quite hard and slaty in structure. Specimens of this rock are forwarded.

11. *Actynolite*, supposed from the anthophyllite locality. This variety has been found in boulders at Corlear's hook, and in other places in the southern part of the island. One of 3 or 4 feet in diameter was discovered in 1826, near the corner of Monroe and Montgomery-streets. I preserved a single specimen, and remember distinctly the character of the whole mass; and on comparing the specimen in my possession with the varieties of anthophyllite in place, I doubt not that all the specimens of actynolite on the island have been transported from this source.

12. *Kyanite.* All the specimens of this rock that have come to my knowledge were in loose fragments lying on the surface, inferior in qua-

lity. I found two specimens in 1826 near Kipp's bay, but have heard of none more recently, nor have I been able to trace it to its geological place.

VI.

The Minerals enumerated : 1st. Those peculiar to the island. 2d. Those from other sources.

1st. Those peculiar to the island.

1. *Quartz Crystals.* (Inferior specimens,) small crystals in the Harlem rail-road cut under the track in veins of gneiss, about 122d-street.

2. *Rose Quartz.* (Inferior specimens,) from the same place; the locality being covered up no more specimens can be obtained.

3. *Epidote.* Very small crystals of a deep green colour, in hexagonal prisms in veins of half an inch wide in gneiss, at 38th-street, on the banks of the East river, in the southeast part of a gneiss quarry.

4. *Tourmaline.* In hexagonal prisms in granite beds or veins in various parts of the island. Many fine specimens were obtained in opening the Harlem rail-road.

5. *Brown Garnets.* With 24 trapezoidal faces, very imperfect; abundant in the gneiss on the shore of the Hudson, between 42d and 50th-streets, and in boulders in every section of the island.

6. *Hydrous Anthophyllite.* Already described, very abundant.

7. *Serpentine.* Intermixed with white limestone and of granular structure, described with the last, and from the same locality.

8. *Red Stilbite.* In small quantities in veins of gneiss; in small scopiform fibres of a reddish yellow colour. From the rail-road cut near the tunnel. The locality is exhausted.

9. *White Pyroxene.* In four sided tables in veins in limestone at the abandoned quarries at Kingsbridge, at about 208th-street, five rods west of the Kingsbridge road.

10. *Fetid Feldspar.* Of a bluish white colour, in tabular masses in limestone at Kingsbridge, Thompson's quarry near 196th-street, and about 100 yards west of the road.

11. *Iron Pyrites.* In exceedingly small cubic crystals throughout the island, in the gneiss and in the limestone at Kingsbridge.

12. *Tremolite, white.* In the abandoned quarries of limestone at 208th-street, west of Kingsbridge road.

2d. Those from other sources.

1. *Mesotype.* In cavities and veins in greenstone.
2. *Datholite.* From the same source.
3. *Apophyllite.* Also from same source.
4. *Chlorite.* Same source, found in small quantities.

All of this last class have been found in small quantities in veins in the boulders of greenstone, barely sufficient to determine their characters.

VII.

Diluvial grooves and scratches.

From the preceding remarks on the transported materials of the island, and from observations on the geology of the vicinity, it is quite certain that an immense force has been in action at a former period and has carried a vast amount of mineral materials from their original beds, and spread them over a large area. That water was in some way the agent is the united opinion of geologists, but the circumstances attending it, the immediate cause or causes of its movement, and the precise epoch in which it took place, it would be difficult, if not impossible, in the present state of our knowledge, to determine.

My remarks will therefore be confined rather to the force and direction of the current than to the causes which produced it.

The direction of the current is ascertained by that of the grooves and scratches left on the solid rocks; and its force, by the size and quantity of the fragments, and the distance and elevations over which they have been transported.

The term *grooves*, as here used, applies to all the furrows that are an inch or more across; the term *scratches* to all those less than an inch across; the word *furrow* without reference to size, but as a general term.

Diluvial grooves and scratches have been found in every section of the island, from 16th-street on the south, to 200th-street on the north, (or to the southern termination of the limestone,) and from the banks of the Hudson on the west, to Harlem river on the east.

The furrows generally are most distinct where the rock has been recently uncovered; and least so where it has long been exposed to the action of the elements. They have been found on the highest rocks, and at the lowest tide water marks, being a difference of more than 100 feet perpendicular height. It is evident, therefore, that if these furrows were the result of a single diluvial action, or a single deluge, the

current was more than 100 feet in depth. The furrows are always most strongly marked on the northwestern slopes of the hills, and least so on the southeastern. In many instances they are very distinct on the western and northwestern slopes, extending to the highest point of the rock, but no traces are to be seen on the eastern and southeastern slopes, although both slopes are equally exposed.

Direction of the Furrows. Observations of the diluvial furrows were made in between sixty and seventy different places on the island. Taking together the whole series of observations, the general course of the current was from northwest to southeast, or north 45° west, but varied in the extremes from north 25° west to north 48° west, making a difference of 23°.

Of the whole series of observations, thirty-nine were north 45° west, twelve varied from north 25° west, (seven being north 35° west,) two were north 48° west, and a few scattering ones, varying from north 35° west to north 45° west.

Abundance of the Furrows. The furrows occur most abundantly in the middle portions of the island, between the city and the Harlem and Manhattanville valley, somewhat less in the western, and least of all in the eastern.

Direction of the Furrows in particular neighborhoods. Half of all the places where the furrows were noticed were in the middle portion of the island in the line of the 8th avenue from 60th-street to 105th-street, where without exception the direction is north 45° west. About one-fourth of all are on the west side, and vary but little from north 35° west, and about one-eighth on the eastern side, where the direction varies from north 25° west to north 35° west. In connection with this subject, I have examined the surface of the greenstone on the neighboring shores of New-Jersey, and find their grooves and scratches abundant, and their general direction is north 45° west. Hence it appears, that the diluvial current which once swept over this island from northwest to southeast, on reaching the western shore was deflected southward, as by the action of some force at a right or some other angle to its course; and that the same current, before it reached the middle of the island, again assumed a southeasterly direction, but was again diverted southerly on approaching the eastern shore. That some portion of the current was diverted southerly on reaching the western shore of the island, is evident, not only from the diluvial furrows, but from the boulders of anthophylite found in large numbers in the lower part of

8th avenue near 15th-street, a distance of two miles in a SSW direction from the only locality whence they could have proceeded.

Again, the white limestone of Kingsbridge has been distributed along the eastern shore of the island, in a direction almost due south of the only locality in the vicinity where it is found in place; whereas had they been carried in the general direction of the current, they would have been deposited eastward in Westchester county, as before stated.

Magnitude of the Furrows. The size of the furrows varies in the same and in different localities. Sometimes they are the finest scratches, not more than a line in diameter horizontally, and of the smallest appreciable depth; from this they increase to grooves 4 inches deep and 18 inches in horizontal diameter. In a few cases, they are furrows, or rather troughs, more than 2 feet wide and 6 or 8 inches deep. A case of the latter kind occurs on 8th avenue, between 79th and 81st-streets; and one of the former on the west side of the island, on the very banks of the Hudson, 500 yards north of Mr. John H. Howland's country seat, (near 97th-street.)

Convenient places for examining the Diluvial Furrows. The nearest places to the city for examining the furrows are at the junction of 22d-street and 1st avenue, south of the alms-house yard; and again about half a mile northward at Kip's bay, at the junction of 1st avenue and 35th-street. Both of these localities will soon be destroyed by grading the streets.

Some of the most interesting localities have been made known by cutting through 8th avenue from Bloomingdale road at or near 60th-street to Harlem and Manhattanville valley, at 105th-street. These localities are on both sides of the avenue, and very conspicuous.

Another, equally interesting in many respects, is on the banks of the Hudson, west of the Bloomingdale road, about six miles from the city, and about 600 yards northwest of Burnham's hotel.

The interest excited by this locality arises from the fact, that the furrows ascend from beneath the lowest tide water up an elevation of 70 feet in 300 or 400 feet distance, requiring a force greater than that of any current with which we of modern days are acquainted.

Respectfully submitted,

L. D. GALE,

Assis't Geologist First District N. Y.

THIRD ANNUAL REPORT

Of E. Emmons, of the survey of the Second Geological District.

To his Excellency, WILLIAM H. SEWARD,
Governor of the State of New-York:

SIR—Owing to many inaccuracies in the county maps of the Second Geological District, and to the incomplete state in which the original surveys which constitute the foundation of those maps were left, especially that portion of the section which embraces the origin of many of the great water courses of the State, I was directed by his Excellency, Wm. L. Marcy, to attempt those corrections and supply those deficiencies, which are of the most importance to the geological survey.

This additional duty, while it has interfered with, and retarded, to a certain extent, the prosecution of my appropriate labors, has not caused at any time their entire suspension. The consequence has only been, that I have not been able to complete the examination of so much territory as I should have done had my attention been directed solely to the collection of geological facts.

It remains to be shown in the final result whether this course was judicious, though it can hardly be doubted that it is important that the proposed geological maps should be as full and accurate in geographical details as possible.

During the first season of the survey, Mr. Hall and myself ascertained the fact that by far the most elevated portion of the State is situated in the Second Geological District.

This circumstance gave an unusual interest to this section, and has induced already many gentlemen to visit this region of mountain; and it will undoubtedly in a few years become a favorite place of resort to persons of leisure. The location, too, of the Adirondack iron works,

form the essential materials in all the finer kinds of pottery. They are at least the most important elements in the China, French and English porcelain; they also enter into the composition of the common Liverpool ware, but in a smaller proportion than in the French or English porcelain.

These substances occur at many localities in the United States, but generally they are not sufficiently pure and free from colouring matter, to render them objects of value; especially is this the case with *feldspar*. It is abundant, but contains frequently too large a proportion of the metallic oxides, which in the process of fusion, imparts colour to the glazing or enamel, a circumstance which entirely destroys its utility and value in this art.

The localities of porcelain clay which fell under my notice, were in Athol and Johnsburgh, in Warren county, and Minerva, in Essex.

The mode in which it occurs is in layers more or less distinct, or in layers interlaminated with those of different colours, as yellow, red and brown. At first view, they might be mistaken for ochre beds; still the peculiar reds and browns are entirely different from the oxides of iron generally termed ochres, and their nature becomes apparent from their association with the white variety.

It is remarkable, that the latter which is in the midst of the coloured portions of the bed, should have been deposited without any intermixture of the oxides so strongly developed in the adjacent portions.

Its colouring matters, I find, consists of a mixture of the oxides of iron and manganese.

The white variety is soft to the touch, and free from that harsh and meagre feel common to some varieties of this species of clay. This peculiar soft feel is owing probably to an intermixture of talc which occurs in it in the form of thin white scales.

My opinion of the excellent quality of this clay has been confirmed by an experienced artist, D. Henderson, Esq. of Jersey City, who has been engaged for a number of years in the manufacture of the blue or Liverpool ware. It is but just to remark, that at this establishment was made the first dining plate in the United States, and that the beauty of the articles now manufactured at this establishment is equal to any of the imported wares from Liverpool.

It is impossible to speak at the present time of the quantity which those localities will probably furnish. I was able to expose only a small portion of the beds which I visited; it would not be safe to make any estimate on those partial excavations. There are circumstances, however, which are favorable to the general impression which prevails in that vicinity, that the substance is abundant. One or two facts in particular, go to corroborate this position; for instance, its occurrence in numerous places, and which are scattered over an extent of country of 15 or 20 miles in length. It would be an anomaly, if throughout so much territory, there should not be an abundance of this valuable material.

This variety of clay is produced by the disintegration and decomposition of granite. Those granites, which are of a coarse texture and contain large lamina of mica, or are intermixed with scales of talc, are the most subject to this change. In the granite of Athol and Johnsburgh, there is more or less of pearl white talc, an association which I consider an advantage to the clay; its presence will increase the fusibility of the silex and alumine, and impart a rich porcellaneous aspect, or a greater translucency to the body of the ware; besides it adapts it for glazing and forming enamels for the common earthen ware, even if it is not employed for the production of the finer varieties of porcelain. In fact, it is of great importance that other materials besides salt, lead and the metallic oxides should be employed for glazing even the commonest articles of pottery, and the discovery of some substance which may be used as substitutes for those oxides, which are so readily acted upon by the weaker acids in domestic economy, has long been a desideratum. It remains, therefore, only to determine the truth of the conjecture, that of its abundance, to render it an important addition to the natural resources of the State.

The porcelain clay beds furnish us with some geological facts which are worth at least a passing notice. I found that they all contain concretions of silex, and of the oxides of iron and manganese.

The silicious nodules belong to the same variety of quartz which is usually denominated hornstone, and like this substance, often contains cavities lined with crystals of quartz, some of which appear under the primary form of the species, a form much sought for and esteemed by mineralogists on account of its variety. They are small, and only large enough to be seen distinctly by the naked eye.

The concretions are evidently masses of secondary formation as it regards the bed in which they occur; and their appearances, together with

the circumstances connected with their position, are such, that we are obliged to consider them as having been once in solution. Chemists are familiar with the fact that water under certain circumstances freely dissolves silex; besides, it is well known that it is held in solution in the hot springs of Iceland, St. Michael's and many others in the vicinity of volcanoes; still, it is an insoluble substance after it has been once separated from water by precipitation, though in a state of minute subdivision. Again, silex becomes soluble by the assistance of the alkalies, potash and soda, especially when aided by heat. But the conditions under which it occurs in those beds are such, that no satisfactory rationale offers itself in explanation of its solution. The following is the only one which occurs to my own mind, viz: that the silex is derived from the feldspar, and that by its union with the potash it becomes soluble, either in the water of crystallization or of absorption, forming at one stage of its decomposition a silicate of potash; this compound, by subsequent reactions, suffers an entire separation of its elements, which finally results in the union of the particles of silex in the form of crystals or crystalline masses, and the entire removal of the potash by solution. If this is the correct rationale, we are obliged still to maintain that only a part of the silex is employed in forming those nodules, for a portion still remains in mixture or combination with the alumine. The silex or quartz of the granite appears in coarse grains, diffused irregularly through the beds.

Whatever rationale we may offer in explanation of this peculiar decomposition, we are furnished with a beautiful instance of a natural and spontaneous decomposition, or analysis of feldspar, as complete and perfect as can be obtained in the laboratory of the chemist; so perfect indeed, that we are able to perceive each element side by side in each of those repositories, with the exception of the potash which is removed in consequence of its solubility in water.

To assist our minds to comprehend more readily the law of those movements, which result in the formation of the concretionary masses, we may consider all the elements of the feldspar as forming at one time a plastic moveable mass like paste, and in which there is a perfect intermixture of the materials, or of the elements which composed the feldspar originally. Under those circumstances, all the truly soluble parts would be washed away or removed by infiltration through the earthy materials. Those which remain would be left to be acted upon by molecular attraction, and which would be exerted between particles of the same kind, or more especially between them. This influence would

bring into closer union the particles of silex in the immediate vicinity of each other, and which, by a continuance of the same influence would produce a gradual accumulation of matter of increasing density and firmness, until finally, those movements have been imparted to the whole of the silex contained in the beds. The accumulations commence at different points, which of course constitute different centres of attraction; at each of which there forms a mass of consolidated silex or of hornstone or chalcedony. An analogous change takes place in the porcelain pulp after the materials have been ground and formed into a pasty mass in the vats in case it is suffered to stand long without agitation; for after long repose it is found that concretions of silex have already formed in the paste, indicating the commencement of a series of changes which would finally affect the entire composition of the materials, and which, if suffered to extend would spoil the whole mass for the purposes for which it is prepared.

The oxides of iron and manganese are always found associated with these beds; they occur in two forms; first, as concretions, which have been formed by the same process as the silicious; and second, as colouring materials, which are uniformly diffused through some portions of the deposite.

The oxide of manganese occurs in the original rock from which the clay is formed, in dendritic implantations, occupying the seams between the lamina of feldspar. Those dendritic implantations may have been formed by infiltration of mineral matter from above, or separated from the general mass and transferred by galvanic agency to the surfaces they now occupy. As the granite disintegrates and decomposes, the oxides undergo a partial solution, and together with the silex become in process of time uniformly diffused through the materials composing the beds. Subsequently, affinity brings the particles of manganese and iron together in the form of globular masses, so that we have all the elements of the rock, the silex, iron, and manganese, alumine and silex, each, according to their affinities, in the form of separate independent masses, or in imperfect combination. To carry our views a little farther, we may suppose that the same beds subjected to the action of heat, when another series of actions would ensue, the result of which might be the reproduction of the original rock, or of other crystalline bodies, as the silicate of alumine, iron, and manganese. We have in these changes and transformations, beautiful illustrations of the alterations in state and composition which the solid materials composing these rocky strata undergo by a modification of the force of affinity. We have too, abund-

ance of evidence, that matter, though inert in itself, obeys the impulse of an invisible intangible power, which, though slow in its operations, yet, in the end produces many remarkable results.

Without occupying farther time in the exposition of the manner in which the porcelain clay is formed originally, or of the changes which subsequently takes place in them, I have only to remark in this connection, that the occurrence of those masses of hornstone and chalcedonic quartz, in place, furnishes us the means of solving a geological fact of some importance, as the following statement will show. Over a wide extent of country, embracing a portion of the States of New-York, Vermont and Massachusetts, there occurs small boulders of this peculiar hornstone and chalcedony. They are found loose upon the surface and in the soil, intermixed with other rocks as granitic gneiss and hornblende; but so far as I have observed, they are never found imbedded in a rock; hence their original formation, and their actual repositories were matters of doubt and uncertainty. We have, however, reason to infer that they were originally formed in beds of clay, similar to those of Johnsburgh and Athol, and that currents of water, or some other forces, have transported them from their native beds, and spread them over a wide extent of country.

Before closing my remarks on the porcelain clay of Warren county, I think it possible some of the readers of the geological reports may be interested in the general description of this valuable substance as it occurs in foreign localities, and of those varieties which are employed in the manufacture of this beautiful ware. The Kaolin, or porcelain earth, is derived from the same source, wherever it has occurred. It may always be traced to the coarse granite as its parent rock, and particularly to the disintegration and decomposition of the feldspar. All the ordinary feldspars possess the property of forming an enamel before the blowpipe, without addition, previous to the change of state which reduces them to the condition of an earth.

But subsequently to this change in consequence of parting with the potash, one of the elements of this mineral, it no longer possesses the property of forming an enamel by fusion; or in other words, it becomes infusible, and remains unchanged when exposed to the highest heat of a furnace. In this remark the petuntze of the Chinese is an exception. In this, the decomposition has not proceeded so far as to effect an entire alteration in its elements, and it still retains the property of the original feldspar, that of fusing and forming an enamel when subjected to a

high temperature. The kaolins are generally meagre to the touch, friable, and unlike the ordinary clays, and do not form a paste with water. The true kaolins are formed of equal parts of silex and allumine, and that they may be employed usefully, and compose this article of luxury and of value in the arts, it is necessary they should be free from colouring matter. Generally, if not always, those clays may be distinguished from all the ordinary clays by scales of mica which indicate their origin, and also by their association in granitic districts. This constant association may often aid us in our searches for this substance, for it is constant in France, in Germany, in China and Japan.

1. *The Kaolin of Saint-Yriex.*

At this place, which is near Limoge, there is found two varieties of clay. The first is called the hard earth, and the other the soapy, or *terre dure*; the other, terre savonneuse. The kaolin is found mixed in the quarry with grains of quartz and scales of mica. The grains of the former are separated as much as possible, as they render the clay more infusible.

It occurs in those quarries at Saint-Yriex, in masses about an inch to an inch and a half in diameter. The surface of each mass is carefully scraped from all the coloured portions which may adhere to them. This part of the operation is performed by females. The hard porcelain clay, or that which is much mixed with the coloured portions, is washed after it is broken and thrown into vats, in which it is suffered to remain a short time only, when the quartz and coloured matters subside, the water is drawn off into other vats, in which it is suffered to repose, when the fine particles are precipitated to the bottom. This portion, after it is consolidated somewhat and dried, together with the pure masses which have been selected at the quarries and put in order by females, is sold at Saint-Yriex at 7 francs and 50 centimes per cwt.

The petuntze, which is the feldspar but slightly changed, and still retaining its potash, is not so valuable. This is used principally for the glazing, or for forming the enamel. The porcelain quarries of Saint-Yriex were discovered in 1760. They furnish at the present time most of the materials for the manufacture of this ware for all France, though there are many localities of this substance in this country. It is well known that the French porcelain is far superior to the English, and in fact to any other; and it has attained such a degree of perfection, that it is considered the *ne plus ultra* of the art.

To return to the clays of Warren county. I would suggest the possibility of employing those which are coloured, (and which, on this account, are unfit for porcelain,) in the manufacture of pipes and the coarser kinds of pottery, where colour is not a matter of much consequence. They would form excellent crucibles and pots, and if mixed with the proper proportion of feldspar, an excellent glazing or enamel for the ordinary earthen wares. The clays of New-York are mostly calcareous, and hence fusible and ill adapted for any kind of ware which requires a high temperature in baking or burning. These clays, then, are of great importance, and may justly be considered as a great accession to the mineral riches of the State.

Marble.

