THE

ANNUAL REPORT

OF

Prof. Geo. H. Cook, State Geologist,

TO

HIS EXCELLENCY JOEL PARKER,

PRESIDENT OF THE BOARD OF MANAGERS

OF THE

GEOLOGICAL SURVEY OF NEW JERSEY,

FOR THE YEAR 1864.

TRENTON, N. J.
PRINTED AT THE "TRUE AMERICAN" OFFICE
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REPORT.

To His Excellency Joel Parker, President of the Board of Managers of the Geological Survey of New Jersey:

SIR:—I have the honor to report that in accordance with the plan submitted to you at the meeting in May last, the work upon the Geological Survey was resumed on the opening of spring, and has been steadily prosecuted since.

Mr. John C. Smock, who was appointed Assistant Geologist, has been constantly engaged in tracing out the boundaries of the rock formations in the northern part of the State. He has but just closed his field-work for the season, and has not been able to write out the results of his work for this report. The writing out of his notes in full, and recording his observations, together with chemical examinations of various specimens collected in his summer's work, will keep him profitably employed during the winter. The pains-taking labor which he has performed will be appreciated when the final results are published.

Major T. B. Brooks, who was connected with the Topographical Survey of Sussex County, has been engaged for a part of the time since September first, in a magnetic survey of the iron ore district. He has already made a pretty full survey of the Ringwood mines, and is now engaged among the well-known iron mines of Morris County. His work is not yet mapped out, but it gives promise of adding valuable knowledge to that already known of our important iron mines.

Prof. David Murray has spent some time during the summer in arranging the materials we already possess and commencing the projection of a map of the State. The scale adopted is two miles to an inch. This work will be carried forward as the Survey advances, and, I trust, will be ready by the time the Survey is done.

Mr. Charles C. Abbott has voluntarily devoted himself to the preparation of annotated catalogues of the vertebrate animals of the State. He has already completed that of the birds, and has made considerable progress with that of the reptiles. These catalogues will make an interesting feature in our Natural History.

Prof. D. T. Reiley has given his services in the collection of suites of the minerals found about the zinc mines in Sussex. This collection contains some rare and valuable specimens, and is the beginning of the series of collections which must be made to illustrate all the important localities in the State.

It will be remembered, that, in consideration of the small amount of money appropriated to the Survey, and the magnitude of its work, the Board authorized me to ask from the several railroad companies of the State, free tickets for myself and assistants while in the prosecution of the Survey; and also that they furnish such information from their surveys as may be properly used in the construction of maps and profiles. I take pleasure in reporting that we have received free tickets on the Camden and Amboy, the New Jersey, the Central, the Warren, the Morris and Essex, the Sussex, the New York and Erie, the West Jersey and its connecting roads, the Camden and Atlantic, and the Raritan and Delaware Bay Railroads.

The United States Coast Survey and the Smithsonian Institution have proffered valuable material and aid for the completion and publication of the Survey. And gentlemen in all parts of the State have, with a most hearty interest in our work, given information and assistance such as could not have been worked out without a heavy expense in time and money. In

fact, the results of the Survey will, to a great extent, consist of knowledge obtained from different individuals.

Information in regard to the geological and other resources of the State has been sought by parties interested, and wherever it could be given without detriment to the work in progress, it has been done, with the understanding, in all cases, that whatever facts are ascertained must be public, and used in the prosecution and publication of the final report. It is a satisfaction to know that information communicated in this way has been made useful.

The last report gave an enumeration of the several geological formations of the State, with references to a section which had been made across them from Shark River Inlet, on the Atlantic shore, in Monmouth County, to the Delaware Water Gap, in Warren County. This year a considerable part of the work has been in defining the outlines of these formations, as they exhibit themselves in belts of greater or less width, extending across the country from the northeast to the southwest. The line between the red sandstone and the gneiss and white clays has been traced, as heretofore, in a nearly direct course from Trenton to the Raritan River, a little below the mouth of Lawrence's Brook. North of the Raritan the line is exceedingly crooked and obscure to Staten Island Sound, near Woodbridge. On Staten Island it crosses almost straight from Fresh Kills to Port Richmond. In New York Bay the line passes near and to the west of Robins' Reef, Oyster Island, Bedloe's Island, and Ellis Island. It then passes back of Jersey City and Hoboken to the North River, below Weehawken.

The gneiss rock which once formed the southeastern boundary of the red sandstone across the State, has been decomposed almost entirely, and its place is now marked by the white clays which have originated from the decomposition of its feldspar. In places where the rock is yet found, as at Trenton, it can be seen with this process of decomposition only part

completed. The gneiss rock itself can be seen at Trenton, on this line, for two or three miles. Northeast of this, it is not seen again until Staten Island is crossed, where it appears just at the Quarantine Landing. It is next seen in some of the low grounds near the river bank in Jersey City. Next it is found on New York Island, about Fortieth Street.

