

GEOLOGICAL SURVEY OF NEW JERSEY.

ANNUAL REPORT

OF THE

State Geologist,

FOR THE YEAR 1874.

TRENTON, N. J.:

PUBLIC OPINION—WM. S. SHARP, STEAM POWER BOOK AND JOB PRINTER.

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STATE GEOLOGIST.

GEORGE H. COOK,	-	-	New Brunswick.
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To His Excellency, Joel Parker, Governor of the State of New Jersey, and ex-officio President of the Board of Managers of the State Geological Survey:

SIR:—Herewith I have the honor to submit my annual report on the progress of the State Geological Survey, for the year 1874.

With high respect, your obedient servant,

GEO. H. COOK, .

State Geologist.

New Brunswick, December 29, 1874.

REPORT.

The Geological Survey of New Jersey, has been continued through the present year, in the field, the laboratory, and the office; and an account of the persons employed and the work done is herewith presented.

PROF. JOHN C. SMOCK, *Assistant Geologist*, has been employed only a part of the year. He has been chiefly engaged in the survey and description of the beds of fire-clay and potters-clay, which are worked in Middlesex, Mercer, Burlington, Camden and Gloucester counties. A small part of his time has been given to the examination of clay beds in other parts of the State, and to some new iron mines.

EDWIN H. BOGARDUS, *Chemist*, has been steadily engaged through the year in the miscellaneous work of the laboratory; analysing ores, minerals, rocks, clays, soils, fertilizers, &c.

PROF. EDWARD A. BOWSER, *Engineer and Surveyor*, was engaged during July and August in surveying and tracing out the Northern Boundary of the State.

JAMES K. BABTON, C. E., assisted Prof. Bowser in the survey of the Northern Boundary, and for the last two months has been occupied in surveying and mapping the fire and potters' clay district of Middlesex county.

SPENCER H. C. DEVAN and JOSIAH TICE, students of engineering in Rutgers Scientific School, also assisted Prof. Bowser in surveying the Northern Boundary.

My own time has been occupied in superintending the various operations of the Survey on the Northern Boundary, and those for demonstrating the geological structure of the series of clay beds, and in arranging the various details of work necessary to be done in order to present our work in form for practical use. The letters of inquiry for the published results of the survey, and for information in regard to ores, limestones, clays, building stones, &c., are increasing year by year, with the more general distribution of the reports on our geology. Such inquiries are always answered as fully as possible; and also those inquiries with which specimens are submitted. Much valuable time in the laboratory and office is necessarily consumed in this way, but such is the proper consequence of attempting to answer the inquiries of intelligent and interested men.

The Northern Boundary Line.

In the last annual report it was stated that the U. S. Coast Survey Officers had taken observations at Carpenter's Point, so as to determine the latitude and longitude of the point which marks the western end of our northern boundary, and to compute the direction and length of the straight line from thence to the monument on the bank of the Hudson, which marks the eastern end of that boundary. These essential data were received from Capt. Patterson, the Superintendent of the Coast Survey in the early part of the summer, and a straight line between these two marked ends has been traced through. The old line of monuments has been surveyed throughout, and the position of each of the monuments, so far as they can be found, has been ascertained and its distance from the straight line has been measured. The old line was originally marked by stone

posts, one of which was set at the end of each mile. The line of these monuments is south of the straight line throughout its whole length; at the two ends it departs slightly, but increases in distance every mile, and through all the middle part of the line, where for several miles it runs across the mountainous region of the State it is quite crooked. The greatest distance that the old line is south of the straight line is at the twenty-sixth mile-stone, which is two thousand four hundred and fifteen feet off from the straight line. The straight line, as run this year, was determined with instruments loaned to the Geological Survey by the U. S. Coast Survey. The theodolite was an excellent one and very long sights could be taken with it. One was eighteen miles long, another was seventeen miles, and nearly all the sights were several miles in length, so that a great degree of accuracy was insured, and there is probably not a deviation of four feet in the whole distance. The old line was run with the surveyor's compass, and was run from both ends. In the best case this would have been a kind of rhumb line, but it was made still worse by the variation of the needle being different at the two ends, to the amount of about two degrees, and being less at one intermediate point than at either end. Local attraction in the mountainous region has helped too in making the line crooked. Of the forty-eight mile-stones originally set to mark the line, the places of seventeen cannot now be found. If these monuments had to be replaced, it would be impossible to locate them precisely in the same spot they formerly occupied, for the old line of monuments is crooked, curving to the south, and this curve is irregular. There are thirteen cases in which ranges of three successive mile-stones can be found, and in these the middle one varies from the straight line between the two end ones by distances of seven, eight, eight, nine, fourteen, eighteen, twenty-two, twenty-seven, forty, fifty-three, one hundred and twenty-one, one hundred and fifty-two and two hundred and five feet respectively.

As it would be impossible to retrace the line with precision where the monuments are gone; as the terminal and intermedi-

ate monuments are all on private property, so as to be at some extent subject to the control of the land-owners; as the property bounding on the line though generally of moderate value, may, as in the case of the mineral lands, be very valuable; and as important questions of jurisdiction may at any time arise, it is desirable to have some joint action with the State of New York, by which the true division line between the two States may always be found, and legal control over the monuments marking it be acquired.

The particulars of the work connected with the northern boundary are given in detail in the report which was submitted to the Board of Managers on the 8th of September last, which report has been printed with the accompanying map and is herewith presented.

Drainage Plans.

The work of draining the Great Meadows, on the Pequest, in Warren county, is fairly begun. The Commissioners let out the work of lowering the bed of the stream from the lower end of the meadows, near Larison's bridge, to a place some distance below the Danville bridge. The contract requires it to be finished in 1875, and already the work is well advanced. The fish-weirs are taken out, some of the bars are lowered, many sharp bends in the stream somewhat straightened, and the channel brought to the full width of thirty feet. The heavier part of the work in lowering the bed of the stream down to the line of a uniform grade is to be done by a steam dredge. This is already constructed and ready, and it is expected that work with it will soon begin. The dredge is on two narrow and parallel scows, which float in the water. The work is to begin at the upper end, and the earth to be dredged out in front of the scows as they move on down the channel,—the passage being made of the proper width and depth as they go forward.

The opening of the outlet in this way is the essential part of the work; and it is expensive. But when once well done it

will be done for all time ; and it will soon show its value and importance. Already the small amount of work done in lowering the bed of the stream near Larison's bridge has let down the surface of the water in the meadow just above the bridge nearly a foot and a half ; and little streams begin to run in the adjacent meadow which have never been seen before. The meadow has been like a great sponge into which streams of water could run and be entirely lost,—and, like a sponge, it would never allow the water to run out so that it could become dry. There are a large number of streams which are lost in this way. Two streams on which saw-mills have been built are among these which run into the meadow and are lost. Whenever the channel is sufficiently deepened this spongy meadow will drain out, and these unsightly marshes and swamps can all be reclaimed, and the whole valley made attractive and desirable.

The full benefits of an improvement of this magnitude cannot, however, be realized in a single year. They will first be felt at the lower end of the meadows, and as the channel scours and is cleaned out further up, the spongy marshes will gradually drain out and settle, and then the waters from the upland will find their way directly to the Pequest, and so run off at once. And it is not unreasonable to expect that the beautiful flats of dry ground which are now seen about Long bridge and above, will finally extend further and further down till they reach quite to Danville.

The drainage of the wet lands on the Passaic and its tributaries, between Little Falls and Chatham, has not yet been begun. The land owners are still earnest for the work, but in addition to the expense of the improvement itself, they are obliged to raise a large sum of money to pay for the damage done to the water power at Little Falls ; and this payment must be tendered before the work can be begun. The financial difficulties of the country and the careful restrictions of the drainage law, have prevented the Commissioners from raising the necessary funds. There is an urgent necessity for the work being done, not only to bring the lands into productive and secure use, but

also to improve the salubrity of the district, and to make available one of the most beautiful, and except for this lack of drainage, one of the most attractive valleys in the State.

The expense of the work is to be met by a tax upon the lands benefited, and they are liable for it, but the land owners are not capitalists, who can raise money beforehand to pay for so large an improvement as this, and they would naturally be very reluctant to sell or encumber their property to make such payments in advance. It would be a wise use of the public credit if the Legislature would authorize the Commissioners of the Sinking Fund to invest the moneys of the State in the bonds of the Drainage Commissioners; thus they could be negotiated at par as the law requires. The expenses of the drainage for which the bonds are issued are to be paid by a tax upon the lands benefited, so that the security is ample; and the funds of the State could be made doubly useful in bringing safe and fair returns to the public revenues, and in fostering most important public improvements. A few years since the English Government loaned \$5,000,000 to land owners, to be expended in draining farm lands,—receiving it back in small annual payments, of such amount that the whole principal, with interest, would be repaid in about twenty years. The loan was very popular, and an amount equal to more than twice that sum was applied for.

Iron Mines in Northern New Jersey.

The business of mining iron ore has been carried on with less energy than it was last year, on account of the depressed condition of the iron manufacture and trade. But as some new developments have been made, and the subject is still one of great practical importance to the State, we print a list of the mines mentioned in the last year's report, together with those which have been opened or largely extended since that was printed.

The arrangement of the mines in the list is a geological one,

the whole district in which the mines of magnetic iron ore is found, being divided into four parallel belts, which extend lengthwise, in a northeast and southwest direction. They are plainly marked on the maps by differences in color. The southeastern is the *Ramapo Belt*, that next to it is the *Passaic Belt*, the next is the *Musconetcong Belt*, and that on the northwest side is the *Pequest Belt*. The name of the mine or its locality is given in the first column and the page of last year's report, (where something is said of each mine) is given in the second column. Notes upon the new mines are appended to this list, and are designated by letters.

The mines of hematite iron ore are put down in the list after the mines of magnetic iron ore.

Magnetic Iron Ore.

MINES OF THE RAMAPO BELT.