Marble of different kinds and qualities is abundant in the Second Geological District. Some of the varieties have been noticed in the preceding reports. Many of the localities are favorably located, both as to water power for sawing, and for safe transport to market. The only variety of marble now wrought belongs to the Trenton limestone, or blue limestone as it is called. This is usually dark, varying from a dark gray to a jet black. The dark colours have generally obtained the preference in market for mantel pieces and ornamental work.

One of the most valuable quarries which has been opened is at Glen's Falls. Nature at this place has exposed the strata in such a way that the whole thickness of the limestone can be examined without the labor of artificial or expensive mining. The river has cut into the rock to the depth of at least 70 feet.

The marble is extensively manufactured by two enterprising companies; it is therefore favorably known to the public, and has acquired a high reputation. For this reason it would be superfluous for me to give a particular account of its qualities. I take the liberty, however, to subjoin a letter which I have recently received from the agent of the Glen's-Falls company in relation to the position of the marble in the quarry, and also of the quantity which has been manufactued, &c.

"The Hudson river at Glen's-Falls has worn a passage through the limerock to a vast depth, rising in some places seventy feet from its surface. The strata measure from one inch to ten feet. A short distance from the river, on the Saratoga side, lying on limestone, is found black slate. Succeeding this are found strata of marble; slabs have been sawed and used for fire-places. It is sound, and of good colour. Succeeding this on both sides of the river, are found 50 strata of limestone, composed

in part of organic remains. Next in succession are found strata of gray marble, two and a half feet thick; it receives a fine polish, but the colour is not admired. A stratum of darker colour follows this which is six inches thick, though valuable only for stepstones. Then follows the black marble, which for brilliancy of polish and beauty of colour, perhaps, has no rival. The whole stratum is ten and a half feet thick. Veins of organic remains run at irregular distances from each other through the strata; these veins are from two to four inches thick, running ten and sometimes twenty feet, break off abruptly. Where these veins do occur, though they are not numerous, they rather mar the beauty of the marble. Who first discovered this marble is not known, and it is of little consequence to inquire. Numerous attempts were made to work it, but without profit, until the present company received it.

"The following exhibits the amount of stone which the Glen's-Falls Company have prepared and sent to market during the last four years. The company run 16 gang of saws, which are equal to about one hundred and sixty single saws.

In 1835,.....	2,157	feet, or	32,000	pounds.
1836,.....	19,800	"	278,500	"
1837,.....	23,400	"	333,900	"
1838,.....	25,000	"	352,500	"

"It is remarked farther by Mr. Roberts, the agent of this company, that the Glen's-Falls marble has gained a good reputation with most of the workers of marble in New-York, Boston and Philadelphia, as it regards its colour, the polish which it receives, and the ease with which it works; and that it is considered equal to any of the kind in this country.

"He states that they have got out shelves for mantels seven feet and six inches long, thirteen inches wide and one and a quarter thick, which sells for sixty-five cents per foot. The price for this kind of stuff has fallen, and at the present is worth from fifty to fifty-five cents per foot; that which is shorter, from thirty to forty."

There are some considerations in relation to the marble business, which are necessary to be understood by those who are disposed to engage in it.

1. The expense of opening the quarry.

It also appears when we attempt to break it, exhibiting a toughness which approaches to that of hornblende.

This property is evidently one of importance; it is more useful for mantel pieces, or in any work where pressure is concerned, less danger in transporting to market, and less risk both to the seller and buyer. It will be found more durable than many of the white marbles, as it is never arenaceous or pulverulent.

Peat.

From the abundance of peat in this State, it appears that the climate and other circumstances are favorable to its production. It is not so hot as to cause a rapid decomposition of vegetable matter, nor so cold as to prevent those changes, somewhat allied to fermentation, which are required for its formation.

Mr. Mather, in his report for last year, gave extensive details of the quantity and value of this substance in the southern counties. It appears from the above report, that the quantity is quite sufficient for its demands at present: when we take, however, into consideration its great value to the agricultural, manufacturing and commercial interests, and the probability that the demands for it will greatly increase as its worth becomes more extensively known, there is no reason to fear that the supplies will be greater than the demand.

I remarked in my report for last year, that little or no peat had been discovered in the counties of St. Lawrence and Essex. I feared, therefore, that this valuable substance would not be added to the list of the useful productions of the northern section of the State. Contrary to expectations, I have discovered it in many localities, and find it in great abundance in the counties of Clinton, Warren and Hamilton; and I may state in general, that most of the fly's in those counties abound in this substance.

It will not be necessary nor useful to give a particular account of all the localities of peat which have fallen under my observation during the past season. The only places where it can occur are those of a marshy character, and the substance itself may be tested by any person, by first drying and then igniting it; if it burns, it is peat. As its presence may be suspected in all low, wet places, especially those bordering on ponds and lakes, it will be well to search for it in all such places, by thrusting down a pole or stick and trying the matter that adheres to it, as it regards its combustibility; or it may generally be found wherever

the surface of the ground is easily agitated by passing over it. One of the largest collections of this substance which has fallen under my observation is in Champlain in the county of Clinton. The peat marsh, or fly, to which I refer, is in the west part of the town, and is about two or two and a half miles in length, and from a half to three-fourths of a mile wide. Over the whole extent of this fly a pole may be thrust down from 12 to 30 feet, and probably in many places to twice 30 feet. It is of course nearly inexhaustible. Others, of nearly equal extent, occur in the county, and many which are less extensive. One fact, which applies to all the peat marshes of this neighborhood is, that they are situated far above the present level of the lake, and that those marshes which are on, or near the same level as the lake, do not contain peat, and those are quite numerous. This statement, if it should be found true, without exception, seems to indicate that the lower marshes have not been reclaimed from the deep long enough for this substance to form, and it goes to support the opinion I have elsewhere advanced, that this region has been subject to repeated osscillations since the commencement of the present order of things.

Another important growth of peat is found in Warrensburgh, Warren county, on the farm of Mr. Richards. In extent it occupies about 60 acres. It is upwards of 60 feet deep, as has been proved by sounding; hence the fly is not so extensive in superficial area as many others. It still contains a vast amount of peat. It is of an excellent quality and easy of access. The value of a marsh of peat may be estimated by determining the worth of a cubic yard, or a load, or any given quantity, and calculating the amount of peat which is contained in the area. The quantity of peat in a square rod of surface, and worked to the depth of 30 feet, would furnish 284 loads, which may be considered as worth 50 cents per load, or if we estimate it at only half this amount we perceive that 50 or 60 acres of it is almost invaluable when favorably situated. Even a small bog in the centre of a farm might be employed to increase its value one-half, as it would furnish an abundance of manure for an indefinite period. Many smaller deposits of this substance I found in the towns of Schroon, Chester, Warrensburgh, Johnsburgh, Queensbury, Lake-Pleasant and Wells, varying in extent from one to five acres.

There are four purposes to which peat may be applied:

1st. As a manure. To secure or obtain an important result something more is necessary than simply to spread it upon the soil. It

more considerations than one. A due proportion of wood-land to that under tillage, adds greatly to the beauty of any district of country; but above all, the preservation of timber lands is becoming a matter of great moment, and calls for legislative aid and encouragement.

Again, since the above was written, I have been informed by an intelligent gentleman, that peat, as a fuel for steam engines, has been proved by actual experiment of great value. To impart to it the power of emitting during combustion a lively flame, a small quantity of tar is mixed with it, which of course creates a larger volume of flame, which is a matter of considerable moment when employed in generating steam. The experiments referred to were made on board of the Great Western during her last passage, and such was the result that a large amount of peat was taken on board for her homeward passage. The introduction of pressing machines, both for the expulsion of water and diminishing the bulk by compression, will be important to all who engage in raising peat.

I see no reason for extending my remarks on the value of this substance. I shall, therefore, state only one more application of this material, viz. as a substitute for charcoal in the reduction of iron. The coal which is formed from it is equal to any coal; hence, it may become of great importance in those sections of country where fuel is scarce, or as it furnishes a resource in this important business, when the ordinary means are expended. We have, therefore, in this homely substance an invaluable article, of which prejudice alone can prevent a general use.

Black Lead. Graphite.

There are several places where this useful substance is found. The most important are situated in Ticonderoga, Crown-Point, East Moriah and Johnsburgh. The graphite of Ticonderaga is well known in market, and has been explored to a greater extent than any other locality in the State. The proprietor of the mine has usually raised it in the autumn in sufficient quantities to meet the demands for it during the next season. The working of the mine is in the rudest manner. As the mineral is in a vein varying in width from 2 or 3 inches to 12 or 15, it was necessary after the surface portion was removed to break away the adjacent rock. This has hitherto been accomplished by heating the sides of the vein and then suddenly cooling them; in this way exfoliation and cracks are produced, and an opportunity furnished to a limited extent of removing portions of the rock adjacent to the graphite.

In this manner the vein has been explored 10 or 15 rods in length, to the depth of twelve feet, in some places. By this mode of procedure the opening downwards has become wedge form, so that it is now difficult to pursue it much farther in that direction. The best part of the lead of this mine is manufactured into pencil points on the spot.

The graphite of Cedar-Point, in East Moriah, has not been explored very extensively, its character was destroyed soon after the mine was opened, in consequence of mixing the oxide of iron with it, to facilitate its passage through the mill in grinding, a mixture which entirely destroys its value for any purpose to which it is ever employed, even for the blacking of stoves.

The locality in Johnsburgh is on the farm of Mr. Noble. The mine is only partially opened, and less than a ton has been raised. It is, however, of a good quality; it occurs in irregular shaped masses of various sizes, and weighing from one to twenty-five pounds. It is associated in a vein of quartz. It occurs in stellate masses similar to that at Ticonderoga. In the vicinity I found perfect hexahedral tables of graphite, which exhibit lines on their broader planes crossing each other at oblique angles, indicating by their direction the system of crystallization to which they belong.

This mineral has occurred in independent masses in the rock and even in the soil. A locality of this kind was discovered in Athol, which contained several tons, the whole of which has been sent to market. Those deposits appear disconnected with a regular vein, and hence they ought always to be carefully examined by persons intending to purchase them for the profit of mining.

Preparation of the Marly and Tertiary Clays.

In agriculture, as in all other kinds of business, many things fall into discredit in consequence of misunderstanding the principle on which their use depends. For instance, the use of plaster on most soils is decidedly beneficial, but there is such a thing as an excessive use of it, and of persevering in its use too long, when its specific effects are imperceptible, and it becomes of no value whatever.

The due preparation of soil is always an essential matter for the production of a good crop, or to produce a favorable result either in an experimental trial of any new variety of grain, or new mode of culture of those ordinarily raised. It is a matter of common observation, that one farmer succeeds well in his crops, while another does not, though

is rapidly exhausted of its nutricious matter, and it is left comparatively barren, if the agriculturist ceases to apply vegetable and animal matter. There remains then but one course, that of supplying directly the necessary nutriment; but it is unquestionably better to maintain a sufficiency of vegetable matter always in the earth, and never suffer a soil to be exhausted or worn out by overtaxing its resources.

HAMILTON COUNTY.

Without entering into details in relation to the geology of Hamilton county, I shall confine my remarks to subjects of a general nature, reserving the more minute relation of its local formations to the future.

This county is underlaid by primitive rocks, with the exception of a narrow strip of the Trenton limestone extending along the Sacanadaga, in the town of Wells. This strip is less than one-fourth of a mile wide, but may be traced with some interruptions for two or three miles. It is a thin stratum, and much broken by partial uplifts. It is filled with organic remains common to the Trenton limestone. It is quite an important rock to the inhabitants, furnishing a cheap and convenient material for lime, and sufficient in quantity for supplying the demands for building, and for agricultural purposes.

The primitive rocks are gneiss, hornblende, primitive limestone and serpentine. These are arranged as in other portions of the district. Gneiss and hornblende are the predominant rocks, while the limestone and serpentine occur in irregular beds, or veins, apparently subordinate to the former. I am led to remark in general, that we find no new arrangements of mineral matter, or new phenomena as regards position; but a continuance or extension of the same as they occur in other portions of the district, thus showing an uniformity in the operation of the laws of nature.

Hamilton county is as yet a wilderness, and consequently we labor under great disadvantages in attempting to explore its mineral riches; should it equal, or even exceed, the other counties of the district in this respect, a full development of them cannot be expected at present.

Contrary to the published accounts, and to common opinions, which are of course formed principally from those accounts, especially from Burr's and Gordon's statistics of this county, I have the pleasure of stating that it is far from being that *wet*, *cold*, *swampy* and *barren* district which it has been represented to be. The soil is generally strong and productive; the mountains are not so elevated and steep but that

the soil is preserved of sufficient thickness to their tops to secure their cultivation, and most of the marshy lands may be reclaimed by ditching; by this means they will become more valuable than the uplands for producing hay. In fine, it will be found an excellent country for grazing, raising stock, and for producing butter and cheese. The strength of the soil is sufficiently tested by the heavy growth of timber, which is principally of hardwood, as beech, maple, yellow birch, butternut and elm. The evergreens, or pines, are confined mostly to the lower ranges of mountains. Some of them are of the largest growth of any in the State, and are suitable for the main shafts of the largest of the cotton mills. In the main the county resembles the mountainous districts of New-England, and like those, produces the same intermixture of forest trees, and has about the same adaptations for the production of the different kinds of grain, as wheat, rye, oats, peas and barley, together with fine crops of potatoes.

The face of the country varies from hilly to mountainous. A low range of mountains cross the county between the town of Wells and Lake Pleasant; the whole width is not far from six miles. This range, in its progress northeastwardly, increases in elevation until it constitutes the highest of the mountain groups in the State, in the towns of Moriah and Keene.

From six to ten miles westwardly from Lake Pleasant, another low range of hills and mountains cross the county parallel to the former, but do not attain an equal elevation. The highest summit of this range is in township No. 19. From these remarks, and from an inspection of the maps, it will be perceived that Hamilton county is situated west and southwest, of the mountainous track in which the most elevated groups occur. Its location in general is more favorable than Essex county, in which those ranges attain their highest elevation.

From the observation of persons who have been residents of the county for a number of years, it appears that the seasons are much the same as it regards heat and cold, the length of the summer, &c. as the mountainous parts of New-England. The incorrect opinions which prevail as it regards its soil and its irreclaimable marshes have arisen undoubtedly from hasty examinations. It is true, that the flys or marshes are numerous, but they are not so wet as to be unproductive, or so sunken as to form nuisances. Where the timber is removed, they produce spontaneously a heavy crop of grass, which is reproduced from year to year without cultivation. Again, the flys are bottomed on a hard clean gra

ceeding in a northwest direction, we soon reach the head waters of Racket lake. It is said that in passing over a very slight elevation or ridge, we come upon a small lake, and following its outlet we may pursue an almost uninterrupted course into Racket lake, and thence into Long lake. It is over this carrying place, between Indian lake and the first lake in the series towards Racket lake, that the Indians are in the habit of travelling, and over which they carry their canoes. The whole carrying distance from Indian to Long lake is six and three-fourths of a mile. The whole course of the route which I have now traced, is one which is feasible for the construction of a canal, and one too which would require but little capital, as there are no high summits to cross, nor heavy falls to encounter, or which would demand a great amount of lockage. But the internal navigation need not end here, for the waters of Racket lake may be connected with those of Moose river, for with scarcely a carrying place, the hunters and fishermen take their boats from the Racket lake into the head waters of Black river. And again, I was informed by a gentleman of Lake Pleasant, that during a visit to Racket lake, a few months previous, he met with two fishermen who came seventy miles in their boats and brought several barrels of salt; and they came the whole distance in their boats from the waters of the Saranac, for the purpose of fishing in Racket lake, from which they carried away seven barrels of lake trout on their return over the same route.

The practicability of uniting the head waters of those streams which flow into the Hudson, Lake Champlain and St. Lawrence, is not doubted by those who have carefully observed the features of the country.

It may be inquired what advantages would result, which could justify an expenditure of capital in a region considered of little value for agricultural purposes.

1st. I will say, that it is not, as has been already intimated, that bleak, barren, desolate tract, which it has been represented to be; but is well adapted to the cultivation of wheat, and suitable for all agricultural purposes, though it is more especially adapted to grazing, and the making of butter and cheese.

2d. This region abounds in the ores of iron, limestone, marble and the usual products of a primitive region.

3d. It would be the means of bringing into market (of which there begins already to be a scarcity,) a vast amount of lumber, which, without facilities of the kind, must be destroyed or wasted on the ground, without benefitting the public extensively.

4th. Inasmuch as communications of some kind must be formed in inhabited districts, the expense of a water conveyance through this region will not be much greater, *in the end*, than an ordinary turnpike; a canal, therefore, might be used as the great thoroughfare, while the minor points would be connected, as usual, by roads.

The above suggestions will appear more important and in their true light, when taken in connection with the proposed rail-ways from the St. Lawrence to Champlain. In case the southern route should be selected, the whole interior of Hamilton and the adjacent counties, to some extent, would be furnished with an easy and direct outlet to market. It is difficult to make an estimate of the number of miles which would be opened at once for batteaux navigation, and which might be opened at a small expense, but it is not extravagant to estimate the distance as equal in length to the Erie canal. There would be opened, also, at least fifty miles of direct steam-boat navigation, by constructing a single lock between Crotched lake and Long lake, and another between the former and Racket lake. The latter is one of great importance, and is much larger than is represented on the maps. It is deeper and more extensive than Long lake. It has several bays which project from the main lake five or six miles; it is probable, therefore, that the amount of water in Racket is double that in Long lake. I have already remarked that the character of the borders of the lakes and streams is well adapted to the easy construction of paths and roads, in consequence of the predominance of hard gravelly bottoms. There is another consideration not to be overlooked, that the whole country being situated upon table land, is not exposed generally to injury by freshets; hence, public works, as embankments, &c. constructed along the rivers and borders of the lakes, will not be liable to excavations by the rapid rise of water; hence, too, the expense for repairs will not constitute a heavy drawback on the profits of the works contemplated. I am sustained in this position by the preservation of the great State road passing through this country, which, though constructed a long time since, has suffered very little in its foundation.

In conclusion, I remark, that whatever may be the present interests of individuals, or the present policy of the State, this region of country cannot remain long unoccupied or unimproved. It would be well, however, if this policy could be settled soon, for landholders would then feel the importance of employing agents to maintain an oversight of their lands. At present, they are exposed to the wanton destruction of trespassers, who for a single cut of a pine, make no more scruple in

The rock dips from each side of the fracture at a very small angle.—Flat rock is more or less a conglomerate, and is generally a coarser sandstone than the variety at Potsdam or Keeseville. It occupies an area of several miles, and presents quite a remarkable aspect. It is covered mostly with low shrubs and whortle bushes, with here and there a solitary tree which has monopolized a little more earth than its humble neighbors.

Economical Productions.

Under this head I shall speak of a few only, and those which are of the most value.

Sandstone for glass.—The sandstone which lies along the borders of this formation and near the primary rock is often of a pure white, it possesses a loose granular texture, which is often increased by weathering, it then passes into a sandy variety. In this state or condition the rock furnishes an important material for glass, and is extensively employed in its manufacture. The most important localities which fell under my own observation were in the township of Mooers. The material is abundant and of the best quality.

Black marble.—A valuable quarry of black marble exists in Chazy, near the lake, and nearly opposite Isle La Motte. It is probably a continuation of the same stratum, which is quarried upon the island. The same stratum, I have observed at other localities. It furnishes a jet black surface, and receives a beautiful polish, and is, altogether a fine production.

The same varieties of the transition marbles are more or less abundant on Valcour's island. It is scarcely necessary to add, that this marble district is capable of furnishing lime to any amount, either for masonry or agriculture. There is one difficulty in raising the limestone, which it is important to bear in mind, viz: the small dip of the rock, or its nearly horizontal position; the expense and difficulty is consequently increased.

Iron ores.—After what has been published in the preceding reports it is scarcely necessary to enter upon a detailed account of the ores of Clinton. It will be sufficient to refer to those reports with this remark, that by far the larger proportion of ore beds exist in the south part of the county, in the neighborhood of Clintonville, Keeseville and in the vicinity of the forks of the Au Sable. There are as many as a dozen beds in this region, some of which are known the world over for the excellence of the iron which they furnish.

One great item of expense which the proprietors of those works have to encounter, is that for transportation of the ore, and of the iron and coal. No relief can be offered to meet or diminish this expense, except the construction of a rail-way. This matter becomes more important every day. The general effect on this region would be the concentration of important establishments at central points along the line of the rail-way; an arrangement which accommodates the public, and is more convenient for those who are engaged in them.

Another variety of iron ore occurs on the head waters of the Saranac. It is the bog ore. Its abundance has not been fully ascertained; but the structure of the county, the nature of the rocks, &c. indicate an abundance of it. Its value for mixing with the harder ores, and also for the production of soft malleable iron, is too well known to require any remarks from me. It is a matter of congratulation to the inhabitants of this truly mining district, that the surrounding country is fertile and productive in the most useful vegetables; so much so that the manufacturing classes must be greatly increased before the country will be unable to furnish the materials for the support of the population.

Changes of the Surface, &c.

The most conspicuous changes which have occurred in Clinton county, and which are confined to the surface, are ridges of pebbles, which have been thrown up by the lake in ancient times. The continuity of those ridges has been broken, and it is difficult to trace them continuously many miles. They are similar to the famous ridge which runs parallel to Lake Ontario, and were probably produced by the same causes, and at the same period. Sand and gravel are raised at the present day by the pressure of ice and the action of waves.