There can be little doubt that this narrow ridge of rock has, at some time, formed the western bank of the North River from Jersey City down to Robins' Reef. There are now three Islands between these two points, viz: Ellis', Bedloe's, and Oyster Islands, and the water between them is shallow and the bottom hard and without mud. Oyster Island, which is seen only at low water, and Robins' Reef, which is seldom bare, still have in their soil the roots of trees, showing that, at no long time since, they supported a growth of wood, though they are now five or six feet below high water mark. The bay, which is to the west of this line, is mostly filled with mud like that now found in the salt marsh. And along the shores, in some places, meadow sod is found under the mud, and much below high water mark. The grounds along the shore have been encroached upon in some places by the tide water. At Caven Point, it is said, that several years ago three acres of upland were washed away within two years. All the circumstances, connected with this bay, point to the conclusion that it has once been a tide meadow, with channels of deep water traversing it in various directions, and having in it low knolls of upland, which are now only marked by rocks and hard ground at the bottom of the water.

The Serpentine rock, which is found at Hoboken, and also on Staten Island, is, without doubt, directly upon the northwest side of the gneiss and adjoining the sandstone, though no place is known where they can be seen in immediate contact.

The northwest boundary of the Red Sandstone is defined by a line starting from the Delaware River at the ferry six miles above Milford, and following a direct line to Little York, and

on within a mile of Clinton; there it makes a detour south by Allertown, and around by the Round Valley Brook to Lebanon. From Lebanon the line is quite direct to Peapack, and almost to Mendham. Thence the line returns and passes around Mine Mountain and along its southerly foot near Basking Ridge, New Vernon and Morristown. There are immense deposits of gravel and earth covering the rocks, so that the line cannot be traced with any accuracy from Morristown to the Rockaway River, near Old Boonton, where the sandstone is seen in the bed of the river. It can be seen again at Montville, Pompton, and along the southeast foot of Ramapo Mountain to near Suffern's, which is just beyond the State line in New York.

There is no place on the whole of this line where the red sandstone or conglomerate has been seen in contact with the gneiss or limestone, though they are in many places within a few feet of each other. Such a locality would be exceedingly interesting and instructive.

The tracing of this line is important, for the northwest border of the sandstone, in many places, is made up, to a large extent, of limestone pebbles and boulders, which form a conglomerate, so firm that it can be burned for lime, and it is burned for that purpose at Lebanon, New Germantown and Pompton. This line also meets obliquely several long narrow belts of blue limestone. The limestones at Holland, Little York, Clinton, Allertown, Pottersville, Peapack and Mendham, are examples of these, and are well known by their use in agriculture and in building.

In the red sandstone between Clinton and Clinton Station, on a hill a half mile south of the road between the two places, and on the land of J. T. Leigh, Esq., black oxide of manganese was discovered. An opening had been made, apparently to search for iron ore, and the mineral dug out was left lying upon the ground. It was said to be hematite, but as it bore a strong resemblance to oxide of manganese it was analyzed and proved

to be that substance. The opening appears as if it were upon a vein three or four feet wide, nearly perpendicular, and without any gangue or vein stone. An analysis shows it to contain forty-five per cent. of black oxide of manganese.

Black oxide of manganese is in demand for the manufacture of bleaching powders, and, if sufficiently abundant, would find use in other arts.

The *Limestones* which lie in the valleys of our Highland range of mountains, along Peapack Brook and the South Branch, Musconetcong, Pohatcong, Pequest and Paulins Kill streams, have been carefully traced out in their boundaries, and the different varieties of pure limestone, magnesian limestone, and cement, to some extent studied, and their order of arrangement determined. The magnesian limestone has been the one chiefly burned for lime heretofore, but a fossiliferous limestone, which is almost free from magnesia, is to be found at several localities in Sussex and Warren Counties. The only place where it is now burned is at the kiln of Mr. A. T. Mains, near Stillwater.

The following analyses will show the difference in composition between this fossiliferous limestone and the magnesian :

Analysis of a Fossiliferous Limestone from the Quarry of J. T. M'Carter, Esq., Newton, Sussex County.

Carbonate of lime, - - - -	87.50
Carbonate of magnesia, - - -	1.98
Alumina and oxide of iron, - -	4.70
Silica and insoluble matter, - -	5.80
	99.98

Analysis of a Magnesian Limestone from the Quarries in Belvidere, Warren County.

Carbonate of lime, - - - -	52.90
Carbonate of magnesia, - - -	42.26
Alumina and oxide of iron, - -	1.40
Silica and insoluble matter, - -	2.90
	99.46

The first of these has not been used for burning into lime. The latter is used in large quantities, and is in good repute.