SOMERSET COUNTY.

						Page of Report for 1878.
Bernardsville,	-	-	-	-	-	24
Janes' Mine,	-	-	-	-	-	24

MORRIS COUNTY.

Connet Mine,	-	-	-	-	-	24
Taylor Mine,	-	-	-	-	-	25
Cole Farm,	-	-	-	-	-	A.
Kahart Mine,	-	-	-	-	-	25
Lanagan Mine,	-	-	-	-	-	26
De Bow Mine,	-	-	-	-	-	26
Jackson Mine,	-	-	-	-	-	26
Ryerson's De Bow Mine,	-	-	-	-	-	27

PASSAIC COUNTY.

	Page of Report for 1873.
Brown Mine, - - - - -	B.
Kanouse Mine, - - - - -	28, C.
Butler Mine, - - - - -	28

MINES OF THE PASSAIC BELT.

HUNTERDON COUNTY.

Large's Mine, - - - - -	28
High Bridge Mines, - - - - -	29
Old Furnace Mine, - - - - -	29
Cokesburgh Mine, - - - - -	29
Fox Hill Mine, - - - - -	30, D.
Pottersville Openings, - - - - -	30
Bartle's Openings, - - - - -	30

MORRIS COUNTY.

Pottersville (northeast) Openings, - - - - -	30
Rarick Farm Diggings, - - - - -	31
Pitney Farm do. - - - - -	31
Hardin Farm do. - - - - -	32
Budd and Woodhull, - - - - -	32
Topping Farm, - - - - -	32
Samson Mine, - - - - -	33
Hotel Property, - - - - -	33
Collis Farm, - - - - -	33
Creamer Farm, - - - - -	33
Swayze Mine, - - - - -	33
Hacklebarnéy Mine, - - - - -	35
Gullick Mine, - - - - -	36
Creager, or Peach Orchard Mine, - - - - -	36
Hedges' Mine, - - - - -	37, E.
Dickerson Farm Shafts, - - - - -	37

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Creamer Farm, - - - - -	38
De Camp Mine, - - - - -	38
Leake Mine, - - - - -	38
Daniel Horton Mine, - - - - -	38
Barnes' Mine, - - - - -	39

Randolph Township.

David Horton Mine, - - - - -	39
De Hart Mine, - - - - -	40
Carbon, or Dalrymple Mine, - - - - -	40
Trowbridge Mine, - - - - -	41
Lewis, or Herrick Mine, - - - - -	42
Combs' Mine, - - - - -	42
Cooper Mine, - - - - -	42
Solomon Dalrymple Farm, - - - - -	42
Canfield Mine, - - - - -	42
Canfield Phosphatic Iron Mine, - - - - -	43
J. D. King Mine, - - - - -	43
Henderson Mine, - - - - -	43
Bryant Mine, - - - - -	43
Connor Foulan Mine, - - - - -	43
Charles King Mine, - - - - -	43
King Mine, - - - - -	43
McFarland Mine, - - - - -	43
Evers Mine, - - - - -	43
Brotherton Mine, - - - - -	43
Erb Mine, - - - - -	43
Scrub Oak Mine, - - - - -	43
Dickerson Mine, - - - - -	43
Byram Mine, - - - - -	43
Baker Mine, - - - - -	43
Millon Mine, - - - - -	43
Randall Hill Mine, - - - - -	43
Jackson Hill Mine, - - - - -	43
Irondale Mines, - - - - -	43

Rockaway Township.

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Washington Forge Mine, - - - - -	44
Mount Pleasant Mine, - - - - -	44
Baker Mine, - - - - -	44
Richards' Mine, - - - - -	45
Allen Mine, - - - - -	45
Teabo Mine, - - - - -	45
Mount Hope Mines, - - - - -	45
Johnson Hill Mine, - - - - -	46
Huff Mine, - - - - -	46
Dolan Mine, - - - - -	46
Swedes Mine, - - - - -	46
Sigler Mine, - - - - -	47
White Meadow Mine, - - - - -	47
Hibernia Mines, - - - - -	47
Beachglen Mines, - - - - -	47
Tichenor's Diggings, - - - - -	47
Righter Mine - - - - -	47
Meriden Mine, - - - - -	47
Splitrock or Cobb Mines, - - - - -	47
Splitrock Pond Mines, - - - - -	47, F.
Greenville Mine, - - - - -	48
Chester Iron Company's Vein, - - - - -	48
Pardee Mine, - - - - -	48
Green Pond Mines, - - - - -	48, G.
Bancroft Shaft, - - - - -	H.
Charlotteburg Mines, - - - - -	49

Pequannock Township.

John Botts Farm, - - - - -	49
DeCamp Mine, - - - - -	50
Decker Farm, - - - - -	51
Gould's Farm, - - - - -	51
Pike's Peak and Righter Lot, - - - - -	51

PASSAIC COUNTY.

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Wynokie Mines, - - - - -	52
Tellington Mine, - - - - -	I.
Rheinsmith Farm, - - - - -	J.
Monks' Mine, - - - - -	52
Board Mine, - - - - -	52
Ringwood Mines, - - - - -	52
Ward Mine, - - - - -	K.

MINES OF THE MUSCONETONG BELT.

HUNTERDON COUNTY.

Little York Mine, - - - - -	L.
Broderick Mine, - - - - -	M.
Harris Mine, - - - - -	N.
Bethlehem Mine, - - - - -	55
Mine of Knight & Hartpence, - - - - -	O.
Van Syckle's Mine, - - - - -	55
Miller Farm, - - - - -	56
Fritts' Farm, (White Hall), - - - - -	56
White Hall (east) - - - - -	56
Banghart's Mine, - - - - -	56
Hunt or Pidcock's Mine, - - - - -	56

MORRIS COUNTY.

Schooley's Mountain, Pleasant Grove, - - - - -	56
William Hann Farm, - - - - -	57
Stoutenburgh Mine, - - - - -	57
Naughtright Mine, - - - - -	58
Sharp's Diggings, - - - - -	59
Rarick Farm, - - - - -	59

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Hopler Farm or Bartleyville Mine, - - - - -	59
Mount Olive Mines, - - - - -	59
Baptist Church Farm, - - - - -	59
Fisher Mine, - - - - -	59
Dickinson Mine, - - - - -	59
Marsh Mine, - - - - -	59
Smith Mine, - - - - -	59

WARREN COUNTY.

Lanning Farm, - - - - -	60
Chapin and Lommasson's Diggings, - - - - -	60
Oxford Furnace Mines, - - - - -	61
Confucius or Creagor Mine, - - - - -	61
Mitchell Mine, - - - - -	61
Johnson's Diggings, - - - - -	62
Egbert Mine, - - - - -	62
Rockport, - - - - -	62
Bald Pate Mine, - - - - -	62
Searle's Mine, - - - - -	62
Buck's Hill, Hackettstown, - - - - -	63
Frase's Farm, - - - - -	63
Young Farm, - - - - -	63
Pyle's Farm, - - - - -	63
Axford Farm, - - - - -	63
Bryant Mine, - - - - -	63
Excelsior Mine, - - - - -	64
Eureka Mine, - - - - -	64
Brookfield or Waterloo Mine, - - - - -	65

MORRIS COUNTY.

Hurd Mine, - - - - -	65
Weldon Mine, - - - - -	65
Lower Weldon Mine, - - - - -	65
Johnson Property, - - - - -	66

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Ford Mine, - - - - -	65
Scofield Mine, - - - - -	65
Davenport Mine, - - - - -	66
Boss Mine, - - - - -	66
Fraser Mine, - - - - -	66
Goble and Duffee Mines, - - - - -	66
Shongum Mine, - - - - -	66

SUSSEX COUNTY.

Byram and Sparta Townships.

Cascade or Smith Mine, - - - - -	66
Allis Mine, - - - - -	66
French's Mines, - - - - -	66
Hude or Stanhope Mine, - - - - -	67
Silver Mine, - - - - -	67
Haggerty Mine, - - - - -	67
Sickle's Mine, - - - - -	67
Gafney Farm, - - - - -	67
Lawrence Farm, - - - - -	68
Sherman Farm, (Sparta), - - - - -	68
Ogden Mines, - - - - -	68
Shafts on Greer Farm and Franklin Iron Co's Property,	68
Hopewell Forge Tract, - - - - -	68

PASSAIC COUNTY.

West Milford Township.

Kimble Farm, - - - - -	68
Budd and Hunt Tracts, - - - - -	69
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Verona Township—Sussex County.

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Williams' Mine, - - - - -	70
Segur and Wright Lease, - - - - -	70
Jacob Hunt Farm, - - - - -	71
Wawayanda Mine, - - - - -	71
Green Mine, - - - - -	71
Ten Eyck's Diggings, - - - - -	71

MINES OF THE PEQUEST BELT.

WARREN COUNTY.

Marble Mountain Mine, - - - - -	72
Schuler Opening, - - - - -	72
Roseberry Mine, - - - - -	73
Barton Mine, - - - - -	73
Shoemaker's Diggings, - - - - -	74
Redell Mine, - - - - -	74
Little Mine, - - - - -	74
Raub Farm, - - - - -	75
Titman Shaft, - - - - -	76
Pequest Mine, - - - - -	76
Henry Tunnel, - - - - -	78
Hoit Farm Mine, - - - - -	80
Smith's Mine, - - - - -	81
Deats' Farm, - - - - -	81
Kishpaugh Mine, - - - - -	82
Weleh and Inschow Lots, - - - - -	84
Stiff Farm, - - - - -	84
Potter Farm, - - - - -	85
Garrison Farm, - - - - -	85
Davis Mine, - - - - -	85
Albertson Mine, - - - - -	85
Shaw Mine, - - - - -	85

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Howell Farm Mine, - - - - -	85
Scranton Lease, North of Danville, - - - - -	87
Schaeffer Farm, - - - - -	87
Livsey's Mine, - - - - -	87
Maring's Farm, - - - - -	87
Haggerty's Diggings, - - - - -	87

SUSSEX COUNTY.