The present existence of those barriers indicate very clearly the former extent of the lake. One of those ridges is crossed by the main road near the village, in Beekmantown. Their general direction is north and south, or nearly parallel with the lake. Theoretical considerations connected with this subject are among the most important in geology. It is not my purpose, however, to present any remarks of this kind at the present time; the subject was partially discussed in my report for last year, under the head of tertiary formations of Essex county.

Remotely connected with phenomena of this nature, is the transportation of rocks, gravel and sand, diluvial scratches, &c. One remarkable instance of transportation fell under my notice on ascending Raven's hill, near Elizabethtown, in the occurrence of boulders of

sandstone near its summit. They were full 2,000 feet above Lake Champlain. They are not numerous, but sufficiently abundant and large to prove unquestionably their transportation by other means than human.

Scratches and diluvial grooves are every where to be seen on the rocks through this whole section of country. Their general course is north and south. The cause of phenomena of this kind seems to be uniformly referred by geologists to currents which in former times have swept over those sections of country where they occur, or to the passage of icebergs loaded with stones and rocks, when it was beneath an ocean. Not only are the flat or horizontal surfaces marked and grooved, but also those which are perpendicular or at right angles to the horizon. Remarkable instances of this latter occur between West-Port and Port-Henry, in Essex county.

WARREN COUNTY.

Warren county is strictly a mountainous district. It is traversed on the southeast corner by the Palmertown range of mountains, and through its eastern portion by the Kayaderosseras range, quite its whole length. Its western side is occupied by the Sacondaga mountains, which are extremely rugged and precipitous. The highest and most remarkable mountain in the county is Crane's mountain, in Johnsburgh. It is upwards of 3,000 feet above the plains of Warrensburgh. Its superior outline is quite remarkable, exhibiting from whatever point it is viewed, a striking resemblance to the human face. This resemblance arises from the remarkable uplifts of the rock of which it is composed. The prospect from the higher class of mountains in Warren county is quite imposing, as from their summits the great ranges of mountains traversing the northern portion of the State, together with the Green mountains of Vermont, are distinctly in view. Crane's mountain, in Johnsburgh, and Harrington's hill, in Warrensburgh, by their position and height, command an extensive field for observation, and are very advantageously located for conducting a trigonometrical survey. The great group of the Adirondacks are very distinctly seen during clear weather from Harrington's hill, almost due north from the observer, together with the remarkable ragged ridge lying to the east, and which passes through township 29, and onward through the eastern border of Keene. The lover of mountain scenery will not fail of visiting Harrington's hill, when in its neighborhood; it is easy to ascend, and in fact a carriage might be driven to its summit.

The geology of Warren county is quite simple. By far the largest portion is gneiss. A part of Queensbury is underlayed by the Trenton limestone. It is found, also, at Caldwell and Bolton, skirting for a few rods in width the border of Lake George. The character and value of this rock has already been spoken of under the head of marble.

Gneiss and hornblende are the predominant rocks; subordinate to them are beds and veins of serpentine, primitive limestone, and a mixture of the two constituting the peculiar marble which has already been noticed. The Kayaderosseras range is composed of gneiss very distinctly characterized. Veins of coarse granite frequently traverse it, and which sometimes spread out into beds of irregular width. It never occurs in masses sufficiently heavy to impart a granitic character to any portion of the county.

The soil of Warren county is sufficiently productive to answer all the ends of the husbandman. It is mostly diluvial, and is made of gravel and loam combined in such proportions as to form a strong soil well adapted to grass and English grain.

The predominance of the diluvial beds gives an interesting character to the whole county. The extent and depth of those beds, together with their frequent occurrence in rounded and conical hills, or their extension in prolonged narrow ridges for miles in extent, give evidence of former agencies which cannot be mistaken. I may here remark, that the lower valleys and those adjacent to the primary rocks, or lying between the transition and primary, present those accumulations of gravel and boulders* into conical hills and waving ridges, far more distinctly than any other sections of the country. In fact, though it would not be proper to say that the primary is bordered by diluvial hills, still this constant occurrence along certain lines, and those mostly which lie along the base of the primitive hills, will arrest the attention of the observer. The particular constituents of those gravel hills merit attention. I found them composed generally of particles of the adjacent rocks. Thus, through the township of Lewis, in Essex county, those hills are made up mostly of particles of the hypersthene rocks, and at least two-thirds of all those accumulations of gravel in the whole northern section are composed of the same materials Hence they have not been brought from a distant region, but have been furnished in the im-

* A remarkable boulder exists in Warrensburgh, near the bridge. It is about 30 feet in height and 80 feet in circumference. It is entirely above the ordinary diluvial of the country. It forms a very remarkable monument of the powerful agencies which were in operation in ancient times.

mediate vicinity of the place where they are now deposited. The tertiary in this county is quite limited, and is confined to the borders of Lake George and the North river. It is the most extensive in Queensbury, and constitutes a valuable section of country; the soil is light and sandy; it is still susceptible of the highest cultivation, and may be made to produce abundant crops.

Primitive Limestone.

Warren county is apparently traversed by a ridge of limestone. Its course is nearly east and west. Its continuity is often broken or interrupted by other rocks. We cannot, therefore, trace it continuously. Still its occurrence in this direction at intervals furnishes proof of the direction in which it has been more generally produced. In this respect those veins or beds are analagous to the greenstone dykes, which are so prevalent in the hypersthene rock. The limestone is generally coarse, and mixed more or less with coccolite and hornblende. Its purity, however, is such that it forms a useful material for lime. I have found it in sufficient abundance in all the towns of the county to meet the wants of the community. It is unnecessary to describe or point out the numerous localities at which it occurs.

A remarkable fact connected with this formation may with propriety be mentioned: it is the occurrence of caves in it in Athol, and, as I have learnt, also in Minerva, in Essex county. Those caves are situate on the North river, about two miles from Warrensburgh. They are from 100 to 150 feet above the river, and as would be conjectured, are evidently produced by water. Their entire extent has never been ascertained. Persons have explored them for upwards of a hundred feet.

The period at which those caves were formed was anterior to the accumulations of the gravel already noticed. This statement is supported by the fact that the openings or mouths are covered by this kind of gravel, and they have generally been discovered in consequence of the falling in of cattle while passing over them. In some instances boulders of rocks foreign to the region are wedged into those openings, and partially close them. They have no other interest than the evidence they furnish of the period when they were produced, and of the agent which was the immediate cause of their production. They contain no remains of organic beings, so far as discoveries have yet been made.

Magnetic Oxide of Iron.

Some important localities of iron ore have been discovered in this county. One in particular on lot No. 80, in Hyde Township. Por-

tions of the ore are mixed with sulphuret of iron, which without roasting and exposure to the atmosphere, would form that variety of iron which is denominated cold short. Much of the bed is free from sulphur, and will undoubtedly form an excellent iron. Beds of iron of this species occur also in the Brant Lake tract. It presents a promising appearance, and is located in a region of wood and water, circumstances quite favorable for its reduction.

Other beds exist in Athol and Luzerne; they furnish a pure oxide, and would, if a demand existed for them, make an excellent iron. The beds of this variety of ore are generally less extensive in the gneiss than those belonging to the hypersthene rock. The latter in the northern region seems to constitute the true ferriferous formation in which the development of this ore is on the largest scale.

Another locality of magnetic iron is found in township No. 16, in the county of Essex. The quality of this bed also appears favorable to the production of good iron. It is an extensive deposit, but cannot become important until some better means of transportation shall be furnished than exists at the present time.

Marl.

An extensive deposit of marl exists in Queensbury. It is on lands owned by Mr. Jenkins, an intelligent farmer, who well knows its worth. It is procured in several marshes in that vicinity, and is generally associated with peat. It is a valuable substance, and well adapted to the soil of that region.

Generally marl is not a product of the northern counties, and there are only a few localities at which it occurs. Ground limestone may be employed as its substitute, though its use is attended with a trifling more expense than marl. Marl, however, is more valuable in itself than limestone, as it generally contains vegetable and animal matter in combination, and its immediate effects are more apparent; it is in a state of minute subdivision, and is duly prepared to become a constituent of the soil.

Having spoken at some length of several substances which occur generally in the northern counties, it will not be expected that those subjects will be resumed again in this connection. Those substances are porcelain clay, feldspar and peat. They are each of them abundant products of this county, but for particulars concerning them I refer the reader to those heads under which they are described.

THIRD ANNUAL REPORT

Of the Geological Survey of the Third District, by Lardner Vanuxem.

Montgomery, Herkimer, Oneida and Oswego, were the counties which formed the subject of the last report. It was in consequence of those counties presenting but few of the attractive valuable mineral products, those which do not enter into the composition or form rock masses, but are the associates of certain rock masses, that it was thought better to adopt a more general plan than the one contemplated at the commencement of the survey.

With few exceptions, all the mineral wealth of the Third District form portions of the great series of rock or geological masses, the right understanding of which requires that the position which each kind holds in the series, should be known. The same reasoning applies to those mineral substances which do not enter into the composition of the series, from making but a small part thereof, but have a determinate place therein; and the same likewise may be said of those products derived from certain materials of the series, and hold a position extraneous to them. Such are calcareous tufa, lake marl, bog-iron, and we may include the products of alluvium likewise.

This blending of the two methods in the annual reports, greatly facilitates the Geologist of each district in the collecting of materials for his final report, being aided not only by his own eyes, but the eyes of his co-associates. For these and other reasons, we shall continue the same plan in the present report.

It cannot be said that any of the counties have been finished or thoroughly examined, for it often happens from the materials which form rocks, having been furnished from different and often opposing geographical points, that a rock which is well developed or forms a thick

in its turn cedes its place in like manner in part to the "millstone grit" and the protean group, causing these two latter masses to occupy the southern half of the area. Whilst the green shale is extending itself through Oneida, other rocks appear which have no existence in Herkimer. These rocks commence between Utica and Rome, and cover the northern side of the area. They appear from under the "millstone grit," and from above the green shale of Herkimer, and of the same rock in the creek to the east of Utica, or in other words, from between the two rocks. These rocks are the shales and green sandstone of Salmon river, and the red sandstone of Oswego; they cover a considerable portion of the north part of Oneida, the greater part of Oswego, and the red sandstone forms the triangle in the northern part of Stirling, in Cayuga, appearing immediately under the "grit."

The further progress of the elevation causes in Madison, another change; the red shale which rests upon the protean group, adds another member to the area. With the exception of the curve from Rome, the entire length of the Erie canal in that county is excavated in the red shale. And the final progression of the elevation in the Third District, causes portions of the gypseous hills of Onondaga and Cayuga, they being the equivalents of the water limes east of Oneida creek, to form as it were portions of the same plain. With the Third District, our observations should end; but a general idea of the whole elevation is required, in order that the report of the salines of Onondaga should be fully understood, and all doubts as to the superposition of the rocks should be removed, which could not be, unless the whole range should be given. Besides it may be said, that no part of the geology of New-York, judging from what has been written, is more obscure than the part we are treating, and its importance requires all the light that can be thrown upon it.

Near the Cayuga lake, the rocks are at their point of greatest depression, and from thence rise, going west. The effect of which is to cause all those rocks which underlie or compose the area or depression to again reappear as an elevation.

Thus the red sandstone of Oswego which covers the triangle in Stirling, Cayuga, which cannot be over 15 feet above Lake Ontario, forms the lower falls of Rochester, rising nearly 100 feet above that level. The red sandstone is followed by the gray sandstone, quarried near the line of the county, between Martville and Hannibalville, and of Hulme's quarry in Stirling, being the "millstone grit" of Oneida, and the "gray

band" of Rochester. The rocks succeeding to the grit, are the green shales, the iron ore beds, the calcareous "fire stones," &c. &c. of the protean group; the whole terminated by its upper member, the concretionary rock of Oneida, which with its immediate associates appear in the low level near Oneida lake, passing thence through the towns of Cicero, Clay, Lysander, Ira, and Victory, in Onondaga and Cayuga, thence onwardly, and finally forming the upper falls of Rochester, the rock of the great excavation of Lockport and the falls of Niagara.

From the information obtained from Mr. Hall, of the geology of the north side of Lake Ontario, we learn that the southern limit of the Birdseye and the Trenton limestone is near Newcastle, opposite to Rochester; and the southern limit of the shales of Salmon river is at Credit river, about fifteen miles west of Toronto; both extending westward in the same direction as in this State. From these facts we are enabled to solve points of the highest importance, and as obscure as were the connection of the series of rocks which form the great south elevation of the Mohawk valley, with those of the middle region and those of the mountain ridge or terrace of Niagara.

Red Sandstone of Oswego.

The red sandstone of Oswego is the lowest rock of the three counties whose examination forms the subject of this report. The counties are, Madison, Onondaga and Cayuga. The red sandstone is only found in Cayuga in the town of Stirling, underlying the north half of the town. It is not to be seen in many places, owing to its alluvial covering. The locality where it is uncovered to the greatest extent, is on Little Sodus creek, at Stirling centre, where it is likewise quarried for building. From the centre it extends along the creek to McFarlane's mill, a mile south. At the centre, a brine spring rises by the side of the creek, through a fissure in the sandstone. There is another spring also near the mill. At both places, salt was made, and of similar quality; both had a sharp taste; that of Stirling centre was highly coloured with iron, which mineral the spring deposits. Care being taken to purify the salt at the mill as to colour, it was white.

The red sandstone is the lowest rock, geologically, of New-York, which contain brine springs of sufficient purity to be manufactured into salt. From the eastern part of Oswego county, to the Niagara river, numerous brine springs are found in this red sandstone.* All the springs in the Third District, which are found in this rock, and there

*See Report of Fourth District.

are several in Oswego, yield the same kind of sharp tasted salt, described as the salt petre taste, and all highly coloured with iron; characters different from the salt of the brine springs which belong to a subsequent deposit, and show a difference of source or contamination from being deposited with a different rock.

Near Little Sodus bay there is another salt spring, which must arise from this rock. It is not far distant from the one described in the first report of this district.

Gray Sandstone of Cayuga.

To the south of the red sandstone, and reposing upon it, is a gray sandstone, the lower part often variegated with the red oxide of iron, and the upper variegated with green shale, resembling a coarse kind of "fret work." This mass for position corresponds with the "mill stone grit" to the east, and the "gray band" to the west. It is quarried in two places. One quarry, owned by Mr. Bentley, on the road between Martville and Hannibalville; the other by Mr. Hulme, and is between Little-Sodus creek and the line of Wayne county.

Protean Group.

The gray sandstone is followed to the south by a series of green shales, with thin layers of sandstone with fucoids, with thin layers of fossiliferous limestone used as firestones, and with the red oxide of iron, the well known products of the protean group. These products are best seen on Little Sodus creek, at Martville, and for about half a mile lower down the creek; also along the south shore of Oneida lake, commencing on the farm of Robert Bushnell, west of Joscelin corners; at the corners, and likewise at Oneida post-office. From thence eastward, from being buried under the alluvial, or more probably washed away, they do not appear until near Verona, excepting on the land of Thomas Donnelly, on the road between Canastota and the State bridge.

The iron, which is the same in kind with the Verona and Westmoreland ore, designated in the report of Dr. Beck as the "lenticular clay iron ore," is found in Cayuga to the south of Hulme's sandstone quarry, on the farm of Peter P. Van Patten. It occurs on and near the surface, fragments being often ploughed up. This bed seems to be the lower, or the Rochester mass, and not the one near the Wolcott furnace, which is the second mass. Iron ore of the same kind is said to be found in the creek near Martville, which I had not time to find, the locality being a secret. I have no doubt that it exists there, for the rock in the bed of the creek at the village, corresponds with the roof of the ore

bed at Wolcott furnace, and the roof of the ore bed worked for the Tayberg, Lenox and Constantia furnaces, near Verona, and will be found between the village and the mill, a half a mile below. No ore has yet been found in Onondaga, the first indication east being in Madison, at Robert Bushnell's, in the loose materials of the bank above his stone quarry on the lake shore; again about three-fourths of a mile beyond, at Joscelin corners, between the road and the lake. It appears to be in two layers, over a foot each, and of pretty good quality. It is exposed along a line nearly horizontal, of several hundred feet in length. This ore, it was said, was taken to Constantia furnace, but no very favorable opinion of it given; probably owing to the specimens having been taken from masses which had for ages rested upon the surface, and had resisted all change, owing to carbonate of lime, which is an associate of this ore, and to which its hardness is principally owing. Had excavations been made, and the softer varieties been chosen, a different opinion would have been given. So far as the eye could determine, I was satisfied that much of the ore which was exposed upon the surface, so far as a judgment from the eye could be formed, seemed to me to be little inferior to the Verona and Westmoreland ore, and fully equal to the ore of the same kind quarried in Pennsylvania, near Danville, on the Susquehannah.*

Indications of the same red ore appear in the bank of the lake, on Mr. Munger's farm, at Oneida Lake post-office.

All the localities on the lake shore are in a right line, but from thence the line in which the ore is found is on a curve, passing to Verona. The ore being on the farm of Thomas Donnelly, in the town of Lenox. It is generally found below the surface about plough deep. Many masses have been thrown up, some lying loose, others piled up. It is in solid masses and in a state of disintegration, colouring the surface of the ground of a blood red. This is the purest kind, the carbonate of lime having been removed by solution in water. The ore covers an area of about 80 or 100 acres, slightly raised above the adjoining allu-

* The ore near Danville corresponds in its fossils with the second bed, that is, Donnelly's in Lennox, Bennett's in Westmoreland, and the bed which once existed above the Tayberg, Constantia and Lenox bed in Verona, which has been destroyed; but the numerous masses and fragments which havo been uncovered in grading the rail-road, show that it had there existed. The common or prominent fossils, are the Strophemena rugosa, Atrypa affinis, Leptæna punctulifera, &c. &c. The encrinal rings with their peculiar rounded edges proving partial solution, are common to the beds of both States, and the characteristic fucoid of the protean group is found just below Danville. The perfect identity of the Pennsylvania and New-York bed show the extent of this thin deposition. It has long been known that the iron ore beds in New-York extended from Herkimer to the Genesee river, and now we know that one of them extends south 160 miles.

vial land on its north, east and west border. The solidity of the ore appears to be the cause of its not having been swept away with its original associates and its superincumbent masses.

From all observations made, it is certain, that there are two distinct beds of red oxide of iron in the protean group, arranged in lines parallel to each other, extending from Herkimer to the Genesee river. These beds are about 25 feet from each other, and from 1 to 2½ feet in thickness. They are not always present in every locality, for sometimes the one and sometimes the other, and even both, are wanting. A circumstance readily conceivable over so great an extent, with masses comparatively thin, where opposing currents both general and partial may have existed, and where the surface over which the iron was floated may not have been level.

It has happened, no doubt, frequently, that the surface over which the iron was floated admitted of its fine particles to escape, that is, to be absorbed by the floor upon which it was deposited. In this way we can explain the stains of iron upon the shales of Little Sodus bay, and of the mill at Martville, &c. &c. A whole bed could not disappear unless passing over coarse sand, for the grains of which the greater part of the ore consists, must have been formed at the point of Thermal action.

The concretionary limestone and its blue shale, as was made known in the second report, terminate this group. The limestone is first met with on the farms of Mr. Hood and Capt. Adams, south of Donnelly's ore bed. The shale and a more compact kind of limestone, were thrown out in digging a well between Donnelly's and the concretionary rock. Near to Joscelin's corners, on the farm of Enos Hubbard, it is burned for lime; so also in most of the towns of the Third District through which it passes. This limestone is readily known by its well defined characters, and is readily traced by its numerous quarries opened in the towns of Cicero, Lysander, Ira and Victory, all which are arranged in nearly an east and west line.

In some of the quarries of the limestone there are small geodes whose sides are lined with crystals of carbonate of lime as at Lockport; in others, but more rarely, the limestone encloses globuliform masses of pure white gypsum, and in others we find that singular concretionary rock which forms the upper part of the Lockport and Niagara limestone, being the terminal mass in the Third District, and from which its name was in part derived. In the upper part of the concretionary limestone, oolite is often found, showing that some of its particles were subjected

to the same cause which gave rise to this appearance common to the iron ore of the group.

Of the fossils of this rock, there are two which have been found only in this rock. The Orthis bicostata is abundant, occuring in Oneida, Onondaga and Cayuga. The other is the Pterinea gibbosa, which is not common or abundant.

Red Shale and the Water Limes of Herkimer and Oneida,

which we shall call in this report, the *saliferous group of Onondaga.*

This group comprises four deposits, between which there are no well defined lines of division, but for practical purposes, the divisions are obvious enough.

The first or lowest is the red shale; 2d. The lower gypseous shales, the lower part intermixed with the red shale, the red shale ceasing entirely with this mass; 3d. The gypseous deposit, which embraces the great masses quarried for plaster, the hopper shaped cavities, the "vermicular limerock" of Eaton, and other porous rocks; and 4th, and lastly. Those rocks which abound in groups of needle form cavities, placed side by side, caused by the crystallization of sulphate of magnesia, which may, from that circumstance, be called the magnesian deposit.