But pure lime has decided excellences over that containing magnesia, for agricultural and building purposes, and for use as a flux in the manufacture of iron. It swells more in slaking, a smaller dressing is needed for land, it takes less to make mortar, and is usually of a purer white and more suitable for whitewashing.

At Peapack there was a considerable quantity of hydraulic lime burned and ground for use in building the locks of the Morris Canal. It has proved to be of good quality, but on account of location away from lines of canal or railroad, it has not been much sought after. Stone, which will yield a good hydraulic cement, has been found in other places in this formation.

The *Slate* which underlies so large a portion of Sussex and Warren Counties, has been traced out in the numerous and intricate folds by which it is mixed in with the limestone, but the details in regard to this would be out of place here. In addition to the importance of this rock as the basis of a most productive soil, the increased prices of shingles, tin, etc., has drawn attention to it as the source from which to obtain a cheap and durable roofing material. At present it is probably the

most satisfactory roof, for cost and quality, that can be put on a building. There is a large slate quarry at the Delaware Water Gap, Warren County, which has been opened for a good many years, and yields first quality slates. A quarry is also worked at Lafayette, Sussex County, and one is being opened at Hackettstown. The demand for slates is greater than can be supplied with the present scarcity of labor, but the material is in sufficient quantity, and must eventually be wrought.

The *Conglomerate* on the top and west slope of the Blue Mountain, in connection with the *Medina Sandstone* which lies upon and northwest of it, have attracted much attention within the last year or two, on account of a lead mine of extraordinary richness having been opened in this rock three or four miles northeast of the State line in New York. Lead ore is said to have been found in this formation in New Jersey, though there are no mines of that ore in it that are now worked. The district along the whole slope of the mountain should be thoroughly "prospected." A copper mine upon the same westerly slope, in the township of Pahaquarry, has been opened, but is not now worked.

Northwest of the Blue Mountain, in the valley of the Delaware and its branches, the lines of meeting of the sandstones and limestones were being traced out when the snow set in. Though the district is limited in extent, from what is already known it is presumed that all the important members of the Silurian and Devonian, from the *Medina Sandstone* of the former to the *Marcellus Shales* of the latter, will be identified. The sandstones and limestones of this formation furnish an abundance of good building materials, and the limestones, shell-marls, and travertin supply an abundance of the best fertilizers.

The Highland Range of mountains, in which the rich beds of *magnetic iron ore* are found, has been the subject of special examination, with the design of finding some method of search-

ing for the ore which might be uniform and easy in practice, and satisfactory in its results,—one for which such plain directions could be given that persons interested in this region could make searches for themselves.

It is well known that these beds of ore are interposed between the layers or strata of the gneiss rock, and differ from the strata only in that after extending along the surface for from a few feet to many hundred rods, they thin out and are lost:

That like the rock they have a general direction, or *strike*, from northeast to southwest:

That the layers or strata of the rock, and the beds of ore likewise, stand on edge, with an inclination or slant downwards towards the southeast. This inclination is called the *dip* or *underlie*:

That the beds of ore, as they descend beneath the surface, extend farther and farther towards the northeast. This latter direction is locally called the *pitch* of the ore:

That these beds are not uniformly distributed through the gneiss rocks; in some parts they abound, while in others no mines of value have ever been found. The most productive mines as yet worked have been in the central parts of the range, but as the demand for ore increases other mines are being sought for in the less promising districts. Among new ones opened recently are several along the southeast border of the Highland range, and not far from the red sandstone formation. Beginning at the southwest in Hunterdon County, in the township of Bethlehem, near Van Syckel's, there is a mine worked by the Lehigh Valley Iron Company. Only one opening has been made, but a large quantity of ore is exposed in that. Another mine has been opened about two miles west of Walnut Grove, in Morris County. The bed has been uncovered in several places, and shows a thick and continuous mass of ore. It is worked by the Bethlehem Iron Company. About a mile west of the church at Pompton, Passaic County, an iron

mine has been opened by J. H. Jackson, Esq., and a considerable quantity of ore taken out. On the Ramapo Mountain, in the township of Hohokus, Bergen County, about three miles east of Ringwood, a bed of ore has been uncovered at two or three points, but working upon it has not yet commenced.

The magnetic needle, in some form of mounting, has long been used in the search for iron ore, and probably will still continue to be used. The compass, with a dipping needle, is coming into general use for this purpose, and gives satisfaction. A very excellent instrument of this kind has been prepared for the Survey by W. & L. E. Gurley, of Troy, N. Y.