Glendon Mine, - - - - -	88
Andover Mine, - - - - -	88
Sulphur Hill Mine, - - - - -	88
McKean Farm, - - - - -	P.
Roseville Mine, - - - - -	88
Tar Hill Mine, - - - - -	88
Franklin Mines, - - - - -	88
Green's Mine, - - - - -	88
Bird Mine, - - - - -	88

A.

Cole Farm.—On this farm, near the Bloomingdale and Boonton road, and three miles north of Boonton, S. D. Brown, of Paterson, has opened a vein of lean ore, lying between walls which dip steeply towards the northwest. The ore occurred in thin layers, alternating with rock. The attraction is strong and steady for a long distance, and indicates a large extent of ore, though possibly much mixed with rock, as was found to be the case in the diggings already made.

B.

Brown Mine.—A new mine named after the discoverer, Mr. S. D. Brown, of Paterson. It consists at present, of one shaft

twenty-six feet deep, two hundred and fifty yards southwest of the old Kanouse Mine. The shaft goes down through seven feet of earth, and then strikes the ore. This forms the whole breadth of the shaft, about twelve feet, the sides being of ore, so that the thickness of the vein is still unknown. Already over one hundred tons of ore have been taken out of this trial shaft. The line of attraction is remarkable for its constancy and regularity. For one hundred and fifty yards in length the attraction is very strong, nearly everywhere, causing the needle to assume a vertical position. The ore is moderately rich, but contains some sulphur.* The nearness to railroad makes this a promising locality. The first work done here was about four months ago. It is owned and worked by the Passaic Mining and Manufacturing Company.

C.

Kanouse Mine.—During the year this mine has been worked by the Schuylkill Iron Company, and it has yielded about two thousand tons of ore. The association of the ore and white crystalline limestone is interesting, and indicative of good quality.

D.

Fox Hill Mine.—Further explorations at this locality have developed a large and promising vein of ore of good quality. Edward Canfield, of Dover, is the present lessee. The distance from railroad lines is still so great, that the transportation of the ore would be too expensive for very profitable mining. This will, however, be partially relieved by the early completion of the High Bridge Railroad.

* An analysis of a sample of ore taken out when the vein was first uncovered, gave 46 per cent. of metallic iron, 2.08 sulphur, and 0.03 phosphorus.

E.

Hedges Mine.—This new mine continues to be vigorously worked by the Union Iron Company, of High Bridge. By the use of the Ingersoll drill and dynamite, a large amount of ore has been very cheaply quarried. The broad shoot of ore so near the surface permits open working. The ore maintains its purity and richness, and is used for the manufacture of steel.

F.

Splitrock Pond Veins.—At the north end of Splitrock Pond Mr. Wm. S. DeCamp has continued mining operations, and the shaft has reached the depth of one hundred feet. The vein as opened by drifts, each way from the shaft is about seven feet wide. The ore retains its richness and its granular character, as observed in the first opening made here last year. North of this point and near the Charlotteburg road, Mr. DeCamp has dug several trial pits, and in nearly all of them found ore of workable thickness. Excepting in three of these pits the covering was very light, from two to eight feet only. The openings extend for a mile along the line of this road, and the furthest is not more than two miles from the Midland Railway, at Charlotteburg, so that the transportation of the ore would be easy and comparatively cheap. Some analyses of samples of the ore made for Mr. DeCamp, show that it is a rich ore, and free enough from phosphorus to make pig iron for Bessemer steel.

G.

The Green Pond Mines.—The several openings included under this head are near the foot of the Copperas Mountain, four miles southwest of Charlotteburg. The most extensive and oldest workings are near the old Copperas Mine holes. These were briefly described in the Survey Report for 1873. During the year other openings have been made, both to the

north and also towards the southwest, so that at present ore is uncovered, at frequent intervals, for a mile northward from the road which crosses the mountain and leading to Greenville. The tract on which these openings have been made, is the property of the Green Pond Iron Mining Company. The mining operations have been carried on by three separate lessees. The work at the southern end of this line, by General Wild, has not developed so large, nor so regular a vein as that to the northward, but a workable thickness of ore, of good quality has been found, and prospecting for other veins, with the most promising indications, is going forward.

The Original Green Pond Mine is now worked by the Timber Brook Mining Company. They have four open cuts, in three of which they are quarrying out the ore, using the Ingersoll drill and dynamite. Several thousand tons of ore have been taken out during the year, and for the past two months they have been getting about seventy-five tons a day. In the large open cut at the south end of this leasehold, the ore appears to form a broad shoot, which pitches steeply towards the north-east, and is capped by rock on the top.

The Rammelsberg lease adjoins the Timber Brook Company's lease on the north. Here the ore has been found quite near the surface on the top of the hill, and has been opened in three cuttings, lengthwise the vein. The strata and the vein appear more regular here than they do to the south of this, and the dip is quite gentle towards the east-southeast. The ore mined here has not yet been shipped.

The ore from all the pits and shafts of these Green Pond Mines is characterized by the presence of sulphur, in the form of pyrite. Although some layers do not contain one per cent. of this element, in others it amounts to nearly three per cent. But on account of the richness of the ore, and the very low per centage of phosphorus, the ore is said to command a ready sale, and is used for Bessemer pig-metal. For the transportation of the ore, a railroad, four and a half miles long, has been constructed from the mines to the New Jersey Midland Rail-

way, near the Charlotteburg Station. An extension of this road southwest to Port Oram is in contemplation. This would afford a direct outlet for the ore, not only for these mines, but also for that from the Pardee and the Chester Iron Company's mines, near Denmark, to the anthracite furnaces of New Jersey and those along the Lehigh.

H.

Bancroft Shaft.—This is about a quarter of a mile northeast of the Rammelsberg openings, and apparently on the same vein or belt of veins. The ore resembles closely that of the Green Pond mines. As yet the mining here has been for exploration only, and no ore has been taken away.

I.

Tellington Mine.—This is a newly opened mine in Pompton township, about four miles northwest of Wynokie, and near the road through the Stony Brook valley leading to West Milford. It was opened by S. D. Brown last spring. There are three shafts on the line of the vein, all within one hundred yards. Of these the deepest is down forty feet, the lower part of it being on the dip of the vein, which is about forty degrees to the southeast. The vein as here opened is about five feet wide. This is not, however, the total thickness of the ore, as the hanging wall of the shaft appears to be a *horse* of rock, behind which there is more ore like that of the shaft. The beds appear to be very regular and the walls well defined. The ore contains some rock, in thin partings or layers, alternating with the magnetite, and is therefore rather lean, but this is compensated by the superior quality of the ore, owing to the very small percentage of phosphorus and the absence of sulphur.

In the most northern opening the ore bed was found to dip towards the northwest, and to be only about two feet thick. The ore from it appears to be a little richer than that of the

shaft which is now worked. The middle opening was not so deep and scarcely did more than uncover the ore.

The attraction at this mine is moderately strong, for one hundred and fifty yards of the line, ranging from twenty degrees to sixty degrees *positive* for most of this distance. On the western side and near the north shaft, it is *negative* over quite a wide belt.

No ore has yet been removed from the bank, although from the openings so far made about two hundred tons have been raised. It could be carted to the Montclair Midland Railroad at comparatively small cost, as the road from the mine to Midvale station is either level or descending.

J.

Rheinsmith Farm.—This is in Pompton township, three miles northwest of Wynokie. S. D. Brown, of Paterson, did considerable work here in search for ore, but without finding a workable vein of rich ore. The shafts and drifts showed a wide vein of ore-bearing rock with some lean ore. The long and steady line of attraction on the farm ought to be further examined.

K.

Ward Mine.—This is a new mine on the Ringwood tract, in West Milford township, near the State line. It is not worked.

L.

Little York.—This locality has not been visited. About one hundred and fifty tons of magnetic iron ore is reported to have been mined on the farm of a Mr. Bloom, about a mile north of Little York, in Hunterdon county.

M.

Broderick Mine.—This is a new mine, owned and worked by Broderick, Conyngham and Company, in Bethlehem township, Hunterdon county, and about one and a half miles southwest of Valley station, on the Central Railroad. It was opened about two years ago. The main working shaft is said to be one hundred and thirty feet deep, and from it drifts each way have opened a wide vein of rich ore. West of this, and west of the Harris mine shaft, the same company have sunk several trial pits and obtained ore.

N.

Harris Mine.—The shafts of this mine are supposed to be in the same vein as those of the Broderick mine. One of these has fallen in; the other is about one hundred feet deep, on the slope. The first work done here was in 1873, since which it has been actively worked by the present owners, Jas. A. Smith & Company.

The ore from these mines is shipped to Bethlehem, Pennsylvania, and is made into Bessemer pig. Mr. Daggett, the Superintendent of the Harris mine, estimates the product of these two mines this year at ten thousand tons.

O.

Mine of Knight & Hartpence.—On the farm of John P. Wean, one mile south of Bethlehem, Hunterdon county. The searches here were for hematite, and consisted of four trial pits, the deepest of which was sixty feet. The ore found was a brown hematite, some of it earthy and some in lumps, and in one of the pits lay between walls of rotten gneiss, dipping about forty degrees to the southeast. In another the ore was fifteen feet thick, and was covered by fifteen feet of drift, while under it there was a partially decomposed feldspathic gneiss. No further

work was done, owing to the dullness of the ore market. The pits sunk show a considerable area of ore, and with an increasing demand for it, the explorations here will be resumed.

P.

McKean Mine.—This new mine was opened in the beginning of the present year. It is located on McKean farm, on the road from Cranberry Reservoir to Roseville, about a mile and a half from the Reservoir, on the northwest side of the road, and about four hundred yards back of the farm house. The opening was made by Clarkson Bird and Son, who have sunk down upon the vein forty feet or more, and have drifted along on the vein for about the same distance. The vein was worked for a width of twelve feet, at the time it was visited last spring, and one thousand or fifteen hundred tons of ore had been taken out. The attraction extends along for several hundred feet. The ore is crumbling, granular, and near the surface is a little stained with some decomposing mineral, possibly iron pyrites, of which a very little was seen in the ore. A sample of the ore, carefully averaged at the mine, was analysed with the following result:

ANALYSIS.