These masses occur from the eastern part of Madison to the extreme western limit of the Third District.

The whole of the group, leaving out its gypseous and magnesian constituents, may be stated generally, to be of argillaceous materials, meaning thereby, silex and alumine in the state of indurated clay, and of carbonate of lime. The former abounding in the lower or red shale mass, diminishing upwards, whilst the carbonate of lime which is but perceptible in the lower part, increases and is in great excess towards the upper part.

From the limestone of the protean group, we pass, going south by a few thin beds of alternating green and red shale, and a thin bed of hard green sandstone, to the great mass of the red shale. At least such are the results of observation throughout the counties of Herkimer and Oneida, where these masses are presented in the wall of the great elevation, and we have no reason to believe that any change has taken place, other than a thickening or thinning of some of the lower beds, not

knowing as yet with certainty the direction from whence the whole of the materials of those beds were derived.

That the red shale increases in thickness going east from Herkimer, is certain; but the point of its greatest thickness is not ascertained. The boring now in progress at Salina may furnish information that will determine it.

The red shale forms the base or lowest mass of the salt springs found along the course of the Erie canal, in the Third District, and has often been confounded with the red sandstone of Oswego, and its prolongation the sandstone of Rochester and Niagara. The two rocks have no connection with each other, being separated by the protean group, nor resemblance, excepting that the same ferruginous material colours them both, and both are connected with saliferous sources.

With the exception of the curve which the Erie canal makes in its entrance into Madison from Rome, its whole course in that county has been excavated in the red shale. From the canal pursuing a more southern route in Cayuga, and from the dipping of the red shale to the southwest, we find that only in a few places in Onondaga, where the canal curves to the north, that it traverses the red shale. These points are its entrance from Madison towards Kirkville, the curve at Bellisle, and the great curve which passes by Canton to Jordan. Near to Jordan, the red shale is exposed on both sides of the canal for a mile or more.

The red shale, with its green spots, noticed in the report of last year as existing to the east of Vernon Centre, is well exposed in the road leading to Oneida Castle.

The same variety exists at Salina on the north side of the canal on the road to Liverpool. Likewise at Baldwinsville, the canal there being excavated in this kind of red shale. The green spots frequently present a nucleus in the centre. When examined by the microscope, the green spots exhibit points which seem to be iron in a lower state of oxidation. Some of the shale is mottled or marbled, some hard, but all the different kinds here as in other parts of the district, speedily crumble by exposure to atmospheric agents.

A boring in the red shale, made by Seth Hunt, for salt water, near to the salt spring noticed by Dr. Beck, at Lenox, on the land of Capt. Clark, presents several important facts. The depth attained was 196 feet, 190 in red shale, and 6 feet in hard green sandstone, which took

several days to bore the six feet. When the boring commenced, the saltness by the instrument used was 21°, and towards the close 9°. No stream of water was met with. It was abandoned on account of the breaking of the auger, which could not be extracted. This information was communicated by Capt. Clark.

This boring proves that the red shale increases greatly in thickness in its progress west from Herkimer. So far as judgment could be formed from the eye, supposing the dip not to be great, its thickness at Lenox could not be less than about 400 feet. The boring exists in a depression to the north of the canal; the hills to the south of it, which are of red shale, are about 200, giving a total thickness of nearly 400 feet.

The red shale, though of great extent, traversing the counties of Herkimer, Oneida, Madison, Onondaga and Cayuga, of the Third District, presenting a thickness of from 1 to 400 feet, yet no where has a fossil been discovered in it, or a pebble, that I am aware of, or any thing extraneous, excepting a few thin layers of sandstone, and its different coloured shales.

Second Deposit.

It was mentioned in the second report of this district, that the upper part of the red shale was far more varied than the lower part, owing to its layers or beds intermixing or alternating with those of the mass above. On the road towards Lenox from Clockville, near the turnpike, there is one of the best localities for the observance of the various alternation of the different coloured shales. Thus we have at top of the mass in descending by the road, the green, then red below it, green, red, blue, green and yellow, this latter by exposure to the air; then red and green in thin layers, being several repetitions, and finally red the lowest visible mass.

This second deposit seems to be very variable as to the colour of its shales. In some red predominates, in others the green, bluish and gray, and in some the red is wanting altogether. In this deposit, gypsum frequently occurs in fibrous masses, either reddish or of a salmon colour; colours peculiar to this deposit. The quantity of gypsum in this deposit seems to be limited; all the quarries I saw belonged to the third deposit. It is in recent excavations that we have the best opportunity of examining the product of this mass, in consequence of the ready alteration which some of the shales undergo by exposure to the air.

Near to Sodom lake, on the rise of a hill about 50 feet above the canal, and on the road from the foot of the lake to Manlius Centre, Eliakim Smith had commenced a large well for water in this mass. The rock passed through gray and greenish marl, with white and red fibrous gypsum. All the products thrown out were like those which I saw in the digging for salt water in the salt valley near Abingdon, Virginia. The same products, too, were obtained in another well about 55 feet deep, on the road to Orville, about a mile east of Syracuse, and are observable likewise in the road descending to Orville from the latter village.

The second and third deposits of the saliferous group of Onondaga have a common character, that of being exceeding permeable to water. This fluid cannot be obtained on any of the hills composed of either mass where the well sinks into them, unless sunk to the level of the water courses; a fact which readily explains the absence of all brine springs above the water level of the country.

Though I dilligently sought for fossils, knowing, from twenty years' experience, that their importance was paramount in Geology, yet it was only in one spot that I succeeded in discovering some. They were a Cytherina, about half the size of those found in the upper and lower groups. They occur in a thin layer of "calciferous slate" of Professor Eaton, those thin drab-coloured layers which make up so large a portion of the third deposit, and the upper part of the second deposit. The locality is near the top of a hill going by the south side of the canal from Jordan to Peru. In descending the hill towards the lower part, repeated alternations of red and green shales occur, characteristic of the union of the first and second deposits.

Third, or Gypseous Deposit.

This is the most valuable mineral deposit of the Third District, and the most important, not only on account of its "plaster beds," but because it is only in this deposit that we have positive evidence that *salt* has existed in this group in a solid state; and that it is the only known source from whence the brine springs of Onondaga and Cayuga could have been derived.

Besides those primary products, gypsum and salt, there are others but of little comparative importance, excepting to those to whom a knowledge of proximate geological causes is a predominant feeling. These products are the "vermicular rock" of Prof. Eaton and other

analogous ones. These products throw the greatest light upon the origin of the saline materials of the group, and of the whole group we would say, were this not a practical report. These products furnish a series of facts, when well considered, will contribute more towards connecting those causes called volcanic action, now in operation, with similar causes, which must have existed and operated from the time that there was a solid crust, but operating with materials differing from those now generally used, would produce different products, and the greater the difference of material, and the greater the difference of age from causes hereafter to be mentioned, the greater would be the difference in the products; and hence the great difficulty of recognizing the products of volcanic action beyond a limited period.

That difference of age causes the products of volcanic action to be different, is evident in the ancient province of Auvergne, in France. There there are three distinct eras or ages of volcanic action, each different from the other. The first or oldest, formed of porphyries and other feldspathic rock; the second of basalts; the third and last of "gray lavas." This latter kind alone in currents and connected with craters. When, too, we bear in mind that the state of the earth's surface was wonderfully different from which it now is, and at no very remote period; nay, that even in comparatively recent times, "the mountains were brought forth," we are not surprised that we so quickly find ourselves at fault when we endeavor to extend our actual knowledge of known volcanic action beyond the tertiary periods.

The great mass which encloses the "gypsum beds," is the "calciferous slate" of Prof. Eaton, a name which he had likewise applied to a somewhat similar, but high fossiliferous deposit which is placed between the layers which contain the iron ore beds and the concretionary or Lockport limestone mass. The two slates so different from each other were considered to be one and the same; nor need we wonder at their union, since few are the observers that have not fallen into a like error. These "slates" of the gypseous beds, bear a strong resemblance in their drab colour, the thinness of their layers, by their composition of carbonate of lime and argillaceous matter with the deposits which form the plains of the table lands of Mexico, and the saline materials of both point to causes of a like nature.

The gypsum in no part of the Third District form layers or beds; on the contrary, it occurs in insulated masses, as though the particles of each mass had been attracted by a common centre, but greatly modified by disturbing causes. There seems to be two distinct ranges of "plas-

On the top of the hill to the right, going to Clockville, are the "plaster beds" of Mr. Brown, about a mile and a quarter from Clockville. The quarries present a range of detached masses more or less round upon the top, but generally smaller and with a flat surface below. The whole of the gypsum is enclosed in the usual thin layers of dark brownish, and apparently a much altered rock. Above the gypsum are a few of those which immediately overlie it, exhibiting the hopper shaped cavities, and the porous or "vermicular" rock, but all in no great quantity, some of the plaster masses being at no great depth below the soil.

The plaster hills range from east to west through the county, extending south of the turnpike for above three miles. The hills are more or less round, rendering some portions of their plaster accessible, the layers in which the masses exist having but a slight inclination.

In Onondaga there are some appearances of working for plaster at the north ends of the hills at Hartsville, and L. H. Roach works a plaster bed in the village. He remarked that there were as many as three courses of plaster. I saw no hoppers or porous rock in his quarry, but there were fragments amongst the rubbish around.

Further west on the turnpike towards Syracuse, are the quarries of Groves and Everson. Besides these quarries in Manlius, are those of Balsley, Potter and King.

In the town of De Witt we have the quarries of Dunlap, Brewster, Wilcox, Burks, Dr. Smith, Edwards, Hurd, Reals, Rumley, and of Hungerford. This latter exhibits the best gypsum that I saw in Onondaga. It belongs, I should judge, to the upper range; it has no porous rock, and was followed about 12 feet above by the terminal mass of the group. This quarry presents a fine arching over the gypsum, the elevation being considerable, and the arch unbroken. This elevation of the layers is an unerring guide in the search for gypsum; it exists in no part of the range without a plaster mass being under it. Hungerford's quarry is about a mile or two below Jamesville, on the road to Orville.

After leaving the town of De Witt, there are few plaster beds that are opened to the west in Onondaga. The greatest quantity that is regularly quarried is by the rail-road that goes to Split rock. The next that I saw was that of Mr. Hunt's to the southwest of Syracuse, near Onondaga valley.

The greatest exposition of plaster is along the Nine Mile creek from Camillus to a mile or two beyond the great embankment. The plaster beds were laid open by the grading of the rail-road from Syracuse to Auburn. Here the dark coloured mass which encloses the lowest range can be well observed for some distance; also the hopper cavities which are above that mass; they are followed by gypsum, and lastly the porous or "vermicular rock," forms the upper part of the whole. This latter is four feet thick.

Throughout the three counties where plaster exists, I have no reason to believe that it is more abundant in one part than in another part, the difference being merely apparent arising from the greater ease of extraction, caused by denudation, which by removing the superincumbent portions, admitted also of less accumulation of rubbish upon the hill sides.

Some idea of the quantity of plaster which the region contains, may be formed by the report of the engineer of the Syracuse rail-road, Mr. Edwin F. Johnson, dated June, 1837. The whole of the plaster was obtained from the hill side going from Camillus to Auburn, and to that period "about 40,000 tons had been obtained, estimated to be worth, in the aggregate, $35,000." Mr. Johnson further remarks, "that the location of the rail-road is such, that the gypsum is exposed at various points in the excavations for the distance of five or six miles. In some places the bed of the rail-road is composed entirely of that material."

Very little plaster is quarried between Nine Mile creek and Owasco river, and no quarry opened in Elbridge or Brutus that I could hear of. In the town of Mentz, about one and a half miles below Troopsville on the Owasco, is a quarry belonging to Mr. N. Marble, of Port Byron. It belongs to the upper range, and this is the last excavation for gypsum before reaching the quarries at Cayuga bridge.

Gypsum is abundant at Cayuga bridge; but one quarry worked, that of Mr. Williard. Mr. Titus has opened a bed a little north of the road, but has not proceeded further.

The beds at the bridge all seem to belong to the upper mass; they are wanting in the hoppers, in the "vermicular rock," the want of arching in the layers above the plaster, and they are accompanied by a class of cavities which I have only observed in those masses which hold the highest geological position in the third deposit.

South of Cayuga bridge, and about two miles north of Union spring, and near the lake shore, are the five plaster quarries of Richardson, Par-

gregate." Within the layer of 8 inches, are two others more compact, of about an inch thick. These have been broken in many places, so that the parts no longer hold their original parallels, the enveloping part showing but few signs of disturbance.

In the material which covers the gypsum of the upper range, the arching is but perceptible, owing to its soft nature, whilst in the lower range the arching is common, and formed of harder, fine grained and a compact material. A considerable portion of all the arches resemble in fracture the material of which the porous rock is composed. These facts show that a hardening or consolidation of the matter of the arching took place before the gypsum wholly separated from the mass in which it must have been diffused, or, in other words, before it acquired the form in which we find it. On the contrary, where the arching does not exist, the particles which compose it, when pressed upon by the forming plaster, would have retired to the place of the least resistance, as is instanced in the material which encloses the two thin layers in the eight inch bed of the water lime of Chittenango.

There are two localities in which the porous rock is found in greater thickness than elsewhere met with, and merit examination from the connection with the immediate salt region.

The one is on the road from Amboy and Bellisle to the turnpike, a few miles west of Syracuse, immediately back of the tavern, and in the rise to the top of the hill. The other is on the Footsheet road, ascending from Syracuse to Mr. Jeptha Colvins.

At the first locality, towards the bottom of the hill, there are about twenty feet of these dark porous layers, and of configurations frequently met with elsewhere, probably belonging wholly to common salt or else to sulphate of lime, not having yet determined. To these others succeed, and then those with vertical fissures, with a few small thin shelled bivalves, similar to those of Bull's quarry, also a few small fucoides. The terminal mass is the "vermicular rock," from four to five feet thick.

The locality near Syracuse is of greater interest, for besides the two porous masses of the hill to the west, there exist at no great distance below the upper porous rock, a series of highly crystalline aggregates, wholly different from every product yet met with in the Third District, if we except the dykes noticed in the last report, and a few thin ones yet to be mentioned, which are found near Ludlowville, above half a mile east of the village. The description of these crystalline rocks,

should time admit, will be given as an appendix to the report. For the present we add the note which was made in passing up to the top of the hill. The first product met with is the gravel of the second alluvial. This is followed by the red earth, and which always forms the third or upper alluvial. Beyond these, in rising, is the drab coloured slaty rock, the first seen. The next resembles the usual envelope of the lower plaster. To this about 20 feet of layers, with small pores, succeeds, and then an interval from depth of soil for some distance takes place, and then again the rock masses which compose the upper part of the hill. The first is a marly shale. Then mixtures with more carbonate of lime, some compact, some crystalline, confused, aggregated, and presenting cavities lined with crystals of that mineral, and containing also sulphate of strontian in the mass and in the cavities. With these and above these, are other aggregates like serpentine, marble, &c. with purplish shale, or slate which are followed by a green and blackish trap-like rock, as to appearance, but too soft for that rock. After this, that is above it, is the mass which resembles the material which forms the arch of the lower beds of plaster, and this is covered by the upper porous or " vermicular rock."

Magnesian Deposit.

This deposit terminates the group. It appears to be a thick series of what is probably a magnesian limestone. Usual colour is of a brownish drab, and also dove, breaking with rather an earthy fracture. Its great characteristic, and which will suffice for the present report, is its fibrous cavities, caused by the crystallization of sulphate of magnesia, as we fully proved in the last report. These cavities are very numerous in the series, and in every locality where they are found show that they follow the gypseous masses. The most numerous are found at Hungerford's plaster quarry, and also by the rail-road just below Split rock quarry, near Syracuse. Likewise near the upper plaster quarries, on Cayuga lake, the mill at Troopsville, &c. &c.

The cavities in this series are more frequently found in a vertical position, like veins, than in an horizontal one, as is usually the case. The cause seems to be, the existence of imperceptible cracks, by which water has had access to the rock, and the salt has crystallized in accordance with the direction taken by this fluid. This opinion is confirmed by the facility which the rock breaks with more or less even surface in the vertical direction, and by toughness and unevenness in the horizontal one. The cavities strongly contrast with the rock, from thin lining of coaly matter.

were not derived from the alluvial is certain; that they were derived from the shales in which the borings were made, there is not one fact to prove.

The proof of saline waters, existing in alluvial materials, being established, and to the depth of 160 feet, as in the Syracuse well, we have now to show that such depressions did exist in this ancient area; for though the fact of the existence of alluvial at such depth is proof sufficient to those well acquainted with the subject, yet we know it is not to those to whom geology is yet a novelty. This proof exists, for we believe that there is no fact, to which a key is not to be found.

Lake Sodom.

This lake was examined by Dr. Wright, Dr. Beck, and myself. It is small, singular in all respects, and merits a better name. It is about one and a half miles east, of Manlius centre, and a few rods south of the canal, the waters of which are about five feet above those of the lake.

The lake is excavated in the second deposit, and in the red shale. Its sides and bottom are covered with lake marl. The trees that have fallen into it are whitened by it. The shore on all sides shelving to a depth of 20 feet at the distance of a few yards. The water is remarkably transparent, and of the greenish tint common to such waters. In proceeding up the outlet from the canal, which is narrow, and about a half a mile in length, you enter the main body of water, and by removing a short distance either side, so as to lose sight of the outlet, the lake then assumes the form of a circular pool as regular as if scooped by the hand of man. It has the appearance of having been caused by a whirlpool of great magnitude.

This lake was sounded in many places. The outlet gave from 25 to 80 feet of depth; and the pool, where the circle commenced, beginning near the outlet, gave from thence to the centre, from 104 to 168 feet in depth. The bottom was of blackish coloured marl, the lead sinking a foot or more into it. The water, near the bottom, we found to be highly charged with sulphuretted hydrogen, but contained no saline matter that was perceptible to the taste. There is another lake rather smaller which we did not visit which is connected with Sodom lake by a small outlet which is only visible when opposite to it. Sodom lake is 44 feet above the level of Onondaga lake. Its depth to the marl, at its bottom 168 feet; leaves 124 feet. What the thickness of marl is, cannot be conjectured; but this depth proves the existence of a deep depres-

sion below the surface of the area, and in the lower part of the saliferous group of Onondaga. When we consider that Sodom lake is wholly unconnected with any of the present or ancient water courses, we should expect a less erosive action than where a connection with such existed.

Onondaga lake is but the extension of the vally which lies south, and the Onondaga valley, like every valley north, is connected with a valley which lies south, and reciprocally every valley south has its northern valley, and whether you rise towards the point where the waters divide, either from the south or the north, you find that the sides of the valley lose but little of their elevation, thereby proving the existence of a more ancient valley, and anterior to the cause which formed the double plane which they present. This view is given to show that great and mighty changes, but simply wrought, have taken place upon the elevations of the Third District, which should lessen our surprise for changes of a like kind upon a depression; when a cause of erosion existed upon those heights; one of which outlets was by Onondaga lake.

Looking over the surface of Onondaga lake we find it encircled by a white margin, which when examined, shows that it is formed of lake marl, the part exposed to the air being in a state of aggregation, which gives it the appearance of tufa, but in gravel-like fragments. With the exception of the hills at Geddes, Salina and Liverpool, the margin of the lake lies very little below the general surface of the country.—These hills show by their composition that they are the remains of the ancient sides of the valley, being formed of the masses which belong to the saliferous group.

The proof being ample, of the existence of a deep excavation where Onondaga lake is seated, and the same excavation being filled, in part, with alluvial materials containing salt water, nothing more is required for a right understanding of this reservoir, than an impermeable covering to prevent the union of the salt water of the alluvial with the fresh water of the lake. The salt water often rising in its reservoir and flowing over its limits to the lake. This covering is the lake marl; it is coextensive with the whole border of the lake, extending inwards until lost to the eye, but met with in every sounding that was made, only sullied by vegetable or argillaceous matter in the deeper parts of the lake. In all the borings for salt water this marl is constantly traversed, unless the boring is in the original mass or rock. Its thickness is about six feet, and highly adhesive or tenacious in its character. No material for insulation could be better, and seems to me to fully explain

the separation of the saline waters which it covers, from the waters of the lake, to which it forms the bottom of the basin.

In order to ascertain the depth of the lake, the kind of water which exists at the bottom of the lake, and the nature of the bottom, Dr. Beck and myself made an excursion thereon. We found that the greatest depth was opposite to Liverpool, about midway between the west shore and that place; it was 65 feet. The water obtained from that depth was just as fresh or pure as at the surface. We found that the water gradually deepened from both sides of the lake, less gradually, however, on the western shore than the east shore. To about fifteen feet from either shore we found the marl was white, but beyond it was of an ash colour, and also blackish blue, the lead sinking into it for many inches. Where the waters from Nine Mile creek enter the lake, as we supposed, the water deepened from 10 feet on both sides to 25 and 28 feet in the inlet.