When not affected by local attraction the needle of this instrument is horizontal, but is disturbed by a very slight attraction. In the case of ores which are themselves magnetic, the north or south end of the needle is drawn downwards, according to the polarity of the ore; while those ores which are not themselves magnetic draw down the north end of the needle uniformly. With the instrument held in position, that is, with the box on edge and the needle settled and pointing north and south, the observer can move forward at a moderately slow walk without causing the needle to vibrate, unless it is disturbed by some attraction, when a movement can be seen at once. The usual direction of the beds of ore being from northeast to southwest, the proper method is to traverse the tract under examination in lines running northwest and southeast, so that if any beds of ore are in it they may be detected when the compass crosses them. By repeated crossings some judgment can be formed of the width and length of the bed.

The force with which the needle is drawn downwards is in some proportion to the extent of its movement, but this movement does not indicate the amount of ore, the attraction depending partly on the distance of the ore beneath the surface, and partly on the magnetism of the ore itself, and both these causes are extremely variable.

By the aid of this instrument it is hoped that the beds of ore

now worked can be traced out in their extension on the surface, and in their connection and relation to each other. They can then be laid down upon a map and arranged for the general study and use of all. There is a great amount of local information in regard to our iron mines which, when collected and arranged, will do much towards giving a rational theory of them, and the best modes of working them.

The *Zinc Mines* of Sussex continue to be worked with energy and success, yielding ore enough to supply a large portion of the zinc white used in the United States, and also a considerable amount of metallic zinc. At Franklin Furnace, and at Stirling Hill, the ore occurs in beds similar to those of magnetic iron ore, except that its associated rock is a white limestone instead of gneiss. The zinc ore of the Saucon Valley Mines, near Bethlehem, in Pennsylvania, though in the gneiss region, is found in blue limestone, and has much more the appearance of a deposit in cross and irregular fractures in the rock. The Bethlehem ore is a hydrous silicate, while that of the Sussex mines consists of franklinite, red oxide of zinc, and anhydrous silicate of zinc. It is, however, remarkable, that at the southwest end of the Sterling Hill mine the hydrous silicate of zinc occurs, and under circumstances to favor the opinion that it has been produced by the decomposition of the anhydrous ores, and a re-precipitation in its present form. The Andover iron mines, which are in the range between these two great zinc mines, contained zinc in some of their ores, and it is not unreasonable to look for other mines of zinc in the same range.

The silicate of zinc has no metallic lustre, and some of its varieties might easily be mistaken for limestone. But this, as well as other ores of zinc, can be easily distinguished by the following test: Take an ounce or two of the mineral and crush it to powder, then throw it upon a common blacksmith's fire, and urge the heat by blowing. If it contains zinc a thick

white smoke will rise, and portions of this smoke which condense in the cooler parts of the fire will appear yellow when hot and white when cold.

Black Lead is said to have been found at several localities within the last year or two. One locality was visited. It is upon the land of Mr. Elias Englemann, about a mile and a half northeast of Peapack, in the township of Chester, Morris County. It occurs in the gneiss rock, in a vein which is between four and five feet thick, almost vertical, and with a strike of north seventy degrees east. The mineral is not pure, being mixed with the disintegrated gneiss. It is said to have been traced for several hundred feet upon the surface, but was open in only one place when visited. It could be mined cheaply.

Lead Ore has been mined in considerable quantity by the Sussex Lead Company, at their mine in Newton Township, Sussex County. The ore has not yet been dressed or smelted. The present high prices of lead have stimulated mining enterprises remarkably. And it is said by those familiar with the subject, that at present prices, and with the best machinery for dressing the ores, those yielding three per cent. of lead will pay the expenses of working.

The *White Limestone* which is found interstratified with the gneiss rock, along the entire northwestern border of the Highland range in Warren and Sussex Counties, is worthy of more attention than it has yet received, as a source of pure lime. It has been burned at Hamburg and at Andover, for some time past, and its use is commencing at a few other places, but not to the extent its qualities would warrant.

Analysis of White Limestone from near Oxford, Warren Co.

Carbonate of lime, - - - -	96.50
Carbonate of magnesia, - - -	1.13
Alumina and oxide of iron, - -	1.30
Insoluble matter, - - - -	.90
	99.83

This was a fine specimen; white, crystalline, and having the characters of good marble. Some of the white limestone is magnesian; the following, from near Ogdensburg, Sussex County, is an example:

Analysis.

Carbonate of lime, - - - -	53.00
Carbonate of magnesia, - - -	42.26
Alumina and oxide of iron, - -	3.50
Insoluble matter, - - - -	.50
	99.26

The *Fire* and *Potters' Clays* of Woodbridge, Amboy and Trenton are rapidly becoming the basis of large and important branches of manufacture. Fire-bricks of the best quality are made in great quantities near the clay pits, and the material is also sent to many other places to be manufactured. At Trenton the manufacture of pottery is conducted on a larger scale than anywhere else in the United States. There are now nine potteries in operation, which employ several hundred workmen, and manufacture crockery of the best quality in all the forms needed for table and toilet use. Another establishment is now in process of erection, which, when completed, will increase the facilities for this branch of manufacture full one-half.