Magnetic iron ore,	-	-	-	-	-	64.36	per cent.
Oxide of manganese,	-	-	-	-	-	.30	"
Sulphur,	-	-	-	-	-	.22	"
Phosphorous,	-	-	-	-	-	.03	"
Titanium,	-	-	-	-	-	-	a trace.
Lime,	-	-	-	-	-	.45	"
Magnesia,	-	-	-	-	-	1.76	"
Alumina,	-	-	-	-	-	3.50	"
Insoluble matter,	-	-	-	-	-	28.50	"
						99.12	

The analysis shows the ore to contain forty-six and six-tenths per cent of metallic iron. It seemed to be a promising mine

when visited, and as the ore contains a little manganese, and scarcely any phosphorus, it may be presumed to be valuable for making Bessemer iron.

Hematite Iron Ores.

	Page of Report for 1873.
Pochuck Mine, - - - - -	88
Cedar Hill or Ten Eyck Mine, - - - - -	89
Beattiestown Mines, - - - - -	89. a.
German Valley, - - - - -	89
Carpentersville, - - - - -	89
Broadway, - - - - -	b.
New Village, - - - - -	89. c.
Thatcher or Stewartville Mine, - - - - -	d.
Shiloh, - - - - -	89
Bird Mine, - - - - -	89 and 119
Hamlen Mine, - - - - -	e.

a.

Beattiestown Mines.—Three companies are here at work, all probably on one deposit of ore. The mine first opened and which has been mentioned in the Survey Reports of 1872 and 1873, is now held by the Thomas Iron Company, although the present excavation is north of the first hole which was dug by Messrs. Shields & Fisher.

The new openings are southwest of the Thomas Iron Company's mine and but a few rods from it. The adjoining property is held by the Musconetcong Iron Company. The excavation for ore made by this company is large and about forty feet deep. The top dirt has an average thickness of nine or ten feet. On the eastern side of the opening a greyish limestone ledge, with its strata dipping about sixty degrees toward the southeast, was uncovered. The ore was found on each side of

it and partially resting upon it. On the west side, Mr. Trethaway, the mine superintendent, says he has found slate rock in place. The ore deposit lies, therefore, between this rock and the magnesian limestone. The ore is mixed irregularly with yellowish clay, with streaks of bluish-black earths, and also with occasional sandy layers. Large masses of ore of irregular shape are also quite common.

The ore is raised on an incline from the pit to the washer. The washed ore is sent to the company's furnace at Stanhope. The product of this mine, although only about two years in operation, amounts to several thousand tons. Next to this mine lot on the south the Boonton Iron Company is digging some ore. Their operations are still, more in the way of exploration than mining. Further down the valley of the Musconetcong Creek other hematite localities have been heard of, but they have not been visited. None of them can be considered as mines, as no ore has been sent away from any of them.

b.

Broadway.—Hematite ore is said to have been discovered on the east side of the Pohatcong Valley, about three quarters of a mile east of the Broadway Railroad depot. It has not been visited.

c.

New Village.—A new hematite mine has recently been opened west of New Village and a few rods east of the Morris Canal, on lands of J. W. and H. Cline. The covering of earth was found to be from three to six feet thick. In the bottom of the small pit which was dug, there was much sandy, white clay. This pit yielded about four hundred tons of ore. It is reported that the Bethlehem Iron Company has leased the place and intends to open it at once.

Thatcher or Stewartville Mine.—This recently opened and productive mine of brown hematite is about two miles northeast of Stewartville and near the base of the Pohatcong ridge. It is probably very near the boundary of the gneissic rocks of this ridge and the magnesian limestone of the valley, although the nearest outcrop of this last mentioned rock formation is two hundred yards west of the mine, while the sloping surface east of it is full of slaty rock fragments, and the gneiss outcrop is not seen until the steeper hill side is reached. This mine was opened in July, 1873. The single excavation for ore is at present about two hundred feet long, seventy feet wide, and has an average depth of thirty feet. The top dirt is on the average ten feet thick, and consists of sandy earth with some gravel and a few boulders. The original surface was smooth, gently sloping to the west, and cultivated farm land. The ore occurs in masses of irregular form, from single lumps, sometimes weighing ten tons, down to angular, granular fragments, mixed with the dirt. Through the middle of the pit there is a sort of vein or elongated pocket of ore, running from northeast to southwest. This appears to be made up almost entirely of large lump ore. In the other portions of the opening the ore is irregularly mixed with a yellowish to reddish sandy clay and ochrey earths. The proportion of large lump ore to the earthy and wash ore is large. And these lumps are, in nearly every instance, filled with a coarse-grained quartz sand, and more or less clay, in which occasionally small fragments of siliceous hematite ore are found. These phenomena seem to show that the iron oxide has come in a fluid form, running through the sandy and clayey strata, in irregular courses and often inclosing large masses of these materials within the geode-like casing. The thickness of this deposit has not yet been ascertained, as the bottom of the excavation is nearly all ore. The top dirt is carted off and then the lump ore is taken out, while the dirt and fine ore goes to the washer. Already about five thousand tons of ore have been obtained, most of which

has been used in the Bethlehem Company's furnace, at Bethlehem, Pa. It is said to be of very superior quality, and to make Bessemer pig iron.

e.

Hamlen Mine.—This is two miles from Phillipsburg, on Mr. H. Hamlen's farm. The ore deposit is said to be exhausted.

Copper Ores.

The copper mine of Richard R. Field, near Warrentonville, Somerset county, and in the valley between the first and second mountain ranges, continues to be worked, but not with much activity, as the works for the dressing of the ores and the extraction of the metal have not yet been erected. The *mine* consists of a single excavation, about sixty feet square and thirty feet deep. On the top there is five feet of drift earth, then descending, ten feet of rather soft, red shale; eight feet of a grayish quartzose sandstone, with some shaly layers; two to five feet of black shaly rock, in which there is a little copper ore in thin strings; three feet of gray sandstone at the bottom. In this layer there is the largest per centage of copper; its average richness in metal is difficult to determine, a single specimen, intended for an average, yielded nine per cent. of metallic copper. The ore is mainly a gray sulphuret, and is irregularly disseminated through the rock. From the bottom of the opening some cellular, altered shale was obtained, and this, together with other changes, observed in the shale in descending, indicate that the trap rock which underlies it is very near. The association of trap rocks and copper-ore-bearing shales seen here is similar to that in many other localities in the Triassic rock formation of the state. The thickness of the ore-bearing beds here is sufficiently great to be mined with ease, and it is rich enough for the Hunt and Douglass method of extracting the metal. Works for the extraction of the copper by this process are contemplated.

If the method of extracting copper from lean ores, by chemical processes, can be successfully introduced, it will add largely to our mineral products; for such ores are abundant throughout the trap and red sandstone district.

Zinc Ores.

The zinc mines in Sussex county continue to yield an abundance of ore. This is worked into metallic zinc, and zinc oxide. Of these two products the latter has usually been made in much the largest quantity. In fact all the grades of the oxides that can be made directly from the ore, are made in our own country cheaper than they can be supplied from abroad, and they are made in sufficient quantity to meet the demands of our markets. A smaller quantity of very fine quality of oxide, which can only be made from metallic zinc, is imported. Eight thousand five hundred tons of zinc oxide were made in the United States last year, and one thousand five hundred tons were imported. The manufacture is about one-quarter less this year.

The manufacture of metallic zinc is increasing from year to year, but it has not yet reached the amount that is needed to supply our own markets. That made from the New Jersey ores by the New Jersey Zinc Company, and the Passaic Zinc Company, is of better quality than any produced in Europe, and although sold at a higher price than any other, it is so much superior for making some varieties of brass, that it is sent abroad for that purpose. From seven hundred to one thousand tons of zinc are now made annually from New Jersey ores; six hundred and fifty tons from Pennsylvania ores, and more than three thousand tons from Western ores. A large amount of the metal is still imported, but it is diminishing very rapidly, and it is probable that our own mines will soon supply the demands of all our manufacturers.

Searching for New Beds of Magnetic Iron Ore.

There is a very general inquiry for new locations for mines, and an active search for new beds of ore. The owners of old and established mines pursue their inquiries and searches with prudence and intelligence; but a great deal of money is wasted in useless or injudicious explorations, by inexperienced and sanguine persons, who know the value of mines, but have not learned the difficulties of finding them. The following directions to those who are looking for iron ore deposits may be useful.

1. *The workable beds of magnetic iron ore are all in the Azoic rocks.*—Strong local attraction is not uncommonly found in the trap rocks of our State, and some attempts have been made to work them, but as yet without success. The ore in the trap is disseminated everywhere through it, but has not yet been profitably separated from the rock.

2. *The magnetic iron ore is all found in beds which are interposed between the layers of the gneiss, and are conformable to them.* It is never in veins which cut across the layers of the rock; it has no gangue rock of calc spar, fluor spar, quartz, or any other mineral different from the common minerals of the adjacent rock layers; it has no rock walls by which the ore is separated from the adjacent rock, which at all differ from any other two adjoining beds of rock which are separated by a seam of softer or otherwise different mineral, and in many cases there is no seam at all, but the ore adheres firmly to the rock; and there are many instances in which it passes into rock by a gradual diminution of magnetite in the mass. These beds of magnetite, like the rocks among which they occur, are highly inclined or almost vertical. In this respect they have an accidental resemblance to true veins, and this has led to their being commonly called *veins*. And, understanding that the word vein simply means a flattened mass of ore standing on edge, the name may be accepted without conveying a wrong impression.