The boring which was commenced in the summer at Salina, by authority of the Lagislature, in the hope of obtaining rock salt, or a stronger brine than any yet discovered, is near its completion. It gives negative knowledge as to the object for which it was undertaken, but some valuable facts for the history of the salines of Onondaga. The facts are confirmatory of all that we have advanced. It was evident that rock salt could not be obtained where the boring was commenced, because it was at least 100 feet below the porous rocks and the position of the hopper cavities, the only position where salt, from observation, could be expected to exist. With respect to salt water, it was too near the line of the shore of the ancient excavation, to calculate that any great depth of alluvial could be obtained, and without which no greater strength of brine could be expected, unless the red shale deposit was in connection with the deepest alluvial, which the deep boring at Liverpool negatives.

At my last visit to Salina, the boring had attained 85 feet, 62 of which in small gravel with earth, large gravel with fragments of 2 or 3 inches diameter, more or less water worn, consisting of granite, hard gneiss, red and gray sandstone, black limestone and a piece or two of the porous rock The last 8 feet was what is called hard-pan, being clay and stones cemented, under which

at 62 feet, red shale yielding at

72 " small veins of salt water from a porous rock.

76 " bluish shale, forming a tenacious clay, in which the boring continued to

85 " when I left Salina. Since then I have received eleven spe-

cimens of the borings from Judge Allen, the inspector of the salines, and also the following account of the continuation of the boring. On the 13th Nov. the Judge writes, "We have drilled 435 feet. Temperature now 55°, (water) very little brackish."

"At about 260 feet from the surface we struck a red rock much of the colour and hardness of red chalk, and it has continued the same until now."

"At 88 to 98 feet below the surface the red shale had a singular appearance. A German who called there, and professed to be a mineralogist, told the workmen it contained mercury."

"At about 150 feet from the surface there is some substance which produces a curious effect on the drill poles. When first drawn up they look as though dipped in butter-milk; when exposed to the air they become encrusted with a red scale. About 60 feet of the rods are encrusted in this way."

The 28th December the Judge again writes: "We are now 531 feet, with little variation since I wrote you; in short, since about 270 feet the same red rock continues, with the exception now and then of a foot or two of green shale."

The specimens received from Judge Allen, arranged in the order of their distance from the surface, are as follows:

G, from 88 to 98 feet. This is in colour a brown fawn, particles almost impalpable to the touch. It is not likely to contain mercury, for there is no ore of that metal which resembles it, and mercury is found in a less ancient position, being of the age of the coal formation.

A, about 100 feet from the surface; 7 feet thick, of a blue ash colour, and slightly effervesces with an acid.

K, from 129 to 278 feet; three varieties, all slightly effervesce, one earthy and of a gray pearl; another in fragments of a similar colour, but in layers; the third kind in fragments; but with a reddish colour.

D, 290 feet; layer 3 feet thick, in fragments of blue or green shale, compact and hard.

E, 297 feet; 30 feet thick, hard dark brown red shale, with some grains of quartz sand.

F, 356 feet; soft red shale, no fragments, all paste, and very adhesive; the last four days cut 8 feet in 24 hours.

H, 364 feet; red shale, fine in its powder, very adhesive.

J, 370 feet; red shale, very adhesive, adhering to the drill in the shape of a plug.

M, 446 feet; red shale, same as above, to appearance. The progress of boring in this shale was 5 feet in 24 hours. These red shales appear to contain very little brine; in some, no perceptible effervescence.

In the same letter, there is an account of the boring of another well, which is as follows: "We began a well in October, near the present well in Syracuse, being about the middle of the valley, and in the margin of the creek.

"The first 8 feet clay and marl; then gravel cemented slightly together, to about 97 feet; from that depth to 115 feet, mostly sand, mixed with the same kind of gravel, and from thence the gravel has been coarser, and but little sand to the present bottom, being 136 feet.

"The gravel is blue limestone, red sandstone, white sandstone, some small pieces of blue shale, very few red, granite and hornblende rock.

"The greater part of the gravel is blue and black limestone pebbles, of an inch or two in diameter, and larger pieces of gray limestone, from one pound to four and five.

"The water is now 60°; we expect to go about 20 feet more, say 160 feet, and hope to get water at 64°."

This boring shows that it is in the alluvial of the excavation, whilst the first or deep boring passes through the same alluvial, and extends towards the bottom of the red shale. Should the red shale be near its termination, then the rocks of the protean group will be reached before the 600 feet of boring will be attained; a fact of no small importance to those who have no faith in geological principles, confidence ending where sight cannot reach.

One boring yet remains to be noticed, that of Major Byington. It was at the top of the hill which rises in Salina, and extends south, passing Syracuse to the east. The boring was near to the Sink Hole, described by Dr. Beck, and not far also from the road where the porous rock may be seen. The boring, with its well, which latter was first dug,

were 370 feet deep. The first mass passed through was alluvial; this was 40 feet thick; then plaster rock 50 feet, after which the boring passed through alternations of greenish, bluish, and red shale layers; the order not remembered by the Major. The borings by drying in the sun, gave an effloresence of salt, but the discontinuance of the work proved that it afforded no encouragement to a further prosecution. The hill where the boring was made is 220 feet above the lake, consequently leaving 150 feet of excavation below the lake.

With an observation or two, we shall terminate all that we wish to say in this report of the brine reservoirs of Onondaga. From all the borings which have been made in the rock, if we except those of Geddes, it does not appear that they afforded any workable or profitable quantity of brine, and I am disposed from that circumstance to believe that such would be the case with the wells at Geddes, were they insulated from the alluvial.

Finally; theory, or in other words, conclusions from facts, prove that the deeper the wells are sunk into the alluvial, all other circumstances being the same, the stronger the water. As the deepest alluvial must be where the excavation was deepest, this point or place must be first determined when stronger brine shall be needed.

The whole of our observations show that we are not to seek for salt or the source of the brine where we now find its waters, but to seek it where it had existence, and where it has been recognized by all who have seen the hopper cavities and know their origin. They may be considered to be too few for so great a source as we have presented to us at Onondaga, but it does not follow because we see comparatively so few, that there are not localities where they were and are more numerous. Were it otherwise, we should vainly look for rock salt, since no trace of its existence in the district has met the eye of any one. Moreover, we must not lose sight of the porous or "vermicular rock," which is far more abundant than the hopper cavities. I do not for a moment suppose that the pores were formed by the salt, for we are without proof of the kind. I adopt the received opinion that they are caused by gaseous or vaporous matter, but I can readily conceive that on the removal of the elastic force that gives rise to the pores, the salt, in obedience to a common law of crystallization, would take to the cavities from offering no resistance. Besides, we must not overlook the fact, that though the cavities of all kinds in any one locality be not great, the deposit which extends south, east and west, is to a great ex-

In the first or lowest deposit, the red shale, we have the red oxide of iron, the least soluble material which characterizes the group. In the second and third deposit, we have the gypsum, which is next in order as to difficulty of solution; between the two upper ranges of this substance, we find the common salt or its hopper cavities where obviously it should be; and lastly the sulphate of magnesia, the most soluble of the four products, appears only in the terminal deposit.

Those who wish to see a practical illustration of the order in which the characteristics of the group separate from each other, will find it on visiting the salt pans where evaporation is carried on by solar heat. There he will find that the first deposit is the red oxide of iron, the second the gypsum, the third the common salt in its form of hoppers, or reversed pyramids, composed of little cubes, and on enquiry he will learn that the magnesia salt remains in solution.

We would also recommend a visit to Mr. Green's salt pans at Salina, where the boiling of brine is carried on in close vessels. There will be seen many products as to form, which are occasionally met with in the New-York rocks, and to which I have ascribed a thermal origin, such as oolite varying from the finest to the largest as in pisolite; also concretions of other kinds, fragments formed of thin layers that have been broken up and cemented together like to those we find in portions of the lower layers of the "calciferous sandrock," and also in the concretionary limestone which forms the base of the saliferous group.

Water Lime.

The water lime group of Manlius, is the next series as to age; it rests upon the saliferous group, and in all cases where a regular denudation has taken place, it is only to be found south of the gypseous range, being the overlying mass. The group is exceedingly well characterized by its fossils, of which some are extremely numerous, and are found from the Hudson to Cayuga lake. With but one exception, the whole of the water lime which is burnt for cement in Madison, Onondaga and Cayuga, is from this group; and the greater part of the limestone which is converted into lime along the same range, is obtained from it.

With this group, all the drab or light yellowish coloured limestones so common, and which gives character to the group below it cease, and with it is the beginning of the usual kinds of blue, gray and black limestone, which exist so abundantly above, and whose range is so extensive east and west

The upper layers of the group are from 3 to 4 feet thick, sometimes subdivided into what are called courses. There are but two layers of water lime separated by bluish black limestone, which is generally disposed to separate into courses, whilst the layer of limestone which is above the upper water lime is broken up by lines of fracture, in all directions. This is the layer which is most commonly burnt for lime. In general, the upper layer of water lime requires less heat from being of a less dense nature than the lower layer.

From the eastern end of Madison county, extending east through the Third District, there is a series of limestone layers which are not found beyond that boundary to the west. These layers are characterized by the Pentamerus knightii, Euomphalus profundus, Delthyris pachyoptera, D. macrapleura, Apiocrinites, &c. &c. and have not been seen west of the falls of Oneida creek.

These layers are followed to the east by a series of argillaceous layers full of that singular marine plant, the fucoides canda galli.

The omission or absence of these two series to the west, causes the next series of layers to repose immediately upon the water lime group. This is the white sandstone noticed on the hill at the falls of Oriskany, and for the present may be called the Oriskany sandstone. This sandstone is well known to extend over many of the States, occupying, like all geological masses, a fixed position in the whole series, but is exceedingly variable as to thickness. According to the report of the State geologist of Pennsylvania, it is there 700 feet thick. At Oriskany falls. about 20 feet on the road from Elbridge to Skaneateles, it is over 30 feet. At the quarries near Auburn, it is from a few inches to about 2½ feet; and at Split-Rock, near Syracuse, it shows itself in some parts by a mere sprinkling of sand, observable on the bottom of the layer which covers it, and in other parts by a thickness of about six inches.

This sandstone is the rock of which the lock at Jordan, not Lyons, was constructed. It was quarried on the road from Skaneateles, which goes by the east side of the outlet towards Weedsport. The lower part of the sandstone abounds in fossil shells remarkable for their great size. Most of them, if not all, are found in the gray sparry crinoidal limestone, which rests immediately upon the sandstone, and so far as I have had time to attend to their examinations, seem to be confined to the two rocks.

occur in short, interrupted layers that are local, being subordinates of the slaty shale rocks which commence from the Seneca limestone. This limestone I did not see at Auburn; the alluvial and village covering the space between the cornitiferous and the black slaty shale or " pyritiferous slate."

The Seneca limestone, I first met with in Seneca county; it is there separate from all other masses of limestone, and could be confounded with no other; hence its name.

This limestone contains but few species of fossil shells, one of which I have only seen in this rock. Another, the Strophomena lineata, I do not remember to have met with in any rocks below, and is highly characteristic of this limestone; for though it is found in the shales, which are several hundred feet above it, yet it rarely occurs in any of the limestones; and in some localities of the Seneca, the individuals are so numerous as to present almost as much shell as stone.

We have now, in this report, and in the one of last year, noticed in brief, the whole of the groups and rock masses, great and small, which occur geologically between the gneiss of Little-Falls and the upper layers of the great east and west limestone range of of New-York, and in the order in which they follow or rest upon each other—the order of their age. The thickness of the whole, taking the measure of each rock and group where its thickness is greatest, exceeds 2,000 feet. All the different groups, containing organic remains, are readily identified by them, causing no difficulty to those acquainted with the fossils in assigning each group, rock or specimen containing them, to the place which it holds in the series.

Of the rocks to be noticed, there remains from 12 to 1500 feet before completing the whole of the series of the Third District. All which are anterior in origin to the coal. We had intended to have given the different groups into which this great mass is divided, from observations made with Mr. Hall, along the line of Cayuga lake to Pennsylvania: but the length to which this report extends, leaves but a few pages for the products which belong to the northern section of the counties, and therefore must be left for the subsequent one.

The Seneca limestone, in many of its localities, is of so dark a colour from carbonaceous matter as to be almost black, which is the case with the mass below it, but not in so great a degree. So great is the quantity of carbonaceous or coaly matter which colours the slaty shale, or the " pyritiferous slate" which rests upon the Seneca limestone, that it

often exhibits itself as coal, giving rise to an expectation of discovering beds of workable or profitable coal, where such perceptible accumulations exist. A number of localities where excavations for coal had been made in this rock to the east of Oneida creek, were given in the last report, and a number of like excavations are to be seen in the same rock, to the west of that creek.

In many places carbonate of lime has been deposited with the material of the slaty shale, but not in sufficient quantity, excepting in one instance, to form a layer or two which extends for some miles. It generally forms those kind of interrupted beds which may be termed concretions, though they are of considerable length as to thickness. It also appears as septaria, but without divisions, or septa; and again, as perfect septaria, as at Auburn, in the outlet of Owasco lake.

Above the falls, on Oneida creek, just below the saw mill, two excavations were made for coal; one by a company, the other by Elias Mason; small pieces were obtained, but nothing which could give the least encouragement to those acquainted with the rock.

A boring of 100 feet for coal was made in the same rock, by Mr. Sage, near the road which goes from Chittenango to Cazenovia: And two excavations were made for the same object near Manlius square; one on the farm of Mr. Nettleton, near the turnpike, about a mile west of the village; the other a little further west, on Mr. Marsh's farm. The excavation made by Mr. Nettleton, is by the side of a brook, and in the black slate which is much contorted, owing to crystalline limestone which is mixed with it. Both are very black from coaly matter, of which minute veins are to be seen. At the place where coal was sought for, there is a fault, the first I met with going west. The waters of the brook flow over layers of limestone, which belong to groups below the slate worked for coal; the two rocks now appearing as parallel masses, and not as they were originally formed. A similar fault likewise occurs at Marcellus, where the slate is deeply coloured with coaly matter, and contains minute plants and fragments of the same. The cause of the fault is very obvious, at Marcellus; for the existence of sinkholes and the abundance of water from springs in the Nine Mile creek below, show subterranean passages or excavations by which portions or blocks of upper masses have been let down to a lower level. The same effect exists in the quarries south of Springport on Cayuga lake, where several extensive masses of two distinct eras may be seen, now nearly on the same level, having, no doubt had their

The depression in which occur the mineral springs of Messina, three miles east by north of Salina, is underlaid by tufa. It is well here to mention, that since Dr. Beck visited the springs a more copious one has been discovered, yielding, according to its proprietor, ten times more water than the former one.

Tufa is extremely abundant between Camillus and Canton, and between Canton and Elbridge.

One mile south of Peru, at the foot of the hill in the road, it occurs in great abundance It is the gravelly kind.

On Limestone creek, about three-fourths of a mile north of the Fabius and De Ruyter road, is a fine deposit of tufa, in the state of earth, and in porous masses, the horsebone limestone. The earthy part is made into bricks and burnt for lime. No lime can be whiter or purer than this is, and from what I could acquire, the lime is highly valued. The owner of the lime kiln informed me, that one bushel of *brick-lime* requires four bushels sand; one bushel of lime from the porous mass requires three bushels sand, whilst one bushel stone lime only requires two of sand. The deposite on Limestone creek extends up the hill for about 100 feet, and extends several hundred feet horizontally; thickness not known.

These are some of the prominent localities of tufa, whose value can not be appreciated in a region where limestone is so abundant, and where the natural soil amply enriches the cultivator, without the aid of art.

Lake Marl.

If the quantity of tufa be great, that of lake marl is prodigiously so, being found in nearly all the swamps, marshes, ponds and lakes which exist along the course of Seneca river and the Erie canal, extending from Cayuga marshes to Oneida creek. We mentioned that the whole of the bottom of Lake Onondaga was covered with marl, which extends along the head and foot of the lake to distances not ascertained, with a thickness of six feet.

The Cowassalon swamp presents the greatest accumulation of marl in the three counties. This swamp contains about 10,000 acres, 8,600 of which are land, and 1,400 are covered with water. Less water exists in this swamp than formerly, being connected directly with Oneida lake by a ditch of 14 feet deep, which was made at the expense of the state.

It is said that when the waters first flowed off by the opening of the ditch, it carried with them the muck which covered the marl, leaving a snow white surface of marl, co-extensive with the whole area which was drained. Imperfect attempts have been made with poles to ascertain the thickness of the marl, but without effect, no bottom could be reached. The ponds or marshes west of the swamp, called the Green ponds, have also bottoms of marl; so likewise has the Vlie or natural meadow to the south of the swamp.

The great swamp of Onondaga is the prolongation of the Cowassalon, and like it, is of marl also. Innumerable are the minor localities met with in going along the Erie canal towards the west boundary of the District.

Lake marl is likewise found in many places upon the great elevation, In the lake-like depression north of Peterboro', after crossing over a low stony ridge on the road to Perryville, the road traverses a level swampy bottom, the ditches for drainage being dug in lake marl. The lakes to the southwest of Tully corners are all marl lakes; so likewise are the ponds above Hamilton village, which serve as feeders to the Chenango canal, and likewise other small ponds in the south part of Onondaga and Madison counties.

Tufaceous Iron.

On the land of Robert Riddle, one mile west from Chittenango, I was informed that there was a deposit of iron, portions of which had been carried over Oneida lake, but the owner of the ore received no encouragement from the owner of the furnace. I found it to be a calcareous tufa, stained with hydrate of iron, and noticed that the spring whose water deposited the tufa, gave no signs of iron, but that the ore came from the sluggish water of the boggy soil above the tufa. In some of the masses of ferruginous tufa there was a coating of oxide of manganese.

The same kind of tufa, stained with oxide of iron, is found on the land of William Wheeler, about two and a half miles northeast of Salina. For a few hundred yards on a slope to a swamp north, there is a deposit of tufa, the upper part of which is in some places deeply stained with oxide of iron. As the deposition of the tufa is constantly going on, the soil, which is composed of muck chiefly, rises. It is from the soil that the iron is derived, as mentioned in the first report of the Fourth District. That the iron is furnished from the soil, is evident from the fact, that the lower part of the tufa is not stained with

by oil of vitriol. These serpentines are at least new varieties for our country. Some have a peculiar appearance, like bronze, owing to small gold-like particles, with a lamillar structure, resembling bronzite or diallage metalloide. Also, other particles highly translucent, like precious serpentine, with frequently small nuclei resembling devitrifications or porcelanites, coloured white, yellow, blood red, variegated, &c. The grain of this kind is like common serpentine. In other kinds, the mass seems to be made of small globuliform concretions, varying in size, being centres of aggregation; some are of dark vitrious and serpentine, others of the compact kind, the enveloping part of a light colour. The first impression of this rock is like some of the New-Jersey trap-rocks, where amphibole is in imperfect crystals, or like a pyroxenic lava, with its imperfect crystals imbedded in the more compact material.

These two principal varieties produce endless mixtures upon the small scale, to say nothing of those derived from difference of shades of colour, the presence of veins and mixtures with the associated shales.

These serpentines seem to resemble the ophiolites of Tuscany and Florence, and should the views of Brocchi be correct, they may not only be similar in origin but in age. The objections which Mr. Brongniart makes to the very modern characters which their associates present, are all in perfect accordance with those of the New-York rocks, and no one acquainted with the facts which the survey has made known, at all doubts that those rocks belong to the period, or age, intermediate to the crystalline or primary rocks, and the coal of Pennsylvania; in other words, to the transition class.

Of the specimens collected during the survey of 1838, there are sixteen boxes in the rooms of the Third and Fourth Districts, at the State Hous·.

I had intended to have given a list of the fossils which have been found in each rock and group, but circumstances render it proper to defer the same to the next report.

Since concluding my report I have again had the pleasure of hearing from Judge Allen, giving the progress made in boring since the 28th December. At that period the depth was 531 feet, and in red shale. Since then the boring has attained to the depth of 550 feet, being an advance of 19 feet. Within the depth of 536 feet it was thought that about one foot of light coloured sandstone, very hard, had been drilled, and followed at 536 feet by what was called blue limestone. The Judge writes, "It probably is that. It is very hard; we bore only about 18

inches in 24 hours. The rods are indigo blue when drawn up; after standing some time they turn brown, or colour of iron rust."

"We are now 550, and in the same blue or black limestone. When we struck limestone, water from the bottom of the well was, say 50°, and is about the same now, not more; the water, which runs away quickly from the surface, at the mouth of the well, is 20°. My own opinion is, there is no salt water in the shaft, except what descends from the gravel beds above, and through the fissures and seams in the rocks, and they are frequent, and occur in the present lime strata."

This information makes it certain that the red shale mass has been penetrated, first meeting with a thin sandstone bed, and then finally the dark blue shales and the black limestone of the protean group. In every locality east, where the connecting rocks can be seen, the limestone is followed and preceded by blue shale. This fact is evident in the ravine back of Dr. Noyes' house, near the college in Clinton, also on the road from Clinton to Waterville at Hart's mill, and on the creek by Rogers' machine factory, which empties into the Sauquoit. The "iron rust" of the borings in the limestone can be seen in many of its localities. At the quarry back of what is called Turkey-street on the Skanandea, also in the road to the northwest of Skanandea village, and in most of the quarries of Onondaga and Cayuga, where the concretionary rock exists, for in altering by exposure to the air, it seems to contain iron and manganese, which is the cause of its brown rust.