In the Geological Reports of 1854, 1855 and 1856 it was shown that the marl region of the State, which comprises a belt of country from five to fifteen miles wide, and reaching from Raritan Bay and the Atlantic Ocean, on the northeast, to the Delaware River, on the southwest, was a regular geological formation, and that the rich beds of fertilizing material called *marl*, or *greensand*, were in three distinct layers, each from fifteen to thirty feet thick, and extending continuously across the State, parallel to each other and to the whole formation. It was also shown that the general bearing or *strike* of these beds was north fifty-four degrees east, and their *dip* or descent was towards the southeast, at the rate of twenty-five or thirty feet per mile. The pits from which the marl was usually dug were shown to be on the sides of valleys where streams of water had cut down their beds below the level of the country, and left the layer of marl which had been cut across exposed at its edges.

During the last season the West Jersey Marl Company has made a survey of the country from Mullica Hill by Barnsboro' to Blackwoodtown, taking the location and height above tide water of every marl pit at and between the above named places; and the results agree with, and confirm to a remarkable degree, the conclusions which had been stated in the former reports.

The marl continues to be used, and in increasing quantities, in all parts of the State to which it can be cheaply transported, and it is rapidly aiding to bring the most unpromising soils to a high degree of fertility.

The substance in the marl which gives it such remarkable fertilizing properties is phosphoric acid, probably combined with lime. Other constituents add to its value, but in a much smaller degree than this. A large number of analyses of marl have already been published, and many more are now ready, but it is not thought necessary to print them all until the pub-

lication of the Final Report. The following represent the most important varieties:

1. *Analysis of Spurious Marl.*—This was a fair specimen of the mixed greensand and dark-colored clay which is at the base of the greensand formation, and shows itself along the northwest border of the marl region. The specimen analysed was taken from the diggings of the Messrs. Ten Eyck, near Matavan bridge, Middlesex County.

2. *Analysis of Marl from the First Marl Bed.*—This is a characteristic specimen from the lowest well marked stratum of greensand. The localities where it is found are very numerous along the northwestern part of the marl district, but it is most extensively developed in Monmouth County. The specimen analysed was from a marl pit of J. B. Crawford, in Nutswamp, Monmouth County.

3. *Analysis of Marl from the Second Marl Bed.*—This is an average of the greensand in the stratum which traverses the middle of the marl district from the Atlantic to Delaware Bay. The specimen analysed was from the marl pit of R. Dickson, Woodstown, Salem County.

4. *Analysis of Marl from the Third Marl Bed.*—The specimen analysed was from the marl pit of Hugh Hurley, Shark River, Monmouth County, and is an average of the greensand of the stratum which is seen near the southeastern border of this formation from Deal, Monmouth County, to Clementon, Camden County.

	(1.)	(2.)	(3.)	(4.)
Phosphoric Acid,	1.15	1.12	2.65	3.73
Potash,	1.54	5.80	6.81	4.98
Lime,	2.52	11.67	1.04	4.15
Magnesia,	2.15	1.97	1.81	.47
Oxide of Iron,	31.50	16.93	19.80	18.70
Alumina,	6.00	7.18	8.04	8 18
Silica,	34.50	40.61	49.73	49.68
Sulphuric Acid,	1.27	.70	.11	2.44
Water,	18.80	8.10	8.34	7.37
Carbonic Acid and Loss,	.....	5 92	.....	.....
	99.43	100.00	98.83	99.70

The *Tertiary* and *Post Tertiary* formations, which make up the whole of the State southeast of the marl region, are now justifying the strong and decided representations which were made of their great agricultural worth in the annual reports of 1854, 1855 and 1856. With the construction of the Camden and Atlantic, Delaware and Raritan Bay, and the West Jersey and its branch railroads across them, which brought them in easy communication with markets, they are being rapidly sold off to actual settlers, and the district is filling up as fast as the new States of the West.