3. *Since the layers of ore and rock stand on edge, it necessarily follows that the ore must come to the surface of the rock.*—The rock surface is usually covered with loose earth and boulders, and of course this outcrop of ore is hidden from sight. But it is only necessary to remove the loose earth, in order to determine whether the ore is there. Blasting out or sinking expensive shafts in rock is not necessary, and such expense should not be incurred in ordinary explorations.

4. The direction in which the beds of ore *range* is the same with the strike of the rock, and the extension of worked beds of ore is frequently proved by ranging, and many successful searches for new openings upon ore have been made in this way.

5. *In ordinary cases where the surface is covered with loose earth it is common to search for ore with a magnetic needle or a miner's compass,* and for preliminary examinations it is now the chief reliance. In using this instrument much practice is required; but this joined to good judgment gives indications of the presence of ore which are almost infallible. The importance of this mode of search is so great that we may describe the instruments, their indications, and the mode of using them, at some length.

Instruments.—The surveyor's compass with a horizontal needle was the instrument first used for detecting and locating beds of magnetic ore, and it may still be used for that purpose, but it is unnecessarily large and heavy, and searches with it go on slowly. Pocket compasses, or those having needles only two or three inches long, which are without sights and so light as to be held steady in the hand, were used very generally till within the last five or six years. As indications of less than two or three degrees were not noted, these instruments were sufficiently large, and much good work was done with them. They may still be used to advantage, but have gone into disuse mainly because another form can be used which gives indications more rapidly.

The Miner's Compass, which is the one now most generally

used, has a magnetic needle balanced on a *horizontal axis* so that the needle itself may turn up and down instead of sidewise, as in the other form of compass. Such a mode of suspension constitutes it a *dipping needle*. The needles used are from two to four inches long and are hung in circular boxes having brass edges and glass sides. The needle is suspended in the middle of the box, and the box itself is held by a ring attached to its edge. The circular edge is graduated inside to degrees, and these are numbered so that when the needle is level it points to 0°, and when it dips down vertically it points to ninety degrees. The box must be held so that its faces are towards the east and west, the needle is balanced so as to be horizontal when in this position, if there is no local attraction. If the box does not face east and west the needle will not be horizontal even if there is no local attraction, so that caution must always be exercised when making observations with it. There is a Swedish compass for miners which has both horizontal and vertical motions, and is most approved there. It has not the steadiness of our instruments, however, and cannot be used with so much confidence in its indications. Messrs. W. & L. E. Gurley, of Troy, have made for me a miner's compass which has the two motions, dipping perfectly and having sufficient horizontal motion to prevent making mistakes in holding the compass. It is mounted in a box like the common miner's compass, and I have no doubt is the best that has yet been invented.

All the compasses need handling with care, they are very delicately suspended, and can easily be broken, worn or displaced. The magnetism of the needle may also be diminished or weakened. If the compass is out of order, the only safe way is to send it to an instrument maker for repairs.

Indications.—It is well known that if a bar of iron is held perpendicularly, it acts like a magnet; its upper end attracting the north end or pole of the compass needle, and its lower end the south pole. If the upper end of the bar is leaned over towards the south about twenty-five degrees in this latitude, its magnetic properties are developed most powerfully, and on the

contrary if the bar slants away from this position it shows its magnetism less strongly, and when it lies horizontal in an east and west direction it shows no magnetism at all. This magnetism in the iron bar, which is developed simply by its position, is considered to be due to the influence of the earth. Magnetic iron ore is susceptible of being made into magnets by the influence of the earth, the same as the iron bar. The beds of ore are like great flattened bars of iron which stand on end with their upper extremities slanting towards the southwest, and their lower ends extending down into the earth towards the northeast. Their upper ends which, of course, are those under the soil but nearest the surface, should attract the north end of the needle, and this they always do. If the bed of ore is broken across by an offset, or its continuity destroyed in any other way, the lower end next this break or offset should attract the south end of the needle, and this it always does if the break or offset is near enough to the surface to move the needle in any way.

Again, if a bar of iron is laid down with its ends pointing north and south, the north end will attract the south pole of the compass needle, and the south end of the bar will attract the north pole. In crossing a vein of magnetic ore from the south towards the north, the north pole of the needle is attracted during all the first part of the passage, but just at the place of passing off the vein the south pole of the needle is attracted; a short distance further all attraction ends, all of which is quite in accordance with the experiment with the bar of iron. The attraction which draws the north pole is often spoken of as *positive*; and that which draws the south pole as *negative*; and in writing, these attractions are expressed by the algebraic signs, plus and minus.

The indications from the magnetic needle, in searching for ore as it usually occurs in our State, may be stated as follows:

An attraction which is confined to a very small spot and is lost in passing a few feet from it, is most likely to be caused by a boulder of ore, or particles of magnetite in the rock.

An attraction which continues on steadily in the direction of

the strike of the rock for a distance of many feet or rods, indicates a vein of ore; and if it is positive and strongest towards the southwest, it is reasonable to conclude that the vein begins with the attraction there; if the attraction diminishes in going northeast, and finally dies out without becoming negative, it indicates that the vein has continued on without break or ending until too far off to move the compass needle. If, on passing toward the northeast, along the line of attraction, the south pole is drawn down, it indicates the end of the vein or an offset. If, on continuing farther still in the same direction, positive attraction is found, it shows that the vein is not ended; but if no attraction is shown, there is no indication as to the further continuance of the ore.

In crossing veins of ore from southeast to northwest, when the dip of the rock and ore is as usual to the southeast, positive attraction is first observed to come on gradually, as the ore is nearer and nearer to the surface, and the northwest edge of the vein is indicated by the needle suddenly showing negative attraction just at the point of passing off it. This change of attraction will be less marked, as the depth of the vein is greater, or as the strike is nearer north and south. The steadiness and continuance of the attraction is a much better indication of ore, than the strength or amount of attraction is. The ore may vary in its susceptibility to the magnetic influence from impurities in its substance; it does vary, according to the position in which it lies—that is, according to its dip and strike; and it also varies very much according to its distance beneath the surface.

Method of Using the Compass in Searching for Ore.—It is sufficient to say that the first examinations are made by passing over the ground with the compass, in a northwest and southeast direction, at intervals of a few rods, until indications of ore are found. Then the ground should be examined more carefully by crossing the line of attraction at intervals of a few feet, and marking the points upon which observations have been

made, and recording the observations. In this way materials may soon be accumulated for staking out the line of attraction, or for constructing a map for study and reference.

After sufficient exploration with the magnetic needle, it still remains to prove the value of the vein by uncovering the ore, examining its quality, measuring the size of the vein, and estimating the cost of mining and marketing it. Uncovering should first be done in trenches dug across the line of attraction, and carried quite down to the rock. When the ore is in this way proved to be of value, regular mining operations may begin.

In places where there are offsets in the ore, or where it has been subject to bends, folds or other irregularities, so that the miner is at fault in what direction to proceed, explorations may be made with the diamond drill.

DIAMOND DRILL.

In the Report of the Survey for 1873 the attention of the owners of mines and mineral lands was called to the diamond drill, as an economical and thorough means of searching for magnetic iron ore, either in new localities or near old mines, in order to their proper development and working. And the results of its employment by J. W. Hussey, of Bloomingdale, on the Kahart farm, were given. (See pp. 95-96, Geological Survey report for 1873). During the year the Allentown Iron Company have tested the ground near the Mount Pleasant Mine, east of the Baker Mine Railroad and near the Mount Pleasant turnpike, by a boring three hundred and thirteen feet deep. The work was done by a company from Pennsylvania. The actual time at work was four weeks. On some single days they bored thirty feet, whereas, in other strata the rock was so hard and firm that scarcely two feet were gone through in a day. The cost of this boring was \$6 per foot for the first one hundred feet, \$7 per foot for the next one hundred feet, and \$8 for the third one hundred feet. As this boring failed to discover the

ore, the company contemplate another put down at an angle of seventy-five degrees from the horizontal line and across the strata, towards the northwest. This will test a breadth of strata nearly equal to the length of the bore hole, and in this respect it will be much superior to a vertical hole. For the examination of strata, this mode has great advantages in time and cost over shafting or tunnelling, and for testing the character of the beds of ore or rock it is almost as satisfactory. Its employment is contemplated at several of our iron mines to determine the extent of the veins, and in this way lead to the best method of working them. If judiciously located and worked, it must furnish essential information at the least cost.

According to recent statements of work done in prospecting for coal by Oswald J. Heinrich, engineer of Midlothian colliery, Virginia, the total cost, including interest, wear of machinery, and repairs, was one dollar and forty-six cents per foot in a boring of nine hundred and twenty-three feet, and ninety-four cents per foot in one seven hundred and fifteen feet deep. The progress per hour in these was seventy-six one-hundredths of a foot in one, and eight-tenths of a foot in the other. The rocks penetrated were quite as hard as the gneissic and granitic rocks of our iron ore districts, and the rate of progress and the cost of boring ought not to vary greatly from these figures.

At present the American Diamond Drill Company, New York, own the right to the use of the drill in this State, but on payment of a certain royalty parties can acquire the use of it on their own land.

Searching for Hematite Iron Ore.

The recent discovery of workable deposits of hematite in the Musconetcong and Pohatcong valleys, and the successful working of Beattystown, Stewartville, and New Village hematite mines, have stimulated property owners, miners, and iron manufacturers to a more vigorous search for this ore throughout all the limestone valleys. All the deposits yet found being on the borders of the limestone, either on the side where it meets the

gneiss rock of the mountains, or the slate rock. The mines at Stewartsville and New Village are at the meeting of the limestone and gneiss; those near Beattystown are at the meeting of the limestone and slate.