Between the blue shale above the limestone, there is a bed of green shale; this may have run out at Salina, or have been replaced by the sandstone met with, or not noticed; as Judge Allen observed in his letter, that at the depth of near 600 feet there is great difficulty in determining changes, unless well marked difference of character existed, and for obvious reasons.

LARDNER VANUXEM, *State Geologist.*

THIRD ANNUAL REPORT

Of the fourth Geological District of the State of New-York, by James Hall.

To His Excellency WILLIAM H. SEWARD,
Governor of the State of New-York.

SIR:—

Conformably with a commission received under the law authorizing a Geological Survey of the State, I have the honor to submit the following report of the progress of the survey in the district assigned me.

During the past season, the examinations in the Fourth Geological District have been principally directed to the counties of Seneca, Ontario, Yates, Tompkins and Chemung. Some cursory observations were made in the county of Steuben; and a re-examination of some parts of Wayne, with a view to ascertain the true position and extent of the iron ore, as well as to determine whether it be confined to a single bed or stratum, as heretofore supposed. The iron ore of Wayne county is of more economical importance than any other object, the gypsum excepted, in this part of the State; and I considered it necessary to devote some time to this subject.

Examinations in that part of the Fourth District which embraces the southern range of counties, can be profitably pursued only during a short period of the summer months. It becomes necessary therefore to divide our labors between these and the more northern and cultivated counties, instead of exploring throughout its whole extent each individual group or series of rocks. This would certainly be preferable, since the rocks are of variable character, and some essentially change or entirely disappear farther west; and from the limited portion examined, we are prepared to find very great differences in the fossil contents of groups at distant points. Such a course however could not be obviated,

unless more time were allowed for explorations in the unsettled portions of this district.

In company with my colleague, Mr. Vanuxem, I passed several weeks in examinations along the boundary line between the Third and Fourth Districts. The admirable facilities afforded by the banks of Cayuga lake, the valleys south and the ravines north, have enabled us satisfactorily to determine the succession and character of the rocks from Lake Ontario to the Pennsylvania line. Hereafter we shall be enabled to avoid collision and discrepancy in our descriptions, and to designate groups without confounding them with each other. We have also found the solution of many difficulties, in part arising from previous partial examinations, and also from the fact that the character of several rocks below the Onondaga limestone entirely or materially change in their eastern prolongation; and more especially after passing the longitude of Cayuga lake.

In Wayne county, on either side of the outlets of Cayuga and Seneca lakes, the rocks are frequently covered with high alluvial hills, thus almost precluding accurate examination; and in some of the softer rocks, which have been worn down by the same alluvial action, the concealment is so complete as to leave us in entire ignorance of the underlying strata. In the neighborhood of the Canandaigua outlet the country is covered in the same manner; and the rocks are visible only where streams of recent origin have found a passage. Thus the examination of such regions is rendered laborious, and accuracy can be attained only by minute and multiplied observations, by continued investigation and an extended knowledge of different localities.

With regard to the arrangement and succession of rocks presented in the section accompanying the report of last year, I have no important alterations to suggest. The names applied to the rocks were nearly all those which had before been used, or such as were merely descriptive, and intended to remain only till further research and concert of action should establish a nomenclature. This to some extent has already been done; and thus far we will point out the changes to be made, and the names to be permanently applied.

Every one who has studied rocks even partially, is aware of the insufficiency of mineral or lithological characters for giving nomenclature, and the many errors into which he may be led, whether in his own researches or by the mistakes of others. So likewise in the present state of our knowledge, we are unable in all cases to give names from fossil

characters; for though without doubt every group embraces its peculiar fossils, yet in all localities these may not be so marked as to excite attention, and in some may possibly be absent. It thus becomes a desideratum to distinguish rocks by names which cannot be traduced, and which, when the attendant circumstances are fully understood, will never prove fallacious. The basis of this nomenclature is derived from localities; and the rock or group will receive its name from the place where it is best developed. For example, the rock denominated in the section calcareous shale, simply to distinguish it from the green argillaceous shales below, will be called Rochester shale. In lithological characters it is extremely like one far higher in the series, but the fossil contents are entirely different. This contains the Asaphus caudatus, Trimerus delphinocephalus, Platynotus Boltoni, besides species of Orthis and Delthyris, all peculiar to this rock, and the characters if studied and well understood at Rochester, will guide the observer in all subsequent examinations. The limestone at Lockport excavated for the passage of the canal, we propose to call Lockport limestone. At this place the rock possesses in an eminent degree the geodiferous character, which has hitherto given it its name; but this is quite inapplicable to the same rock where seen in Wayne county. Yet it is believed that if thoroughly examined in all its varieties at Lockport, it will not be mistaken even in its eastern prolongation where it becomes a dark, nearly black, compact limestone. At some intermediate points, as Rochester, the rock exhibits an intermediate character, and at such places it can be advantageously studied. The rocks just named, together with the green shale and iron ore, the upper member of the series being the Lockport limestone, belong to a group very appropriately termed by Mr. Vaunxem, Protean. To this belongs a rock which has been designated by its contained fossils. Associated with the green shale and iron ore is a mass of limestone characterized, as Mr. Conrad observes, by broken shells of Pentamera, which abound in this rock and are found in none other in the district.

It may be objected to the proposed nomenclature, that in order to become familiar with the rocks, they must be examined at the designated localities. It is true that this system requires more labor than the study of a few cabinet specimens; which we are sometimes told is sufficient to prove, at sight, every rock on the globe. But thus we shall be enabled to avoid the egregious errors which have led to such false impressions regarding the identity of rocks; and if this system be established, and means taken to ascertain the character of strata, the community may be saved the useless expenditure of many thousands in search-

ing for mineral wealth in rocks where it does not exist. As for example, in digging for coal among the black shales of the Hudson river, and Western New-York, neither of which contain it; though externally they resemble the black shale of the coal measures. Numerous similar instances might be mentioned, where dependance on lithological characters has been attended with vexation and loss; while public confidence in scientific researches, which thus appear to have no sure basis, is gradually diminished.

The course of the rocks, as mentioned in a previous report, varies little from an east and west direction; each being limited on the south by the next successive and overlying member of the series; so that in going south we are constantly ascending in the chronological order, and in going north, every rock is an older one than the preceding. East or west the same rock may be found extending throughout the district. No important disturbances, arising from subterranean action, have yet been found to exist within the fourth geological district; those known are confined to a few undulations or slight downheaves, affecting only a small extent of country, and producing no perceptible change in character or outline.

I have made some attempts to procure topographical maps of the counties examined; but the present county maps are so inaccurate that little advantage can result from any constructed on these as a basis. They cannot be expected to give objects their true location within a mile or two, and can only present the prominent features of a country. Under these circumstances, I have thought it advisable to postpone the subject. A topographical survey of the whole State is a very desirable object and much needed, and to accomplish it in a proper manner, requires much expenditure of time with the necessary instruments to ensure accuracy.

Confined as the annual reports are to facts of utility, the rocks are described under the head of each county, with their localities, changes of character, and other important facts; and where the same rock occurs in more counties than one, reference may be made in the second to the previous description. Thus repetition will be avoided, and easy reference to particular localities secured.

SENECA COUNTY.

"*Saliferous group of Onondaga.*" All that part of the county north of the Seneca lake outlet, with the exception of a small portion south of a line drawn from Waterloo in a northwest direction to Ontario

county, is occupied by the "saliferous group of Onondaga." Nearly all this northern part of the county is deeply covered with alluvium; and the rocks appear at very few points. One of these is in the bank of Bear creek, where gypsum was quarried many years since, and another about three miles north of Seneca falls, where gypsum and gypseous marl were penetrated in digging a well.

The great depth at which gypsum is found in the north part of the county will, for the present, and for a long time to come, preclude its profitable exploration. The waters of Seneca lake, which have worn a recent outlet along the southern limit of this series, expose the gypsum and associated rocks near Seneca falls village, and for nearly three miles below. Along this distance the gypsum is extensively quarried. It occurs in irregular, often conical masses, enclosed in a grayish friable marl, with which it is often much intermixed, and in consequence deteriorated in quality.

There is here no evidence that the masses of gypsum have forced up the strata, as noticed in some places in Monroe and Ontario counties. On the other hand the lines of stratification in the marl are continued through the mass of gypsum without interruption. The strata are undulated; the depressions being between the beds of gypsum; and this appearance may have been caused either from the porous nature of the marl by which some of it has been dissolved and carried off, or from contraction, on drying of the mass between the gypsum beds. The latter being a chemical compound, and the force of aggregation greater, on becoming indurated, has contracted less than the surrounding marl; it consequently presents a slight convexity in the surface. In these beds all appearances prove that the gypsum was separated from the marl by chemical attraction, while each was in a fluid or semifluid state. Small particles and seams of gypsum still remain scattered through the surrounding mass, and it very appropriately receives the name of gypseous marl.

The rocks belonging to this formation, were described in the report of last year; they all bear much uniformity in character at different points, and are easily recognized even when the gypsum is not present, by their argillaceous nature, and nearly uniform drab or ash colour on exposure to weather. Some portions are harder and darker; frequently green on first exposure. Owing to the usually soft nature of the strata, they have been removed from extensive tracts, and the space filled with alluvium from more northern rocks; this is particularly the case in Wayne, and

the greater part of Monroe counties, as well as in Seneca and Ontario; and from this fact, a principal member of the series, the red shale, has been overlooked. But after knowing the character of this rock, from examining other localities, we find evidence of its existence along the northern part of this formation from the colour of the soil; but after much careful examination, I have not found a point between the Cayuga lake and Genesee river, where that rock is exposed. Near King's corners, in the town of Butler, Wayne county, the soil for some distance along the road is of a deep red colour, owing to the proximity of the red shale: farther west the line of this rock is covered by deep alluvium; in many places coloured by the red shale.

The quarries before mentioned, below Seneca falls, are extensively wrought, and large quantities of the plaster sent westward on the Erie canal, and southward up the Seneca lake, and thence by the Chemung canal; thus distributed over the counties of Chemung and Steuben. I have not been able, accurately, to ascertain the quantity of plaster annually taken from these beds, but believe it to be 5,000 or 6,000 tons. A small proportion only of the vast quantity has been removed, and at the present rate of consumption, it will be long before these beds are exhausted.

That portion of the county south of the outlet and north of the turnpike leading to Cayuga bridge, is probably underlaid by plaster, and the working of the beds on that side of the outlet will gradually lead to its development.

Above the gypsum, at this place, is a compact marl, containing small masses of granular gypsum or selenite, which often appear to have crystallized in the fissures and seams; these being generally separated, and the marl held together by the crytallized mass of plaster. The action of crystallization in this case appears to have taken place after the rock had become partially indurated; and the indurated part of the marl in many places is filled with irregular cavities, lined with crystalline carbonate of lime. This appearance may have occurred from the rock, having been broken up after partial induration, and have formed with the gypsum, then in solution, a kind of conglomerate, as is seen in some rocks below this.

The soft gypseous marl, surrounding the beds of gypsum, could be very advantageously employed on the sandy soils north of Seneca falls, and west, towards Waterloo. The argillaceous matter of the marl would form with the sand a soil of proper consistence; while the calca-

reous matter, and the small admixture of plaster, thus introduced, would be efficient in promoting vegetation.

The water lime series is the upper member of the "Onondaga saliferous group;" but at Seneca falls, the essential characters of this formation are not developed. The soft marl is succeeded by a grayish blue limestone, very compact and brittle, breaking with a conchoidal fracture, and exhibiting numerous crystalline points. The rock in place is fissured into irregular masses by seams which traverse it in all directions. It possesses neither the colour nor mineral composition of the water lime. Throughout the whole series it is extremely variable; and though in many places possessing all the external characters of good hydraulic cement, it burns into quick lime, or the product being too siliceous will not "set" under water. Depending, as this does, on a certain combination of the ingredients, it is not surprising, that a sedimentary rock, where the materials were transported from different directions, and subjected to the varying action of currents, should often be unfit for purposes where a constant mixture is required. This rock, at Seneca falls, passes into a compact coarse grained mass, and presenting often a geodal structure. The latter character may be seen at the large stone mill in the upper part of the village, where it has been quarried and used for building. The usual accompaniment of irregular or concretionary strata are not visible at this place; the rock passing by insensible gradations into the Onondaga limestone. A few strata of the latter rock are seen south of the falls, and at the quarries near Waterloo; but in general it is not as well marked as in other counties; while the succeeding rock attains a greater thickness, and is more exposed than in the counties westward.

Seneca Limestone. South of Seneca falls, and covering the greater part of an area of five or six miles, occurs the limestone which succeeds the Onondaga. This limestone commences about two miles south of the falls, and extends a mile south of Cayuga village: its southern limit is in a line drawn from this point to Seneca outlet, two miles west of Waterloo. The rock is fine grained, compact, often brittle, and contains thin layers and nodules of hornstone, which have frequently striated surfaces, and are covered with a deposition of carbonaceous matter. They present some analogy to the striated surfaces of portions of the water lime, and some other rocks, but probably cannot have had precisely the same origin. Few species of fossil shells are found in this limestone; the most constant and characteristic one being the Strophomena lineata, a shell which I have not seen in any of the limestones, above or below, though it occurs in the shales above the Seneca lime-

The shale in some places appears to be composed entirely of small fragments of organized remains, and towards the upper part of the mass is a stratum composed of a species of Orthis, so numerous and so closely compressed that the form and outline of the shell is nearly obliterated. The points where this shale can be seen are, south of McAllister's quarry, along the east and west road on lot 26, and about two miles and a half south of Waterloo; at this place it contains Posidonia and a few other fossils, besides numerous small fragments.

II. *Dark slaty fossiliferous shale*, in Varick and the southern part of Fayette, and of Flint creek, Mud creek, &c. in Ontario county. The upper part of the last described shale becomes very fissile and crumbles rapidly on exposure to the weather. From this it passes into a dark coloured or black slaty shale, readily separating into thin irregular laminæ. Nodules or concretions of limestone are scattered at distant intervals, and never disposed in regular courses. The fossils, both in the contained limestone and in the rock, are entirely different from those in the mass below, being an Orthis deeply striated or grooved, and in the shale very much compressed; and a flattened spiral univalve. At many points fossils are exceedingly rare, and the mass, on slight examination, might be mistaken for a non-fossiliferous one.

This shale is exposed along the shore of Seneca lake for several miles above the outlet, and in ravines across the county. On the Cayuga lake it is well developed along Sinclair's creek near Mr. Wicker's, and in a ravine one mile farther south; also along the lake shore.

III. *Compact calcareous blue shale.* The shale last mentioned graduates into a bluish, more compact and less slaty, calcareous shale; which, in the upper part, approaches in character a blue limestone. Some portions of this mass are sufficiently pure for burning into lime. The two masses together attain a thickness of more than one hundred feet, and the whole is characterized by fossils peculiar to itself. One or two species of Pterinea occur below the more compact portions associated with Cyrtoceras, Orthoceras, a large Delthyris, Leptæna, &c. The Delthyris with a long striated spiral univalve, are found in the more calcareous portions.

This part of the series is easily recognized near Tyler's tavern, on the Seneca lake shore, ten miles from Geneva; also on the ravines on Cayuga lake, near Mr. Wicker's, where its projecting edges produce beautiful and picturesque falls. Its great hardness protects the softer shales both above and below, from the rapid destruction which the streams

would otherwise effect. Almost all the ravines where this shale is exposed, appear to have formerly been large water courses, the present streams cutting a narrow channel in the *bottom*, composed sometimes to great depth of water worn fragments of shale, and the rocks above, and covered with soil supporting the largest forest trees. Along the banks of the ravines, the destruction of the shale has produced a thin but rich soil, which, though the rains are constantly washing it down into the valleys below, produces a small growth of trees, and a luxuriant one of flowers, of which a greater variety and in greater beauty, can scarcely be seen. The family of Trillium, the Corydalis, Dentaria, Caulophyllum, Tiarella, and the delicate Mitella, with hundreds of others, spring up in the greatest perfection and profusion. As beautiful objects of natural scenery, these ravines cannot be surpassed.

IV. *Olive shale.* Succeeding the compact calcareous shale, is a more fissile, bluish or olive shale, often containing small nodules or concretions like the claystones, or concretions in common clay: the lower portion of the mass is highly calcareous, partaking of the character of that below; it readily crumbles on exposure to the weather, producing a fertile soil. Above this it becomes gradually more fissile, and of a darker colour, and the fossils gradually diminish, and finally almost entirely disappear. In this rock, for the first time among the shales now described, we meet with a finely striated species of Orthis, which occurs in the Rochester shale. Circumstances, however, appear to have been more favorable to its development here than there, as it appears in much greater numbers, and twice the size of the same in the Rochester shale. Another fossil which existed at the time of the deposition of the Rochester shale, again makes its appearance about this period. Trilobites, which are extremely rare in any of the lower shales of this series, begin to appear here, and attain their maximum a few hundred feet higher.

The upper part of this shale becomes of an olive colour, and separates readily into thin laminæ, which are deeply stained with manganese; it contains few fossils, and those noticed, were fragments of Orthocera.

This rock may be examined to advantage a few miles south of Tyler's tavern, on the Seneca lake shore, for several miles, though in many places, from its ready destructibility, it is broken down and covered with alluvium. On the Cayuga lake shore, the shale can be examined near Shelldrake point, and along the ravine in the neighborhood. The fos-

rocks and fossils, succeeding the limestone which follows. The Calymene bufo, and Cryphæus calliteles are characteristic fossils of this shale

"*The Tully limestone*" succeeds the shales just described: the greatest thickness of this mass of limestone, in Seneca county, does not exceed sixteen feet; but it extends over a great area, maintaining a very uniform character. It is of a light bluish gray colour; in some localities blue, fine grained and very compact; it contains few fossils, and those of the same species as in the shales below. This rock presents many of the characters of the Seneca and other lower limestones; and in hand specimens does not appear to differ from these, but is readily distinguished by its associations from any of them. The mass consists of three or four layers, for the most part of uniform thickness. It is not generally fit for building stone, being traversed by seams in all directions, and breaking into irregular masses. In some localities the whole mass crumbles, on exposure, into small fragments, from half an inch to three inches in length and breadth, but presenting no further tendency to decomposition. The fragments are all clay coloured on the exposed surfaces, resembling in this respect some of the harder gypseous marls.

There are a few localities where this rock is very compact; the layers are from one to two feet thick, and it can be quarried of any required dimensions. Its northern edge extends in a curve entirely across the county. From where it is first seen it may be followed in a northeasterly direction to a point two miles north of Ovid village, where it is quarried for burning into lime, and for various other purposes, on the land of Mr. Thompson Johnson. This point is the greatest northern extension of the curve. From here it gradually bends to the southeast, and appears on the Cayuga lake shore, in a line nearly east from its point of appearance on the Seneca lake shore. This curved outcropping of the mass is merely the effect of erosion; the greatest force of the northern current being in the channels of the two lakes, its force was diminished towards the centre of the county, which consequently left the limestone extending farther north at this point.

This mass being so distinct in appearance from the shales above and below, manifests, very clearly, the beautiful undulations produced by subterranean action upon the contiguous rocks. At the point where the limestone first appears, in a ravine near the lake shore, it is sixty feet above the level of the water; half a mile south of this, it comes to that level, and after disappearing beneath the water for a short distance rises again toward the south and soon disappears from the lake shore.

The ascent to the south continues for more than half a mile, at which point it has attained an elevation of sixty or seventy feet above the lake; here the rock becomes nearly horizontal, and so continues for nearly a mile, when it again dips to the south, and disappears for the last time beneath the lake a short distance south of Goff's point, and four miles from its first appearance. The shale, both above and below pursue the same undulations, proving that this appearance does not arise from the limestone having been deposited in an uneven bed in the shale. From this rock appearing at so great an elevation above the lake at two distant points, it might, unless carefully observed in its southern ascent, be mistaken for two beds, occurring several hundred feet apart; and it is only from investigations along the lake shore, that we are able to point out the precise cause and manner of its recurrence at a point so far south of its outcrop.

Undulations of the strata are not confined to the extent here mentioned, and we shall have occasion to allude to the same phenomenon in rocks farther south; though nowhere so well exhibited as in the case just described. A corresponding undulation is seen in the Tully limestone, on the eastern side of the county, also on the eastern shore of Cayuga, and on the western shore of Seneca lake, the amount being about the same in each place. The points of final disappearance of the rock beneath the water on either side of the same lake are nearly opposite each other, or in the same line of latitude. This limestone generally contains few fossils; in some localities, Calymene, Cryphæus, and Atrypa affinis are found in considerable numbers, and may be considered the characteristic fossils of the rock. The transported masses of the same rock which have been found many miles south, all contain the same fossils, and thus enable us to refer the loose masses to their original place.

The erosive action of the lake waters has removed the shale below the limestone in many places, causing it to fall into the lake, where huge masses are seen to line and protect the shore for considerable distances. In Seneca county these masses are raised from the water and carried by boats to the head of the lake, and up the Chemung canal, where they are burned for lime.

Upper Black Shale. Reposing upon the Tully limestone we have a thickness of 150 feet of shale, exhibiting throughout a uniform black colour, and slaty structure. It differs from the black shale below in being more brittle, the surfaces of laminæ grained or rough, and contain-

ed under the head of Tompkins county. Near the village of Penn-Yan the same group is perhaps better displayed than in any other place examined. Its fossils being so distinct and peculiar place this in an independent group, or it may be joined with the black shale below, and constitute a characteristic group composed of the two members.