The undeveloped resources of New Jersey are immense, and only need to be really understood to be appreciated. Thus we have more than a million acres of good land which are still unoccupied and almost unproductive; and this, too, when the average price of farm land throughout the State is sixty dollars an acre. We have perhaps one hundred thousand acres of wild and unreclaimed meadow which only need the benefit of public attention and combined effort to quadruple their value. There are nearly a million acres of tide marshes that need the benefit of intelligent and well-directed enterprise to reclaim and bring them into agricultural use

Our limestones, the largest source of artificial manures, abundant as they are in quantity, are not alike in quality, and the results of the present year's survey show that the best are not generally known or used. The marls, singularly useful as they have been in changing what was a waste into a fertile soil, still exist in sufficient quantities to enrich all the soils of the State, and need to be generally and well understood in their geological relations, in order to invite their more extensive working and introduction to districts they have not yet reached.* The remarkable facilities we possess for gathering from the sea,

*There has been transported over the Freehold and Jamesburg Agricultural Railroad the last year 13,179 tons of marl; there has been sent by S. R. Gaskill & Sons, of Pemberton, over the Burlington and Mount Holly Railroad, 12,000 tons; and over the Camden and Atlantic Railroad 10,000 tons.

fish and other substances for the richest fertilizers, should be improved. Thos. Beesley, Esq., of Goshen, informs me that at a single establishment in Goshen, Cape May County, four hundred tons of *Cancerine* have been made and sold the past season. This fertilizer is composed entirely of king-crabs, dried and ground. It is worth about half as much as Peruvian guano.

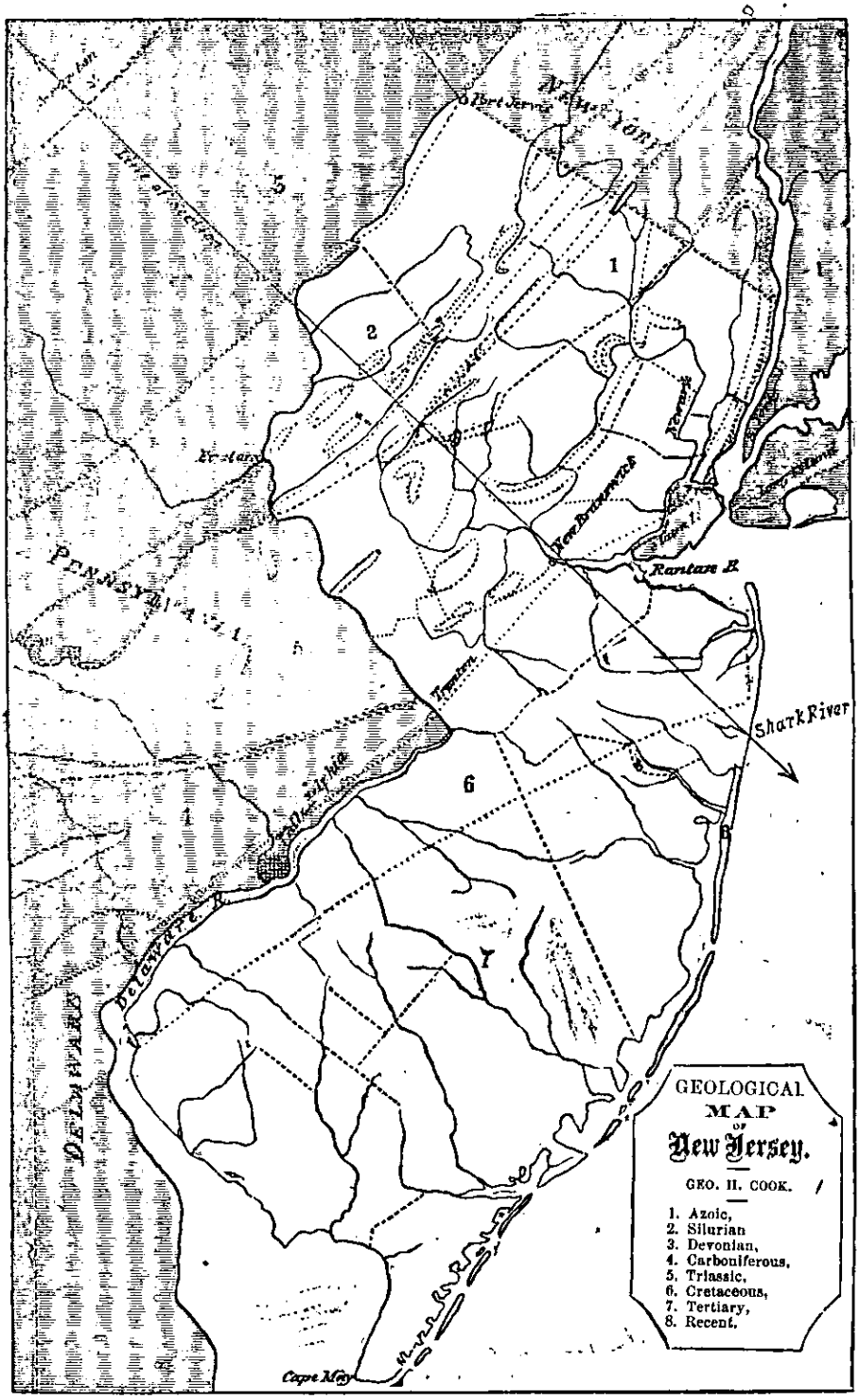
To the mining industry of the State the development of our resources is not less interesting than to the agricultural. Our rich mines of iron ore are yielding large and increasing returns every year. The President of the Morris Canal Company, W. H. Talcott, Esq., furnishes the following:—The amount of iron ore transported on their canal this year is 206,512 tons, against 176,531 tons in 1863. There are 20,000 or more tons mined besides the above, which finds its way to market by railroad or by teams. The price of ore this year, on the canal bank, is seven dollars a ton. There is as yet no systematic search for new mines carried on, and there is no such description of the occurrence of the ore as can become a guide for the mining engineer in economically opening and working new mines. Such a description is due to the heavy interests involved, and would do much to economise and extend our mining enterprises.