As this ore is not magnetic, a compass cannot be used in searching for it. Among the surface indications, the presence of loose pieces of float ore in the soil is most reliable. Further examination consists in digging or boring. The mode of digging trial pits or wells was described in the Geological Survey Report, for 1872. These are sunk in the overlying earth, mixed clay and ore deposits, from fifteen to forty feet deep, and having a diameter of from two and a half to three feet. A pick and a spade, with handles about a foot long, are the only tools necessary in digging in so narrow a space. The hoisting of the materials is in buckets, holding about fifty pounds of dirt each, and is done by the aid of a windlass, made so light as to be easily moved from pit to pit by a couple of men. With these helps two men are able to do all the work. The cost of digging these pits, aside from the tools and hoisting gear, is about twenty-five cents per vertical foot. And here it may be stated that in the Lehigh Valley the contract for digging such pits or wells, two and a half to three feet in diameter and up to fifty feet in depth, ranges from fifteen to twenty-five cents per foot, being more expensive the greater the depth. At this apparently low cost laborers make good wages, an experienced man being able, under favorable circumstances, to go down twenty feet in a day. Such an easy, and, comparatively, inexpensive mode of search, is admirably adapted to explorations for hematites, ochres, clays, or other earthly materials where there is no solid rock or indurated earth to be encountered, and is here recommended to all desirous of testing ground for such minerals. In such searches recourse may often be had to boring instead of digging. This is much quicker and cheaper, and preferable in not disturbing so much of the soil or any crop growing upon the ground. Stony strata, or those containing cobble stone or large boulders, cannot be readily penetrated by an auger, but

such stony beds are not common over hematites, or, if so, they constitute a thin, superficial, drift layer, and, in such cases, the boring could be started after a pit has been sunk through this top stratum. Generally, the covering consists of earthy beds, containing much clay, and an augur can easily be driven through these materials.

Clays for Pottery and Fire Brick.

The white clays found about Woodbridge, Perth Amboy and South Amboy, in Middlesex county, have long been noted for their excellent qualities, and their adaptation to the manufacture of fire brick, common and fine pottery, as well as for the minor uses in making alum, facing wall papers, &c., &c. With the growth of our manufactures, the demand for these clays has increased, until in the value of their annual product they stand among the foremost of our mineral productions.

It is estimated that two hundred and sixty-five thousand tons of fire clay are dug annually in the places mentioned above, and sent into market for making fire brick, fine pottery, sewer-pipe, terra-cotta ware, retorts and crucibles, facing for wall-paper, alum, &c. The prices at which it is sold vary from \$1.50 to \$13 a ton, according to its quality, but its average price may be safely set down at \$3.50, which produces an aggregate of \$927,500 for the amount of annual sales of the fire-clays.

The amount of stoneware clay dug annually in the vicinity of South Amboy, is estimated at twenty thousand tons. It is shipped to all parts of the United States, and supplies the material for most of the stoneware that is used in the country. Its price varies slightly, but an average is near \$4 a ton, the aggregate of which is \$80,000 a year.

The industries dependent on these clays are large and varied, and are among those which supply the staple products of art. Common pottery can be made from the poorest varieties of clay, but for the production of the finer kinds, pure and white clay is needed. And these fine clays near our great commercial

and manufacturing centres, have an increased importance from their location near navigable waters and the great markets of our country. Fine earthen ware was formerly imported almost wholly from Europe, but within the last ten years potteries have been established at Trenton, which have been remarkably successful in the quality of the wares made, and in finding a ready market for them. There are now twelve potteries in Trenton, which employ about one thousand men, and one thousand women and boys, and turn out \$1,500,000 of ware annually. The ware made is of the common white earthen, and ironstone, and its quality is now fully equal to the best English ware of those grades. The manufacture of such ware was very limited at the beginning of the late civil war; it has now grown so as to supply a quarter of the demand in the country, and the market for it is still kept up, even under the present financial distress. A few years more of like progress, and we shall be able to fully supply the demands of our own market, and from the peculiar advantages of New Jersey, in regard to materials, fuel, and markets, it must become the centre of such manufactures.

From the excellent quality, and comparatively low price of our fire bricks, those of foreign manufacture are no longer brought into market. From five to seven million fire brick are made annually at Woodbridge and Perth Amboy, and the materials for three or four times that number are sent from those places and from South Amboy yearly, to be made up in the localities where they are used.

The geological position of these deposits of clay is in the *cretaceous formation*; and they constitute the lowest member of it in New Jersey. They are found in a belt of country which stretches across the State from northeast to southwest; its northeast end being on Staten Island Sound and Raritan Bay; and its southwest end on the Delaware in Gloucester county. On its northwest edge it joins the red sandstone from Woodbridge to near Trenton, where for five or six miles it borders on the gneiss rock, and from thence to the southwestern end it follows

along or near the Delaware river. Its southeastern edge descends beneath the clay-marls,—*i. e.*, the clays containing green-sand marl. White clays sufficiently pure to make fire-brick and some varieties of pottery, are found throughout the whole length of this belt. But those of the finest quality have been almost entirely got from the eastern end of the belt, comprising that part of it which lies in the break or opening between the trap ridge which extends along the west bank of the Hudson river and across a part of Staten Island, and that ridge of trap which begins about six miles west of the Raritan, and under the name of Rocky Hill, extends on for many miles to the southwest.

The clay pits through the whole length of this belt have been visited, samples collected, and many analyses have already been made. Special attention has been given to the eastern end of the belt, from which the largest amount of clay is obtained, and from which it is probable the largest supplies will continue to be drawn for many years to come. A careful survey has been made of some sixty or seventy square miles of the clay district bordering on the Raritan, and the map is well advanced. It still needs, however, the contour lines on it, so as to enable any intelligent person to learn from it both the geographical position of any place and its height above the sea level. This map, with the sections needed to make its delineations fully understood, will be ready for engraving as soon as the necessary levels can be run and drawn on it. And it is believed that they will furnish a clear exhibition of the position of the various beds of fire clay, black clay, kaolin, feldspar, sand, and stone-ware clay to each other, and to the surface of the ground.

The studying out of these different beds has been attended with peculiar difficulties, from the lack of those characteristic features upon which geologists depend for proving the identity of any bed or deposit of material when found in different places. The three things by which identity can be established are: 1. Uniformity in mineral composition. 2. Fossils of the same kind in different parts of the same bed. 3. Superposition,

or the relation of different beds to each other. There are three beds of fire clay so much like each other that they cannot be distinguished by their composition. There are no fossils in the white clays; the fossil wood in the black clays is not characteristic of any particular bed, and the few fossil shells that have been found were all from the same locality. And the surface of the country is so uniform and the beds so little inclined that only one of them has yet been opened in the same place, and of course its relations to other beds could not be made out by seeing them together. Besides all this the surface is covered irregularly with two considerable deposits of drift. The lower of these deposits of drift is composed of yellow sand and gravel, and appears to have come from the south and east; the upper of the deposits of drift is made of sand, gravel, fragments of red-sandstone and reddish earth, and has undoubtedly been washed, or in some way scraped over from the country north and west of it.

The first clew to the true relations of the different beds, was found in the observation that the numerous clayspits on the slope descending from Woodbridge towards Perth Amboy, were nearer and nearer down towards tide water. Loughridge and Powers' pit at Woodbridge, being fifty-three feet above tide, Hampton Cutter's about two-thirds of a mile southeast, only twenty feet above tide, and W. P. Benton's pits, which are five-sixths of a mile further southeast, being twenty feet below the level of tide water. From these observations, it may fairly be inferred that this bed of clay has a dip or descent towards the southeast of about thirty-five feet per mile. Fire clay on the banks of the Raritan, occupying about the same position to the red shale that the Woodbridge clay does, may be presumed to belong to the same deposit, and the straight line drawn from the one at tide level at Woodbridge to that at tide level on the Raritan, has a true bearing of about south fifty-four degrees west, which may be taken for the strike of the bed. With these approximate data, levels have been run to all the clay, kaolin, and feldspar pits, and the

following facts regarding the several beds of the formation have been established :

1. There are three beds of fire clay, of which that opened by Wm. B. Dixon, of Woodbridge, is the lowest ; that opened most extensively about Woodbridge, and also on the north bank of the Raritan, is the next above it ; and that opened on the south of the Raritan, by E. F. Roberts, Geo. Such, Sayre & Fisher, and others, is the third, or upper of the three beds.

2. The feldspar and kaolin belong to the same bed, and only differ in that they have been differently exposed to the washing and sorting action of water. This bed is between the second and third beds of fire clay, and much nearer the latter than the former.

3. The bed of stoneware clay is higher in the series than any of the fire clay beds, and is only found on the south side of the Raritan, where it exhibits the same structural characters in regard to dip and strike, that the others do.

4. The beds of black clay which are interposed between those of white clay, as far as we have yet examined, are like the adjoining beds of white clay, except that they are blackened by fine particles of woody matter or lignite, and some of the layers contain grains and lumps of iron pyrites. They burn white, and the pyrites can be separated by washing.

5. The beds of fire sand are superficial, and probably belong to the lower drift deposit; though there are thin layers of extremely fine and pure quartz sand interposed between layers in the clay beds.

6. The breaks or interruptions which are frequently found in the continuity of the fire clay beds, have been produced by drift agencies, which have cut deep channels into the beds of clay, and then filled up these channels with earth, clay, gravel and boulders.

COMPOSITION OF FIRE CLAYS.

The refractory part of fire clay is the *compound of silicic*

acid and alumina; it is this which enables the clay to stand the most intense heat of furnaces without melting. The *silica* or sand, if fine and thoroughly mixed in the clay, causes it to shrink less under intense heat, and makes solid and stronger brick; it is however more easily cut away by fluxes. The *oxide of iron, lime, magnesia, potash* and *soda*, are all fluxes, and so injurious to the refractory character of clay. The *titanic acid* probably does not produce any injurious effect in the clay. The *water* is that which remains in the clay after it has been dried in the sunshine, and the best clays have the largest percentage of it.