The rocks of this group are the highest in Seneca county, extending southward into Tompkins, where they are succeeded by another group, which will be described under the head of that county.

ONTARIO COUNTY.

In this county we find the same rocks, and in the same general order, as in Seneca. The "*Saliferous Group of Onondaga*," occupies that part of the county which lies north of a line drawn from a point one mile north of Oak's corners, in the town of Phelps, along the course of the Canandaigua outlet to Manchester, and thence west to Victor. The vast accumulation of alluvial, however, leaves the rocks exposed but at few points, which are mostly along streams. In a few cases, what externally appear to be alluvial hills are isolated masses of gypseous marl, &c. deeply covered with alluvium; and in some instances small masses of gypsum have been found in these, much above the ordinary level of the valleys and surrounding country. Admitting that the gypseous mass originally held a higher elevation, and equal to that of the alluvial hills, before the intermediate portions were transported southward, the fact proves the vast quantity of matter removed by alluvial agency.

This group of rocks is much better exhibited in Ontario than in Seneca county; having a greater extent, and in one or two places developing a different character. The gypsum here occupies three distinct ranges; the northern or lowest appearing upon or just north of the county line, and the other two within the county. In the first the gypsum is associated with a gray marl, which reposes on a green marl containing no gypsum. The gray marl exhibits iron stains and decomposing pyrites; and pyrites is also found with the plaster which occurs in small, irregular masses, having a granular or crystalline texture, and frequently accompanied by selenite. Masses of selenite are very abundant in the marl, varying from the size of a walnut to several pounds weight, isolated as regards themselves, and having no connection whatever with the larger masses of gypsum. In appearance and mode of formation they are very analagous to those found in the marly clays of the Tertiary formation. The limpid selenite often embraces a small

piece of solid marl, having its faces and edges grooved or striated as in the pseudomorphic crystals of muriate of soda.* The gray marl is also traversed by seams of gypsum, generally flesh coloured or reddish, in such quantities that the whole is ground and sold for plaster. Both the green and gray marl rapidly disintegrate and form a tough clayey soil.

The second series is developed near Port Gibson, and also about a mile distant, at an elevation of twenty-five or thirty feet above the Erie canal. An argillaceous limestone appears on or near the surface in low knolls or hillocks; this rock, on removal, is found to be fractured, as if upraised from beneath, and at the depth of four or six feet, is found a flattened, spheroidal mass of gypsum. It is always of this form, and quite disconnected with the surrounding rock. This gypsum is fine grained, compact, contains no Selenite, and in general appearance is quite different from that last described. The surrounding fractured rock is in thin layers from four to six inches thick, which break into pieces from one to three feet square. The surfaces present numerous little seams or cracks, similar to those produced in clay on drying, and the sides of these are all smooth, and appear worn as if by the passage of water. This character is very constant, so far as has been observed, and serves better than any other to distinguish the rock. The external colour, after weathering, is that of common clay; on fresh fracture, it is bluish, often nearly black. Water is with difficulty obtained along the extent of this formation; the fractured rock beneath admitting the percolation of water so rapidly as entirely to drain the soil, the little hillocks become in summer too dry to support vegetation. Very little gypsum has been obtained from this series in Ontario county, though it seems to be the same which furnishes a great part of that mineral in Monroe county. It will doubtless be explored after the supply along the Canandaigua outlet in Phelps, becomes exhausted.

The third series embraces the gypsum which is extensively quarried in the town of Phelps, between Vienna and the town line of Manchester, along the Canandaigua outlet. West of this point, one or two masses are seen in the bank of the outlet; and with this exception, and a single bed recently opened near Victor, the town of Phelps furnishes all the gypsum from the county. This with its associated rocks are very similar in character to those on the Seneca outlet. It occurs in the same irregularly shaped or somewhat conical masses, producing no disturbance in the surrounding strata; while the lines of stratification in

* Their form, however, is less regular, and they occur much lower in the series.

Manchester to that village it approaches the surface, and could easily be obtained in any required quantity. Thence it extends west to the quarries in Mendon, though the surface of the intervening space is mostly covered with deep alluvium.

At Maffit's quarry, in Phelps, the drab limestone is succeeded by several feet thickness of bluish gray limestone, which divides into thin laminæ by parallel seams; when struck with a hammer, it yields a metallic sound, like some of the trap rocks. On the surfaces of the laminæ are found Cytherina and a species of Orthis, which are the only fossils I have seen in connection with the drab limestone. This rock, when exposed to the weather, presents numerous linear or needle form cavities, frequently almost covering the surface of the stone; these result from the decomposition and removal of thin crystals of strontian which have pervaded the entire mass. Specimens are frequently obtained where the crystals are preserved, and others where they are only partially removed.

The Oriskany sandstone, is well characterized in the Third Geological District, and described by Mr. Vanuxem; it appears but at one point in this county, and not at all in Seneca, being either entirely wanting or deeply covered with superficial materials. This rock could be easily identified did it exist, but I have yet seen it only in Flint creek, at Vienna. Here it is a coarse porous sandstone, destitute of fossils, so far as observed, with the exception of a single specimen of Icthyodorulite; the large Orthis and Delthyris, which characterizes this rock in the Third District being entirely wanting. Its purely silicious character and porous texture are well adapted to withstand the effects of rapid heating and cooling; and at the locality mentioned it is much quarried for free stone, and used in the Ontario furnace, and in the glass furnace at Clyde. It contains numerous small geodes lined with chalcedony; also rounded masses of a dark rock are imbedded in its surface. These, on examination, prove to be very compact aggregations of fine sand, coloured with carbonaceous matter, and may have resulted, as well as the chalcedony, from the long continued action of Thermal waters.

At the place where this rock is quarried, it is four feet thick, divided into two or three layers, one of which is about two feet. It rests immediately on a slaty, argillaceous limestone, four feet thick, which succeeds the water lime proper. The thin layer of conglomerate mentioned in the report of last year as separating the drab limestones at

Tinker's quarry from the gray and blue limestones above, is the representative of this rock, which, we learn from Mr. Vanuxem's report, attains in the Third District a thickness of thirty feet, and contains abundance of peculiar fossils. This rock, the "shell grit" of Prof. Eaton, is a well characterized mass in the Helderberg range, interposed between the upper and lower limestones.

The "gray crinoidal," or Onondaga limestone, which follows the Oriskany sandstone, is well characterized, and distinguished from any other by its peculiar gray or grayish blue colour, and compact crystalline structure. It is tough, breaking with a large conchoidal fracture. When free from seams, it is perhaps the most durable of the limestones, and one of the most beautiful for buildings. For this purpose it is much quarried; and at Oak's corners, its eastern limit in Ontario county, it is also burned for lime. It is very abundant as a surface rock.—In several localities there is a gradual merging of the water limestone into this rock, the Oriskany sandstone, which should intervene, not being in place. In most instances the strata succeeding the water lime are an irregular gray limestone, containing abundance of fossils, mostly in fragments, or single valves of shells. Fragments of Calymene are very numerous, but perfect specimens are rarely or never found. Strophomena rugosa, Orthis affinis, and several others, are abundant. A large species of Orthis, peculiar to the Oriskany sandstone, or "shell grit," sometimes accompanies the other fossils in this part of the formation, and Madreporites, Cyathophyllites, &c. are found above the more shelly portions of the rock.

West of Vienna this limestone spreads out over a great surface, covered only with a thin coating of soil, and having its northern termination about a quarter of a mile south of the Canandaigua outlet. It extends to Flint creek. The principal quarries in this neighborhood are McBurney's and Wayland's, within two miles of Vienna, which furnish materials for locks on the canal, for building and step stones, and some partially crystalline portions, from the unequal expansion, form a good firestone for the ordinary heat of a fire place. At these quarries four layers of limestone are exposed, two of which only are workable, the others being too thin, or separated by seams. The upper one has in many places been nearly destroyed by the action of running water. Sometimes layers of chert, or hornstone, are interspersed between those of the limestone; and some of these contain much of that mineral, while in others it occurs only in small nodules. In such cases it does not injure the quality of the stone, but where it occurs in large masses

The course of the limestones just described, can be easily traced by the elevated terrace formed by the line of their northern outcrop. Their superior hardness withstood the erosive action of water, while the softer gypseous rocks, and water limestones on the north, were excavated to a much lower level, producing in one case a valley, in the other a corresponding elevation. Where this terrace is unbroken, the alluvial hills for the most part terminate in the valley north, or on the gypseous formation; and the deposition of transported matter in such abundance along this line, is doubtless owing to the partial check which the current received from the limestone elevation south.

The terrace here described, must not be, as it often is, confounded with that extending east from Lewiston, the mountain ridge; the latter is entirely a different rock, though the outline is produced by similar means and from similar causes. The mountain ridge is not perceptible east of Rochester.

In this county, as in Seneca, the black shale succeeds the Seneca limestone; and possesses the same essential characters. It appears in the banks of several small streams in the eastern part of the county, though its immediate connexion with the limestone has not been observed. On Flint creek, three miles from Vienna, this shale is extensively developed. The lower part is compact and highly bituminous; it contains much pyrites, and the decomposing shale effloresces large quantities of sulphate of alumine. On the Canandaigua outlet it is not so well developed; nor at any intermediate point; for the force of the original water having widened the channel, leaves the shale now covered with alluvium. On Mud creek, it is seen above the locality of the Seneca limestone, near Hill's mill.

The different members of the shale series succeed the last mentioned in the same order and with the same characters as in Seneca county. These I shall speak of together, deferring the minute distinctions to a more detailed report. Several members of the group are well exhibited in the ravines and on the shore of Seneca lake, above Geneva. Along Flint creek, from two miles below Orleans to the village of Bethel, they are seen in great perfection. The upper mass is particularly well developed at Monteith's point, on Canandaigua lake, and the Encrinal limestone appears about half a mile below. The shale is seen in many places along the eastern shore, and in all the ravines entering the lake, for seven or eight miles south of Canandaigua.

The mass of encrinal limestone, which has already been mentioned as dividing the upper mass of shale from that next below, occurs in great perfection along this lake. Large masses have been transported to the foot, and lie along the beach and in the wall which protects the road from the action of the water. Some of the these boulders contain few or no encrinal columns, but their other characteristics refer them to this formation.

Along Mud creek the shales may be seen at various localities, and in all the large ravines; but in the smaller ones their decomposition has formed a soil which in many cases conceal the rock. In the western part of Ontario, and particularly west of Mud creek, the alluvial hills have covered the underlying rocks as far south as the extent of these shales; while in other counties the southern limit of the high alluvial hills is generally, except in valleys, the limestone range before described.

The Tully limestone I have observed but at two points in Ontario county; one in the bed of Flint creek at Bethel, and only visible when the water is low; the other four miles northwest of that village, near the main road and about a mile from the north line of the town of Gorham; there it consists of a single layer three feet thick, and exhibits the characteristics of that rock. This point is on the elevated land between Flint creek and Canandaigua lake; the surface slopes in either direction towards the valleys, which are valleys of denudation. These produce very irregular lines of outcrop.

West of the point last named, I have not seen this limestone, although its place in the shale is well defined for many miles along Canandaigua lake.

The line of distinction between the lower shale and the black shale succeeding the Tully limestone, is well defined as far west as the Genesee valley. It occupies the southern part of the town of Seneca, and appears in some places in the more elevated parts; and in Gorham extends several miles north along the high ridge between Flint creek and Canandaigua lake. West of Canandaigua lake this shale spreads out over a much greater extent of country, passing through the towns of Cheshire, Bristol and Richmond, and becomes fossiliferous in all its parts. It appears on Mud creek and in the ravines and streams about the outlet of Honeyoye lake. The burning springs, so called, of Bristol, proceed from the carburetted hydrogen, arising from this shale; the numerous localities will be mentioned in another place.

the alluvium; as in most localities east of Canadaigua lake, it is almost destitute of fossils. On the south bank near Mallory's, a road cut through the shale exhibits it to great advantage; also Bruce's ravine farther south. Next succeeds the Tully limestone seen at Wait's mill, where the water of the outlet falls over it. Thence it dips east for more than half a mile and disappears, and shortly afterwards it reappears, dipping to the east. No dislocation or disturbance of the rocks is visible at any point, and the change appears to be owing to an undulation, similar to that observed on Seneca lake, which is at right angles with this. The ascent of the limestone to the east, or its dip west, is about ten feet in the mile, as ascertained by tracing it through that distance. At Hopeton, the limestone is sixty or seventy feet above the bed of the stream, and about one hundred feet above the lake. Beyond this point, it has been entirely swept off by the waters of the original outlet.

The Moscow shales are seen at Wait's mill, and also at Mallory's mill, and along the bank of the stream to within half a mile of the lake shore. At Hopeton, about sixty feet of it is visible, containing the usual fossils in abundance. Here the shales and Tully limestone are beautifully exhibited in a little conical hill, which stands isolated in the valley of the outlet, a monument of the power of ancient waters. The hill is about one hundred feet broad at the base, and perhaps eighty feet high. The first sixty feet are of the shales last described; then succeeds the Tully limestone, and the top is capped with a few feet of black shale.

The same undulations as those noticed on the east of the lake, occur on its western shore south of Dresden. The Tully limestone and black shale soon disappear below the level of the lake, and the next series continues to dip in the same direction, till within one or two miles of Big Stream point, or about eight miles from Dresden. Here the rocks begin to ascend to the south, and half a mile south of Big Stream, the black shale appears above the lake, and continues rising for a mile or more, where it attains an elevation of forty feet above the water, and begins to descend southward.

A circumstance worthy of notice is that at this point, and extending as far as the shale continues above the level of the lake, this rock contains within five or six feet of its upper surface, a concretionary mass of silico-argillaceous limestone, from three to five feet thick, consisting of three layers divided by interposed seams of shale. The lower stra-

tum is irregular and more concretionary, sometimes appearing to be merely individual masses of Septaria joined at their edges. It occupies nearly the place of a course of Septaria elsewhere occurring in the black shale: it doubtless results from an aggregation of a greater or less proportion of calcareous matter; so that what in one place becomes a few isolated masses of Septaria, in another is a continuous stratum four or five feet thick. Above and below this are the usual fossils of the upper part of the black shale. This limestone is burned and used for hydraulic cement in mill dams, at Big Stream point and elsewhere; and is considered better than any obtained from other quarters. Mr. Townshend, of Big Stream point, is now erecting a mill for grinding it after burning. The mass is situated in the bank of the lake, where boats can approach for loading, and thus the facilities for transportation will be great. If it prove equal to the expectations of the proprietor, it will supercede much of the material now used as hydraulic cement.

Between Seneca lake and the east branch of Crooked lake, a high ridge or elevated plain slopes gradually to both, being divided transversely by the ravines and streams. Another elevated table land, varied by slight undulations, rises between Seneca lake and the valley of Flint creek, which extends to the head of the west branch of Crooked lake; this is interrupted by a depression to the northeast of Penn-Yan. Another similar portion, though more irregular, rises between the valleys of Flint creek and Canandaigua lake; and the part of the county between the two branches of Crooked lake terminates in a high bluff, called Bluff point. From near the head of the west branch, extending quite across the peninsula, is a valley which appears once to have connected the two branches; the highest point is now not more than one hundred feet above the lake. The soil of this county ranks among the first in quality.

TOMPKINS.

The northern portion of this county, between Seneca and Cayuga lakes, is underlaid by rocks of the group last described in Seneca county. These, as well as the rocks below the black shale, Tully limestone, &c. appear in all the deep ravines communicating with the lakes, and are finally exhibited at the gorge of Goodwin's falls. This is an immense chasm, into which the water descends perpendicularly one hundred and ninety-three feet, from the bottom of which we see the amphitheatre of rocks rising around us, and by the effect of perspective, closing over us three hundred feet above our heads. The black shale visible for eighty feet above the Tully limestone, is succeeded by more than

water in motion which might transport from different directions the two materials of the rock. This group appears to have been deposited from an ocean alternately at rest, and disturbed. Thick masses of sandy shale occur, bearing ripple marks through their whole depth; these are succeeded by others of variable thickness, without ripple marks, and having the faces smooth and plain. Numerous alternations of this kind have been noticed through many hundred feet. Fossils never accompany the rippled layers, but are invariably found with the smooth. The materials of the two differ very slightly in mineral composition, the rippled ones being more sandy. The absence of fossils in the latter may be explained, by supposing the unquiet state of water during the deposition of the rippled shale to have been unfavorable to the development of organic life. So far as I have observed in this and other localities, the greatest accumulation of fossils is always accompanied by fewest ripple marks.

The changeful state of our planet at that period may have occasioned numerous risings and sinkings of the crust, some portions of which may have been disturbed oftener than others; one undergoing the oscillatory movement while another was at rest. This may be considered proved from the fact that undulations are exhibited in some localities, while a distance of a few miles shows a plane and undisturbed surface. Thus the undulations of the rocks on Seneca lake have not been communicated to those on the western shore of Crooked lake; although the latter are part of the same mass, separated only by a distance of ten or twelve miles. The valley of Crooked lake could have had no influence in interrupting the motive force, as probably at that time it was not excavated; and farther south we find other undulations of which the counterparts are exhibited on each side of the valley.

These uplifting movements would form bays, or protect certain portions of the sea where animals might exist in great numbers, while every other part for miles in extent, were too unquiet for the development or preservation of animal life.

In numerous localities of these rocks, the edges of strata, when exposed in ravines and other places, are found covered with crystals of sulphate of lime. This circumstance is by no means universal among the shales below, although observed in some localities; while in the present group there are few exceptions. Pyrites, in minute particles, is every where disseminated, decomposing on exposure, and hastening the destruction of the rocks; while the sulphuric acid combines with the mi-

nute proportion of lime which they contain, exhibiting the crystals along the edges. Wherever larger masses of pyrites occur, we find a proportionate increase in the quantity of sulphate of lime. Similar conditions in some of the limestones below have produced a mass of gypsum, filling the cavity previously occupied by the pyrites; and analogous circumstances, and varying in extent and effect, may have formed the vast gypsum beds of the same series, extending throughout the whole of Western New-York. The latter however could only have occurred before the entire induration of the surrounding rocks.

CHEMUNG COUNTY.

In this county, the group last described forms the surface rocks of the northern towns; and in the ravines and valleys, extends south to the southern line of the towns of Veteran and Catlin. The rocks here retain most of their essential characteristics; but fossil shells are exceedingly rare, and in many localities entirely wanting. The peculiar fucoidal markings are every where preserved in the thin layers of sandstone. The rocks of this group are well developed in Gulf creek, near Jefferson, at the head of Seneca lake; and at many points south on the west branch of the valley, and the ravines coming into it.

From Jefferson to Millport, the rocks dip south, exhibiting throughout continued alternations of shale and sandstone; and towards the upper part the compact shale is covered with fragments of a Fucoid, different from those below, and appearing only in curved fragments.

In the vicinity of Millport, and farther south, the sandstone layers attain a thickness of a foot or more, and are quarried for works on the canal and various other purposes; and at Pine valley, the sandy layers of the rock, are quarried in two places. Mr. Sexton, the owner of the last, informs me that the firmest layers of sandstone often pass into shale so as to be unfit for any economical purpose. This appears to be unlike the thinning out of the layer; but the proportion of argillaceous matter becomes so great that the mass crumbles on exposure.

At the last named quarry, I observed the singular fact of non-conformable strata, as yet the only instance noticed, and which various circumstances seem to render incredible. The strata are parts of the same mass, once continuous, the lower dipping south at an angle of four or five degrees, and the upper dipping north at about the same angle; and a short distance farther south the whole mass dips north. The only explanation that now offers, is that at the time the rocks were subjected

other; these are used for water vessels, &c. the concavity being often so great as to contain several gallons.

In the valley of Cayuta creek the group is exposed in a ravine three miles north of Factoryville, where fine flag stones could easily be obtained. In the north part of Barton are great numbers of loose masses containing the fossils of this group, probably washed down from the tops of the hills in the vicinity.

A group so characteristic and so well defined in the valley, and particularly in the town of Chemung, merits the appellation of the Chemung group.

The topography of this county is very simple; the Chemung river passes through the southwestern part of the county, and opens a broad and beautiful valley, bounded by a range of hills which are only broken by the lateral streams flowing to the river; the rocks on one side sometimes approach the river, while on the opposite is an extensive flat or bottom. Here, as elsewhere, the rocks on both sides of the valley bear evidence of erosion, and show that this river, as well as other streams, flows in a bed once occupied by rocks like those of the mountain mass.

The eastern boundary of the county is along the valley of Cayuta creek, which has its origin in the small Cayuta lake, in the north part of the county, and forms a continuous valley thence to the Chemung river. Wynkoop's and Baldwin's creek form valleys of less importance.

The Chemung valley, extending from the head of Seneca lake to the Chemung river, is the most prominent feature in the county. It offers the only route by which a canal could have been constructed, being through its whole extent alluvial, and presenting no remarkable elevations. The ascent from Seneca lake to the summit level of this canal, is 440 feet in a distance of fifteen miles.

STEUBEN COUNTY.