The same remarks apply to our zinc mines. In the copper mines there is still more necessity for the fullest examination, and the most careful description and publication. The localities in which copper ore appears are very numerous, and many mining enterprises have been undertaken, in nearly all of which ore was found, and yet the working has been generally unprofitable. It is to the interest of the State to have these mines and works so fully described that mining capitalists may be properly warned of the difficulties they present, and encouraged in what is of substantial value, in them. With the high price of copper, and greatly improved processes in reducing its ores, the mines at Belleville, and some others, are now successfully worked.

The topography of the State should be more perfectly laid down and described. Accurate maps aid wonderfully in studying the capabilities of a country for drainage, for supplying water, for projecting and carrying out works of internal improvement, and for selecting locations for important manufacturing enterprises. The water power in the streams of New Jersey has been a source of great wealth to the State. Paterson, Millville, Bridgeton, and many other places, owe almost their existence to power derived from the streams upon which they are built. At the very door of the best markets on the continent, in close proximity to inexhaustible mines of coal, with a soil from which to raise abundant and cheap supplies, and with the State traversed by great lines of railroad and canal, we possess unequaled advantages for the location of manufacturing towns. Take the Delaware River as a source of power for driving machinery. Its volume of water is immense even in the dryest weather,—greater by far than the Merrimac at Lowell. Its fall from Port Jervis to Trenton is not less than four hundred feet. "From the South Mountain below Easton to the tide-water at Trenton the river has a southwest course of about sixty miles, in which there are twenty-five noted rapids, with an aggregate fall of one hundred and sixty-five feet."—(*Gordon.*) The power which is here lying idle would, if improved, be sufficient to drive the machinery of a Lowell every ten miles, would furnish profitable investment for millions of capital, and create a large and constant home market for our farm and garden products.

I trust that this exposition of the work in progress, and of the value of the interests it is intended to develop, will be acceptable to yourself and the Board, and useful to the State.