	1	2	3	4	5
Alumina,	27.13	40.14	39.94	28.11	16.33
Silicic acid, combined,	30.22	41.67	42.22	29.67	17.99
Silicic acid, free,	1.10	1.21	1.22	1.11	1.10
Silica, quartz sand,	29.00	.50	.71	27.23	55.30
Peroxide of iron,	1.26	.51	.41	1.91	1.19
Magnesia,	.0837	.29
Potash,	tracc.	.41	.47	.44	.66
Titanic acid,	1.93	1.42	1.63	1.06	1.25
Water, combined.	9.63	13.59	13.44	10.36	5.84
Total,	100.35	99.45	100.04	100.26	99.95

A comparison of these different fire clays, all of which are in good repute, will show that there is very little difference in the composition of the *true clay*, that is of the combination produced by the silicic acid and alumina. The principal variation is in the amount of quartz sand in the different kinds used, and which are thought to be specially adapted to different purposes.

No. 4 is the Stourbridge clay, from the place of that name in England; it has been long and very largely used for making fire bricks, and the pots in which glass is melted. The bricks made from it are solid, strong and durable, and are much liked.

No. 5 is a German clay, from Coblentz on the Rhine, it is im-

ported for the glass manufacturers, and is used in making the pots in which glass is melted, and it is preferred to any other for its durability and strength. No. 1 is clay from the pits of William B. Dixon, of Woodbridge. It has nearly the composition of the Stourbridge clay, and where it has been tried for making fire-bricks and glass-pots, it has been found to possess the same qualities of solidity, strength, and durability. No. 2 is from the pits of Powers & Loughridge, near Woodbridge, and No. 3 is from the pits of E. F. & J. M. Roberts, South Amboy. These clays contain less fine quartz sand than either of the others, and they are of the quality that has given reputation to the clays of those districts. They are used for making fire-bricks, and for pottery. The bricks are unequalled for their refractory qualities, but are not quite so hard or strong as those made from clay containing more uncombined silica or sand. If these rich clays could be made poorer by the addition of fine sand, such as is abundant in the immediate vicinity, it would greatly increase their amount and usefulness.

STONEWARE CLAYS.

The clays found at South Amboy along the shore of Raritan Bay and Chesquakes Creek have gained a wide reputation for their excellence as a material for the best quality of stoneware. It is the highest member of the series of plastic clay beds which characterize the basis of our Cretaceous Formation. Where it is unchanged, the bed is from sixteen to twenty feet thick. It has been most extensively dug along the tide water, but it extends back towards the northwest, rising with an ascent of about thirty-five feet per mile, and there is a large area from which it may yet be obtained.

Composition of the Stoneware Clays.

These clays contain sufficient potash to cause them to undergo partial vitrification when burned at a very high temperature in a potter's kiln. The oxide of iron in this clay is sufficient to

discolor the ware made from it, and so renders it unfit for fine pottery,—but it makes a ware the body of which is nearly equal to porcelain in its quality of not absorbing liquids of any kind. The following analyses will show its component parts:

Analyses.

	1.	2.
Alumina, - - - - -	21.29	21.07
Silicic acid (combined), - - - - -	28.65	29.11
Silicic acid (free), - - - - -	.81	.84
Silica (quartz), - - - - -	38.14	36.75
Potash, - - - - -	1.82	1.56
Lime, - - - - -	.11	.11
Magnesia, - - - - -	.30	.30
Peroxide of iron, - - - - -	1.71	1.47
Titanic acid, - - - - -	1.01	1.15
Water (combined), - - - - -	6.81	7.22
	<hr/>	<hr/>
	100.65	99.58

No. 1. is from the clay pit of Noah Forman, of Chesquakes, and No. 2. from that of E. R. Rose, of South Amboy. They are fair samples of the clay from this bed.

Fuller details in regard to the location, structure, composition, &c., of the clays, kaolin, fire-sand, and other materials of the plastic clay series will be given with the report and map of the clay district.

OTHER DEPOSITS OF WHITE CLAY.

At Woodmansie, on the New Jersey Southern Railroad, in Burlington county, near the Ocean county line, there is an extensive deposit of white clay, which has attracted a good deal of attention. It is not worked at present.

At Mt. Misery, in Burlington county, ten miles northwest of

Woodmansie, white clay is found, and was used for making fire-brick when the Mary Ann and Hanover furnaces were in operation.

Near Williamstown, in Gloucester county, white clay has been found. It is probably in the same range with those above mentioned in Burlington county. It is now being used for the manufacture of terra cotta ware, sewer pipes, etc.

BETHLEHEM CLAY.—This bed of kaolin clay lies in a narrow valley, one and a half miles southwest of Bethlehem, Hunterdon county. The ridges on each side are gneiss rocks, and the bottom of the valley is also gneissic in character, but just here the rocks have been so decomposed by surface agencies, that this clay is all that is left of the original rock strata. The clay was discovered two years ago by the owner of the property, Mr. Willever. For a short time, the place was worked by a company from Easton. Last spring it was reopened by the present owner, S. L. Shimer, of Phillipsburg. The clay is covered by a very thin bed of drift earth. Its thickness has not been ascertained, although a shaft thirty-three feet deep has been sunk in it. Two trial pits, one lower down the valley, and the other several rods west of the mine, indicate an extensive bed. The mining operations consist of the single shaft, and a little digging at one side of it. The clay is properly a kaolin, being a mixture of white clay with a large percentage of very fine white quartz, and partially decomposed feldspar. Analyses of the crude material show a large amount of potash, with some lime and magnesia, and a little oxide of iron. A trial of it made by a Trenton pottery firm, shows that it will not make porcelain ware, on account of the dark color from burning. It would probably make good stoneware; and selected portions when washed, would answer well for paper-facing. The company have erected a drying shed in which there is a washer, and at the side there are small vats for the reception of the clayey liquid. The sand in this clay is remarkably fine, and that sorted out by washing, appears pure

enough for some uses in the arts. Only a few tons of the washed clay have been sold, and this more for its introduction into the market, than as a regular business.

MACOPIN CLAY.—This clay deposit is in Passaic Co., on the east side of the Kanouse mountain range, about a mile north of Macopin pond, and the same distance east of Daniel Cisco's hotel. It was first worked about thirty-five years ago, by Moses Kinzey, afterwards by Mr. Wooley. But during the past twenty years nothing has been done. At present the pits are filled up by the surrounding earth, and the bank is so fallen down that there is no clay exposed to view. A little digging at the time of our visit in September last, cut through some thin layers of mottled (red and white) clay, which is apparently quite pure. A chemical examination of samples thus obtained, gave four per cent. of alkalies, indicating the presence of some partially decomposed feldspar with the clay, and showing it to be unfit for the ordinary uses of fire clay until it is washed.

The statements of residents in the neighborhood, and of one man who worked in the pits, are, that the clay occurred in layers, or beds, nearly horizontal and not exceeding two feet in thickness and separated by thin strata of fine white quartzose gravel. The banks, as now exposed, show that over this clay there was a quite thick covering of this quartz gravel, mixed with yellowish clay, and in places with a dark red sandy clay. The clay obtained from the pits was washed in works that stood near the pits, and then carted to Mead's Basin. Its use was not learned. This bed is very near the conglomerate outcrop of the Kanouse mountain range on the west. About four hundred feet west of it in the hillside a pinkish red bed of shaly rock was dug for red paint. On the east side of the valley the gneissic rocks crop out. About a quarter of a mile south and near the farm house belonging to the clay mine lot, there is an old pit, in the sides of which a conglomerate, made up of quartz pebbles and a white clay, crops out. It is said that some clay was dug here. If so

it would appear to point to this feldspathic conglomerate rock as the origin of this bed of clay.

To facilitate the inquiries of those seeking new deposits of clay, &c., the following is reprinted from former reports :

Searching for Clay, Marl, etc., by Boring.

The auger is available in all borings through strata or beds free from stone, and is, therefore, valuable in searching for clays, marls, glass-sands, peat, hematites, ochres, &c. In the southern half of the State there are scarcely any beds which cannot be penetrated by the auger, aided by a chisel or needle for breaking an occasional stone or layer of *hard pan*. It has been employed for many years in searching for clays about Woodbridge and Amboy, but too often these have been quite superficial, and often without any system. Hence the failure to get results of any value. A large area of territory embraced within the limits of the clay and marl formations, has never been touched by the auger. Here, then, is a wide field for future explorations. The beds of marl are remarkable for their uniformity in thickness, strike, dip, and other features, as are, possibly, the beds of glass-sand and clay, while the overlying loam, gravel, sand, clay, &c., which are of more recent origin, are noted for the irregularities of their layers. It is, therefore, impossible to get any definite information respecting the beds they cover, except by digging or boring. But digging is slow and quite expensive. Boring scarcely disturbs the surface, is quickly done, comparatively cheap, and affords us correct knowledge concerning the strata penetrated. For this work augers of various patterns are in use. Generally, an ordinary threaded auger with a bit, diameter from an inch to two and a half inches, is used. This is welded on to an iron rod, whose cross section may be square or circular. This is made to screw on a second rod, and that on another, so as to get any desired length. These rods are generally square, and about three quarters of an inch on a side, but as a rule the size of the

rods is proportional to the diameter of the bit. They may also be spliced together and fastened by a ring shoved down over the two lapping ends. Upon a rod thus constructed a handle is fitted so as to move up and down upon it, and to be fastened by a wedge at any desired point. By means of this the auger is turned, requiring, generally, two men. When the thread is filled the auger is drawn up and the material examined, so that every portion of the strata penetrated can be examined at the surface. Augers are rarely used at greater depth than forty feet, and in nearly all cases this is sufficient to test ground. At such depths, and even at twenty feet, the raising of the auger is a difficult matter, and then a windlass, or better, a derrick, with a block and pulley, may be employed. Such a length of rod also requires guides to keep it erect, and for this purpose shear poles set up at the mouth of the boring are necessary. These may be of the same length or a little less than that of the rods. Sometimes strata of wet, running sands, or quicksands, are met with, and this fills the boring, and the auger makes no headway. To counteract this, tubing must be used. Sheet iron pipes of the size of the bore are driven down to shut off the sand, and the boring is then resumed inside of the tube. Gravel or small cobble stones may be broken by a chisel-pointed rod, and then either raised by the auger or pushed to one side. Sometimes the bit is made convex, or spade-shaped, at the bottom. Equipped with these tools, two men can put down several twenty-foot holes in a day, or one (possibly more with favoring conditions), forty-foot boring. Of course, the location of the borings must be judicious. Side hills or sloping ground is always to be chosen rather than summits, or ridges, or flats.