The examinations in Steuben county during the past season, were principally confined to the eastern and southern part, along the valleys of the Chemung, Canisteo and Conhocton rivers, the valley of Crooked lake, &c.; and beyond this, some other points of interest, with one or two reputed localities of coal, which prove like all others of the same kind, a fruitless enterprise.

The rocks of that part of the county examined, belong principally to the Ithaca and Chemung groups, varying in some slight degree from these groups farther east. Along the western shore of Crooked lake they consist chiefly of sandy and slaty, or argillaceous shale, the former rippled or undulated, showing that each thin layer of the shale was subjected to the action producing the rippled surfaces, and this action continued uniform throughout the whole deposit. Alternating with the greenish shale just noticed, is a darker slaty shale containing fossils. At some localities occur a few thin layers of sandstone, but these are not abundant until we approach the head of the lake.

Four miles below Hammondsport, in a ravine on the bank of the lake, can be seen a concretionary stratum of impure limestone, composed of roundish or irregular masses cemented together by an argillo-calcareous cement. In other localities, the concretionary forms are not so distinct, and the whole bears the character of an irregular mass, separated in various directions by thin seams of shaly matter. So far as examined, this mass bears a very uniform and constant character; it disappears beneath the lake on the east side, one mile below Hammondsport. This limestone has been burned, but found too impure for quick lime, though it possesses some of the characters of water lime.

At Hammondsport, in the ravine above Mallory's mill, we find about three hundred feet of rocks exposed, belonging to the Ithaca group; they are well characterized by the fucoides resembling a bird's foot. Few fossils other than fucoides appear through this thickness, though higher in the ravine, are some fossils peculiar to the group. The mass exposed consists, in the lower part, principally of shale and thin layers of sandstone, and at a higher point numerous layers of sandstone from four to ten inches thick. The edges of all the layers exposed, are covered with crystals of selenite, or crystallized gypsum.

About one mile from the mouth of this ravine, an excavation for coal has been made in the black shale, which alternates with the sandstone and olive shale. The indications of coal at this point were a few fragments of vegetables, iron pyrites, and the odor of bitumen arising from the shale; all these were supposed to be unfailing evidences of coal beneath. The work is at present abandoned until some new excitement or reported exhibition of burning gas, shall induce others to engage in the enterprise. In the shale thrown from this digging, I found Inoceramus, Ptenirea and several other fossils.

On the east side of the valley, opposite Hammondsport, a similar ravine exposes the same strata as those just described.

it covers the green shale, including a thin mass of purple or chocolate colored shale. The green shale below the purple includes some wedge-shaped masses of crinoidal limestone, which have apparently taken this form in consequence of the insufficiency of the material to form a continuous stratum at the time of its deposition; the masses do not all hold the same place, appearing as if they had been infiltrated from above, some finding lower levels than others.

Above the Pentamerus limestone we find again green shale, not much dissimilar to that below. This mass is twenty or thirty feet thick, and succeeded by a mass of encrinal limestone in thin layers, which is the constant associate of the upper green shale, and separates it from the Rochester shale. Associated with this encrinal limestone, is a bed of iron ore, the thickness of which we could not ascertain at this place without excavation, which was not made. This bed corresponds in position with that at Wolcott furnace, and also with that in the eastern part of the town, from which ore is obtained for the supply of the Wolcott furnace.

The only indication of iron ore below the Pentamerus limestone, is the purple shale which has probably been colored by infiltration of iron from above. This shale occupies nearly the same position as the stratum of ore at Rochester, and the western part of Wayne county; this difference of position was probably produced while the whole mass was in a fluid state, by the iron passing through some of the strata, and forming beds upon others which were impermeable. With this view of its formation, it is not surprising that we should sometimes have one and sometimes two beds, and that their position in the rock should be variable, higher or lower in one place than another.

Farther west we have evidence in favor of the hypothesis just advanced. At Cental's mill near Sodus bay, the ore occurs in several places, and particularly on the creek above the mill. The ore at this place is intermixed with the Pentamerus limestone, and replaces the lower strata of that rock. The green shale below is but two or three feet thick, the sandstone being visible at the same place. The purple shale noticed at the two last localities, is no where to be seen. Here then we find the ore to have changed its place, and to have formed a bed below the Pentamerus limestone. At the other localities, the purple shale may be considered as the representative of the iron ore stratum; while a sufficient quantity did not pass the superincumbent strata to form a bed of the ore, some of the finer, almost soluble, particles penetrated and colored the rock. But at Cental's mill and west of it, the whole

mass of ore has passed to about the position held by the purple shale at the Shakers' mill.

At the latter place, and at several localities farther west, no indications of ore could be discovered in the position of that first mentioned, or immediately below the Rochester shale. The mass at Cental's mill holds the same place as that at Ontario, Rochester, and other places where it has been observed.

I have ascertained by this examination, that the ore bed occupies two positions, one above and the other below the pentamerus limestone. The lower bed extends from Cental's mill westward to the Genesee river; and the upper bed from near Sodus bay to the eastern limit of the county. Thus far, I have not been able to ascertain the existence of the ore below the pentamerus limestone throughout this distance, though there are some indications of it in one or two places. From the situation of the rocks being near the lake level, boring would be required to ascertain the fact.

The facts relating to this ore, and the rocks of the group containing it, will be given more in detail hereafter.

In this examination, several fossils have been added to those already collected in Wayne county, and which may perhaps serve to identify these rocks hereafter. Among them is the Graptolite,* which occurs abundantly in the green shale above the pentamerus limestone, at the Shakers' mill. It is also found farther west, and one or two specimens have been seen in the same shale at Rochester, which is there characterized by the Agnostis pisiformis.

Alluvium. All the counties examined are more or less covered with alluvial deposits, which in some places merely form a thin covering of the subjacent rocks, and in others rise into hills, or fill deep valleys, caused by the removal of rocky strata. The more elevated parts of the southern counties exhibit least of this deposit, while the northern ones are in many places deeply covered.

It is often difficult for the student in Geology to conceive of water flowing over the surface of a country so much elevated above the sea;

* The Graptolite has been found in fine bituminous shale in Norway and Sweden, in rocks of the same age as those of Western New-York; those found in Wayne county nearly resemble the figure of this fossil given by Mr. Lyell, in his Elements. "These bodies are supposed by Dr. Beck, of Copenhagen, to be fossil Zoophytes, related to the family of sea pens, of which the living animals inhabit mud and slimy sediment." *See Lyell, Elements of Geology. page* 462.

Clay. This deposit is extensively distributed in the valleys and low grounds of the counties examined. The valleys between the ridges in the north part of Ontario and Seneca counties are clay, with sometimes a slight admixture of other ingredients. The destruction of northern portions of the Onondaga saliferous group has doubtless given rise to a large proportion of the clay, which from remaining longer suspended in the winter was deposited upon all the other materials. Bricks made from this substance are usually of a light colour, and from the large admixture of calcareous matter are of inferior quality; though to many beds of clay this objection does not apply.

Boulders of granite, gneiss and other ancient rocks are scattered upon the surface or embedded in the soil. Besides these are fragments of limestone and some other rocks of the district; as of the Tully limestone in the valley south of Seneca lake. One of these masses is fifty feet square and six feet thick. Numerous others are found of less dimensions, which furnish lime for the country around. These have scarcely been worn by attrition, but present the appearance of fragments just removed from the parent rock, while their nearest locality is from thirty to forty miles. Fragments of the conglomerate above the Chemung group occur in many of the valleys; these bear evidence of attrition, and have probably been derived from the tops of the neighboring hills.

Upon the lands of Messrs. Lawrence, in the valley on either side of Cayuga lake, are several large angular masses of rock, differing from any seen before in the district either in place or otherwise. Some of these have the colour of red sandstone, approaching to that of red jasper; others are nearly white, with veins and irregular spots of red; the rock is exceedingly hard and tough, presenting an uneven fracture. It effervesces slightly with acids. From comparison, it proves to be the same with the altered silicious limestone described by Prof. Emmons, as resting on the slate at Burlington, and doubtless equivalent to all the limestone of the western part of Massachusetts, usually termed primitive. A circumstance very remarkable is that none of these fragments have heretofore been observed, the present being more than 250 miles from the nearest locality of the rock.

Lake Marl and Tufa are very abundantly distributed over many parts of the counties examined, and are already becoming useful both for lime and agricultural purposes. Along the line of the saliferous group, these substsnces are abundant, arising from the decomposition of the

soft gypseous marl. In the southern counties they are in more profusion than in the limestone districts, thus proving the alluvial origin of marl in these places; for if it resulted from the decomposition of limestone in place, it would be found in those regions most abundantly; which is not so. The alluvium contains a large quantity of calcareous matter, as is evidenced by the gravel being cemented by it in many places, forming a coarse conglomerate; and in others, the pebbles are covered with a deposit of the same material. The percolation of water through these immense piles of alluvium results in the solution, and afterwards the deposition of the calcareous particles; forming when deposited under water a fine pulverulent lake marl, and when exposed to the atmosphere, the porous substance called tufa.

In many places where these materials exist in abundance, limestone is brought from a great distance and burned for lime, while the marl, which is equal, if not superior, remains in the bog. Thus at points distant from limestone quarries, the cost of lime greatly exceeds that for which it might be obtained from materials on the spot. I am not able to state the exact amount in loads or bushels, but am quite sure that the deposits of marl in the southern counties, are sufficient to supply the demand for lime and other purposes for an indefinite period.

There are several localities of marl in Seneca county; one of these is in the north part of Varick, about a mile from the lake shore.—Near the village of Ovid, on Mr. Dunlap's farm, are several beds of marl; one of them, covering four or five acres, has been penetrated four feet, below which point it becomes sandy. It has been used both for lime and for agricultural purposes, in its present state. For the latter Mr. Dunlap considers it very beneficial; and a dressing of marl produces perceptible effects on the crops for many years afterwards. The marl at this place is a deposit from springs which have their source near the summit of the hill east.

The Cayuga marshes, embracing an area of forty thousand acres, are in many, and probably all places, underlaid by marl to the depth of several feet. This immense deposit contains far more than all known in the fourth district besides; and when the marshes are drained, as doubtless they will be eventually, this material will furnish lime and manure for an extensive district of country.

Some notice of the attempt to drain these marshes, was given in the report of last year; but so long as the lakes retain their present elevation, and are subjected to annual floods, such a plan, as the one pro-

of these springs were dry at the time I visited the place, and the pebbles in the course of their outlet were covered with a deposition of sulphur. Some of the springs were flowing copiously, and one more than all the others, the quantity of water discharged being much greater than from any other spring of the kind I have ever seen, and the whole strongly impregnated with the gas. Calcareous deposits of considerable thickness are forming about the springs; these are covered with an incrustation of sulphur, as also the stones, grass and moss about the spring and along the outlet.

The spring at Canoga, from which nitrogen is emitted, has already been mentioned under Seneca county.

At Townshend's mill, four miles north of Bath, noticed as a locality of marl, there are several copious springs. These springs are the source of the inlet of Crooked lake, and in dry seasons afford more water than from all the other streams flowing into it.

Saline efflorescences are of common occurrence on the exposed surfaces and cliffs of the upper black shale, and of the group above. These efflorescences are principally of sulphate of alumine and magnesia, but in many instances, muriate of soda or common salt occurs, and in such quantities as to produce brackish springs. These circumstances are, however, no evidence of a large quantity of the material, but only of its presence, which we might expect from the conditions under which these rocks were deposited. The largest proportion of the rock being shale, deposited from an ocean in the form of clay, which from its nature remains long suspended in water, would carry with it, during its slow deposition, some portion of the saline ingredients of that fluid. The saline matter, as the clay consolidated, became part of the rock, which now disintegrating by the action of water, the saline matter is dissolved, giving its character to springs, or appearing in efflorescences upon the exposed surfaces.

The numerous deer licks which occur in this region, derive their saline ingredients from the same source. At Jefferson, head of Seneca lake, there is a spring of this character; it is about two hundred and fifty feet above the lake. The pebbles along the stream which flows from the spring, are often in dry weather covered with particles of salt. At some distance below the spring, is a deposit of ochery iron, which impregnates the soil for some distance from the stream; this deposit has nearly disappeared, as the water from the spring is but slightly impregnated with this mineral. Saline springs are said to have been found

in the margin of the large marsh or swamp at the head of Seneca lake, and Mr. Quin has obtained salt from the water by evaporation. Of these and similar indications of salt water, we may confidently say that they should encourage no expenditure in digging or boring, as the quantity of salt obtained will be too small to repay even the least labor or expense.

Carburetted hydrogen. This gas, frequently accompanied by bituminous matter, rises in many springs and streams, also in ponds and stagnant waters, as well as in places where water is not present. Surface water, indeed, has no connection with the phenomenon, any more than to indicate the presence of the gas in its passage upward, by the bubbling produced. The term carburetted hydrogen springs cannot, therefore, be used with the same propriety as sulphuretted hydrogen springs, for in the latter case the gas combines with the water, while in the former it does not. The occurrence of this gas is observed over a great extent of country, particularly in the black shale from Cayuga lake to Lake Erie. It sometimes appears to be connected with fissures or rents, whether the cause producing the latter has any influence in the production of the gas, we are unable to say. In one place on the outlet of Crooked lake, this gas is emitted in a line extending NW and SE, for the distance of several rods. The line of bubbles was traced diagonally across the canal, and from thence several rods distant across the outlet, and I was informed that at some distance SE, where a digging had been made, the gas was perceived issuing in the same line. The gas escapes in several other places in the vicinity, though there was no means of ascertaining the direction. The course here noticed is not that of the joints occurring in this rock, and may probably be connected with a fault or dislocation of the strata, as there is a slight depression of the rocks not far from this point.

In Yates county, in the town of Middlesex, one mile and a half from Rushville, this gas issues in large quantities from the soil; an excavation to considerable depth has been made, and a large volume of gas now escapes from the water, and also from a small spring near. The quantity of gas is sufficient to supply a constant flame from the entire surface of the spring. It was formerly used for warming and lighting a house near the spot, but has been for a long time neglected.

In Ontario county, near Goodwin's tavern in Bristol, there is a copious emission of this gas, and also on the opposite side of the valley. In Cheshire, five miles east of the last place, there are several localities;

GLOSSARY OF TECHNICAL TERMS

Alluvium. A recent deposit of earth, sand, gravel, peat, &c.; the term is applied to depositions which are now accumulating, as at the mouths of rivers, &c.

Alum rocks. Rocks which, by decomposition, form *alum.*

Amorphous. Bodies devoid of a regular form.

Amygdaloid. A rock more or less cellular in its structure, and at the same time abounding in cavities in the shape of an almond. It is one of the class usually called Trap rocks.

Anticlinal axis, ridge, &c. The line from which the strata of any formation dip in two directions, like the roof of a house.

Augite. A simple mineral of variable colours, passing from white through gray, green and black of different shades. It is a constituent of many volcanic and trappean rocks, limestone, granite, &c.

Basalt. A black or grayish black compact rock occurring frequently in a columnar form, as at the Giant's Causeway in Ireland. Many geologists consider it to have been formed by the fusion of augitic and feldspathic rocks under great pressure, as at the bottom of an ocean or deep sea; hence its compact structure.

Basin. Deposits lying in a hollow or trough-shaped excavation, are said to occupy basins.

Bed. A mass of mineral matter lying between the layers or strata of any rock.

Bitumen, bituminous, &c. An inflammable substance which presents itself under two forms, a solid and liquid; when in the former state, it is called *asphaltum.* In its liquid state it is like tar. Seneca oil is an example of it. Coals, slates, limestones are often bituminous.

Blende. A German name for sulphuret of zinc.

Boulders. Rocks which have been transported some distance from their original beds; they are more or less rounded by attrition and the action of the weather.

Botryoidal. Resembling in form a bunch of grapes.

Breccia. A rock or portion of a rock composed of angular fragments, cemented together by lime, iron, or some other substance.

Calcareous spar, is crystallized carbonate of lime.

Calc sinter. A deposition of porous carbonate of lime, from the waters of mineral springs.

Carbon. A simple substance, known in a pure state in the diamond only. It is one of the combustible elements in coal.

Calciferous. Bearing or containing lime.

Carbonates. Compounds formed by the union of carbonic acid and a base.

Carbonic acid. An acid gaseous compound composed of carbon and oxygen. It is incapable of supporting combustion, and deleterious to animal life. It is heavier than atmospheric air; and hence is found

Geology. A science which has for its object the investigation of the structure of the earth and the materials of which it is composed. Connected with these investigations, are deductions which may be derived legitimately from the known influence and effects of causes; these are employed as expressions of the modus operandi by which the earth has been brought to its present state.

Gneiss. A stratified primary rock, composed of quartz, feldspar and mica.

Granite. An unstratified rock, composed of quartz, feldspar and mica.

Grauwacke, graywacke. The name was originally applied to a rock composed of grains and pebbles cemented together by clay. It belongs to the transition series. The name is applied also to a group of rocks in the same series, consisting of sandstone, slates or shales, alternating with limestone, sandstone, &c. The term is rather indefinite, yet very frequently used.

Green sand. Beds of sand, sandstone, limestone and marly clays, intermixed somewhat with greenish particles, belonging to the cretaceous period, and situated beneath the true chalk.

Greenstone. A variety of trap, composed of feldspar and horneblende.

Grit. Coarse grained sandstone.

Gypsum. A mineral composed of sulphuric acid and lime.

Hornblende. A mineral, usually of a dark green colour. Crystallizing in long slender prisms.

Hornstone. A silicious translucent mineral, resembling flint, but tough and more difficult to break.

Incandescent. White hot—a degree of heat more intense than that at redness.

Iceberg. Floating masses of ice.

Ichthyosaurus. A fossil reptile, intermediate between the crocodile and fish. A fish lizard.

Induction. A consequence, conclusion, or inference, or some general principle drawn from facts or phenomena.

In-situ. Original position.

Isothermal. Equality of temperature. Zones, lines, &c. where an equality of temperature prevails are called *isothermal.*

Lacustrine, of, or belonging to, a lake.

Laminæ. Plates, sometimes used as synonymous with layers.

Landslip. Land which has slidden down an inclined plane, from its position in a bank or terrace. It is generally produced by water, which either undermines the mass of earth, or insinuates itself into it, so as to render it semi-fluid.

Line of Bearing. The point of compass to which the anticlinal ridge or line runs, or is directed. When the anticlinal ridge cannot be determined, the *line of direction* may be known by ascertaining the intersection of the planes of the strata with the plane of the horizon, that will be the line of bearing.

Lithological. The character of a rock or formation considered with reference solely to its mineral composition.

Lignite. Wood partially carbonized in the earth; it usually retains the vegetable structure. The change does not seem to have been effected by heat, but is the result of some chemical process, as the action of pure sulphuric acid in some instances, and of water in others.

Littoral, of, or belonging to, the shore.
Loam. A mixture of sand and clay.
Mural Escarpment. A rocky cliff, more or less inclined.
Mammillary. Protuberances on the surface of a mineral, which are segments of a sphere; mammæ, breasts.
Mammoth. An extinct species of animal, allied to the elephant.
Marl. Any mixture of clay and carbonate of lime, which effervesces with acids.
Matrix. Gangue. The mineral mass which is in immediate contact with the ore of a metal, both of which constitute a vein.
Manganese. A hard black mineral, resembling the dark coloured hematites. It is the oxide of manganesium, one of the metals.
Megatherium. One of the extinct fossil quadrupeds, resembling the sloth.
Mechanical origin of, Rocks composed of sand, pebbles, &c. or sedimentary rocks generally, are said to have a mechanical origin. The term is used in contradistinction to rocks having a crystalline structure, which have a chemical origin.
Mica. Sometimes called isinglass. A mineral, which may be split into numerous elastic laminæ.
Mica slate. A primary rock, composed of fine grains of quartz, and generally small scales of mica. It is eminently fissile.
Miocene. An era or period subsequent to the eocene, and characterized by a greater proportion of animals analogous to those now living. Deposits formed during this period are termed miocene strata.
Molusca. Moluscous animals. Those soft animals, whose covering is a thick shell, as oyster and clam.
Monocotyledonous. One of the grand divisions of the vegetable kingdom. It includes the grasses, palms, liliaceæ, and whose seed have only one lobe.
Mountain limestone. A series of limestone strata immediately below the coal measures.
Muriate of Soda. The chemical name for common salt, because it is composed of muriatic acid and soda.
Naphtha. A very thin volatile, inflammable liquid, of which there are springs in some volcanic districts.
New Red Sandstone. A series of sandy, argillaceous, and often calcareous strata, whose predominant colour is brick red, but contains many spots and stripes, which are gray and greenish gray. It is therefore sometimes called the variegated sandstone. It overlies the coal measures.
Nucleus. A solid central piece, around which layers of the same or other matter has collected. The kernel.
Old Red Sandstone. A rock belonging to the carboniferous group.
Oolite. Oolitic. A limestone composed of rounded grains, like the roe or eggs of fish. The name is applied to a large group of strata, characterized by peculiar fossils. Only a part have this peculiar structure.
Orthocera, orthoceratite. An extinct genus of animals belonging to the order Mollusca. They inhabited long strait tapering shells, divided into parts by septa or partitions. Common in the transition or Trenton Falls limestone.
Outcrop. The edges of strata, as they appear at the surface.

INDEX.