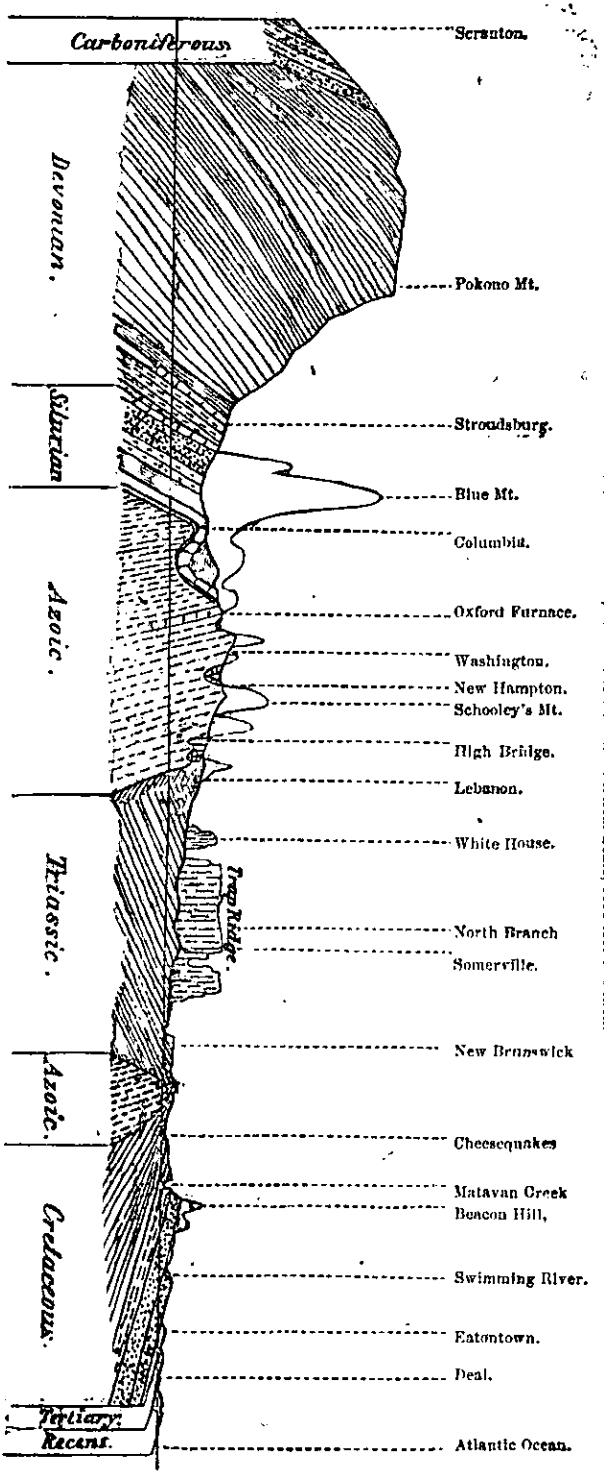
GEO. H. COOK, *Geologist.*



Geological Section from Shark River Inlet, N. J. to Scranton, Penn.

BY GEO. H. COOK.

Horizontal Scale, 16 miles to 1 inch. Vertical Scale, 1600 feet to 1 inch.



Tabular Statement to accompany the preceding Map and Section, giving the Geological Periods represented in New Jersey,—the principal rocks in the order of their occurrence, beginning with the lowest,—and some localities where the rocks may be seen.

1. AZOIC.

GNEISS AND SYENITE—Highland range of mountains and the rock at Trenton.

WHITE LIMESTONE—Vernon, Hamburgh, Franklin Furnace, Sparta, Andover, Jenny Jump Mountain, Oxford, Roxburgh.

MAGNETIC IRON ORE—Mines at Ringwood, Mount Hope, Succasunny, Oxford, and many others.

ZINC ORE—Sterling Hill and Mine Hill.

CONGLOMERATES AND SANDSTONES—Green Pond Mountain, Bearfott Mountain, and Copperas Mountain.

2. SILURIAN.

SANDSTONE—Franklin and Oxford Furnaces, and near Mount Bethel.

BLUE LIMESTONE—Valleys of Warren and Sussex Counties.

SLATE—Kittatinny and Longwood Valleys.

CONGLOMERATE—Blue or Shawangunk Mountain.

RED SANDSTONE—Northwest slope and foot of Blue Mountain.

GRAY SANDSTONE—Valley of the Delaware, above the Water Gap.

LIMESTONE—Valley of the Delaware, above the Water Gap.

3. DEVONIAN.

SANDSTONE—Valley of the Delaware, from Walpack Bend to Port Jervis.

LIMESTONE—Valley of the Delaware, from Walpack Bend to Port Jervis.

SHALE—Valley of the Delaware, from Walpack Bend to Port Jervis.

4. CARBONIFEROUS.

Not represented in New Jersey, but found in the adjoining parts of Pennsylvania.

5. TRIASSIC.

RED SANDSTONE—Paterson, Little Falls, Belleville, Newark, Trenton, and Milford.

RED SHALE—Everywhere in (5.) See Map.

BASALTIC OR TRAP ROCK—Bergen Hill, Palisades, Sourland Mountain, Rocky Hill, Range from Pluckamin to Paterson, &c.

6. CRETACEOUS.

FIRE AND POTTERS' CLAYS—Perth Amboy, Woodbridge, South Amboy, and Trenton.

DARK COLORED CLAY AND LIGNITE—Shore of Raritan Bay, Cheesequakes, ane Bordentown.

CLAY AND GREENSAND, "SPURIOUS MARL"—Matavan, Crosswicks, and Kincora.

GREENSAND, "FIRST MARL BED"—Nevesink Highlands, Middletown, Freehold, Cream Ridge, Shelltown.

FERRUGINOUS SAND—Red Bank Monmouth County, Mount Holly, ulli ca Hill, &c.

GREENSAND, "SECOND MARL BED"—Blue Ball, New Egypt, Pemberton, White Horse, Barnsboro', Woodstown, &c.

TERTIARY.

GREENSAND, "THIRD MARL BED," (EOCENE)—Deal, Shark River, Squankum, New Egypt, Pemberton, and Clementon.

CALCAREOUS MARL, (MIOCENE)—Jericho, Shiloh, Woodstown, and south of Mullica Hill.

LOAMY GRAVEL AND SAND—Central and Southern New Jersey.

RECENT.

ALLUVIAL LOAMS AND SANDS—Margin of upland along tide-water.

BEACH SANDS—Beaches of Sandy Hook, and the Atlantic Shore.

TIDE MARSHES—Newark and Hackensack Meadows, Salt Meadows along the Sea, and Delaware Bay Shores.

SWAMPS AND WET MEADOWS—Cedar Swamps, Long Meadow, Whippany and Passaic Meadows.