In Germany, boring is an almost universal mode of searching for brown coal. The strata covering this are earthy, and are such as are readily penetrated by the auger, but the thickness of this covering often exceeds 100 feet. At this, and even greater depths, the auger is employed with success. In Saxony, borings having an average depth of 120 feet, cost twenty-seven

cents per vertical foot. There the augers are often made with a valve opening upwards to hold the material as it is loosened until raised to the surface. Pool augers, with a vertical slit, or a spiral slit, constitute another form. To break a stone or to push it aside, the bit is made double-edged, or a chisel borer or drill is let fall upon it. The diameter of the bit is sometimes as much as six inches, and then the rods are correspondingly large, and the working of them requires long levers at the surface and increased power.

In New Jersey, depths of forty feet are in nearly all cases sufficient, as at greater depths the amount of top earth is too much to be moved, and subterranean mining would be too expensive. For this depth an auger two or two and a half inches diameter, with five-eighths inch rods, is sufficiently large. The employment of this comparatively inexpensive mode of searching is earnestly recommended to all interested in the discovery of clays, marls, sands, or other valuable earthy deposits.

Infusorial Earth.

A deposit of infusorial earth, at Drakeville, Morris county, has been brought to public notice within the last two years. It is on the property of the late Frederick S. Cook, and about five hundred yards northeast of the inclined plane on the Morris canal, at that village. It has been known as a white earth or marl, for a long time, and some years since was dug out and spread upon the soil as a manure. It had also been observed to possess remarkable excellence for scouring silver. The establishment of a manufactory for making nitro-glycerine and giant-powder, at McCainsville, near Drakeville, in which infusorial earth, imported from Germany, was used, led to an examination of this deposit, when it was found to be the same material with that they were bringing from Europe.

The deposit occurs in a swale or depression of the surface, just at the foot of the mountain. The swale appears to be occupied in its lowest part by a common swamp of low bushes, growing

in wet black earth. But by digging in the black earth it is found to be only about a foot thick, and underneath it is the infusorial earth. The extent of the black ground is about five hundred and forty feet in length by two hundred feet in breadth, and one hundred yards farther northeast is another but much smaller deposit. A trial pit sunk in the middle of the swale showed a thickness of twelve inches of black earth, eight inches of very light infusorial earth, and twelve inches or more of a much denser infusorial earth. This lower part is said to be three feet thick, but I only examined the upper foot of it.

An examination with the microscope shows the infusorial earth to be entirely made of the silicious skeletons of minute animals (*diatoms*), both in the lighter and the denser portions. When boiled in solution of caustic soda it nearly all dissolves. In one experiment only ten per cent. being left undissolved, and in the other six per cent. This was calculated on the dry specimens. When first taken out they are very wet, and when dried by heating them red hot they lose nearly two thirds their weight, the loss being water. The infusorial earth is very light, fine and white, having much the appearance of fine chalk, except that it is lighter. When to be used for making giant powder it is wet up thin with water and then poured in shallow square moulds of eight or nine inches on each side. In these the material settles and dries, after which it is burned at a high temperature. The cakes or blocks thus burned are very white, and so light they would float on water. And when made fine the dust is as elastic and loose as bran.

There is likely to be a considerable demand for such earth, as the quantity to be used for making the *dynamite*, or giant powder, is large. Fifty tons have been taken from this deposit the present season. Its value when dry is about one cent a pound.

There is little doubt that other deposits will be found in the small ponds and swamps in this gneiss region, and those interested will do well to make search for it in any of the swales where these little swamps occur. It can be easily reached by digging, and when found can be distinguished from any other white earth

by its not effervescing with acids as white marl does; by its not becoming plastic when wet, as white clay does, and by its dissolving almost entirely in a strong boiling hot solution of washing soda.

The importance of this material will be appreciated when it is stated that the manufacture of *dynamite*, or giant powder, at Drakeville, has reached fifty thousand pounds a month. There are different grades of *dynamite*, but some of it contains twenty-five per cent. of infusorial earth.

Native Iron.

It has been observed by surveyors, that the trap rocks produced a great deal of local attraction, and in spots it is known to be so strong, as to turn the needle very far from its proper direction. It has, however, been attributed to the presence of magnetic oxide of iron, in the rocks. From some of the questions which have arisen in regard to meteoric iron, we were led to examine our trap rocks, when we found that metallic or native iron could be obtained from any of the specimens we had from the various ridges of trap in the Red sandstone region of New Jersey. The method of getting it was to crush the rock to as fine a powder as possible, then to pick out the magnetic particles with a magnet, and then to test them by putting hydrochloric acid on them, when bubbles of hydrogen would be liberated. The trial was made in March or April, and at first it was supposed to be a new discovery, but though not generally believed, the fact appears to have been observed long ago. There is a notice in Vol. 15, Sill. Jour. (2) p. 443, that Dr. Andrews had discovered metallic iron in the basalt from the Giant's Causeway, and from Slievemish. The notice is written in 1853, with an account of his method of detecting it. After pulverizing the rock and separating with a magnet the grains that were attracted by it, he subjected these grains, which were mostly magnetic iron, to the action of an acid solution of sulphate of copper in the field of a microscope. This salt produces

no change with the oxide, but if a trace of pure iron be present the copper is deposited. In his trials there were occasional deposits of copper in crystalline bunches; the largest of which obtained was little more than one fiftieth of an inch in diameter. Some trials made in the laboratory of the Geological Survey, by Prof. Van Dyck, showed that the Bergen Hill trap contains much more metallic iron than Dr. Andrews appears to have found in the Irish rocks. Prof. Van Dyck removed the ferruginous grains from the powdered rock by means of a magnet, and then flooded the selected matter with a solution of sulphate of copper under the microscope. The particles of metallic iron precipitated the copper in crystals of a dendritic form of arrangement. At the meeting of the American Association for the Advancement of Science, at Hartford, in August of this year, the occurrence of metallic iron in rocks, was mentioned as having been proved by several observers.

The amount of iron in the specimens of trap which have been examined is very small, only a fraction of one per cent. and it is not of any value at present; but the fact of its existence is of some interest, for it has been generally assumed that all the masses of native iron which have been found, were of meteoric origin. Some masses of iron weighing several hundred pounds, have been found lying on igneous rocks in Greenland, and native iron in sufficient quantity for use by blacksmiths has been found among the earth and rocks in Liberia, and has been known for years past. The facts thus recently obtained, may make it important to re-examine the whole question as to the origin of native iron.

Miscellaneous Examinations made in the Survey Laboratory.

1. An iron ore, said to have been found two miles from Danville, and three-fourths of a mile southwest of the Kishpaugh mine. Sent by C. H. Albertson, who says: "We dug about fourteen feet through clay (shaft seven feet square) before

we struck the ore. It is six and one-half feet thick on one side, seven and one-half feet thick on the other side of the shaft. It lies on a rock, pitching southeast at an angle of about twenty degrees. There is interspersed through it some hard iron ore."

Analysis.

Per oxid of iron,	-	-	-	-	78.61
Per oxid of manganese	-	-	-	-	5.20
Insoluble matter,	-	-	-	-	10.40
Water,	-	-	-	-	5.00
					<hr/>
					99.21

This specimen contains scarcely a trace of either phosphorus or sulphur, and has in it 55.6 per cent. of metallic iron and 3.3 per cent. metallic manganese. The description is more like that of an overflow of ore from a vein higher up the hill than that of a regular vein. If such ore can be produced in quantity, it will find a ready market at the steel works, for it is of the best quality.

2. A beautiful specimen of granular iron ore, resembling magnetite, was sent from Bloomsbury, in Warren county. It was not magnetic, but on crushing it yielded a red powder, showing it to be per oxid of iron—an ore that is very highly esteemed. It contained sixty per cent of iron; Mr. G. E. Vliet, of Bloomsbury, sent it to the laboratory. It was said to be part of a boulder of ore.

3. Two or three specimens of titaniferous iron ore have been sent to the laboratory by different persons. It is compact, black, hard, and when crushed yields a black powder that is not attracted by the magnet. This is not a desirable variety of iron ore.

4. Some beautiful specimens of red hematite iron ore have been sent from near Phillipsburg, Warren county. The ore is

excellent, but heretofore it has only been found in small quantities in that vicinity.

5. Several specimens of good yellow hematite have been examined, but they have already been referred to in their proper place. One specimen from immediately under the white clay at the Staten Island clay pits, was interesting from its location. It contained forty-two per cent. of iron, no chromium or manganese, or sulphur, and 0.17 per cent. of phosphorus. It was said to be three feet or more in thickness. It probably is connected in origin with the Staten Island ores, which are near the serpentine rock.

6. A specimen of bog iron ore was sent by W. S. Ayres, from Allamuchy. It was a rich specimen, containing forty-four per cent. of metallic iron, but it also contained a considerable percentage of phosphorus. The mining of bog ores has been but little attended to for a number of years past, though they are to be found in almost every county of the State. They were formerly the main dependence of many blast furnaces in southern New Jersey, but the changes in the method of working ores, and the use of mineral coal for fuel, caused them to be discontinued. It is reported that this ore is now being dug in the south part of Middlesex county, for use among the mixed ores of a blast furnace. A demand for it may again grow up as blast furnaces are established in our vicinity.

7. An examination of the clay marl of the green sand series, has been made in answer to an inquiry in regard to its composition and agricultural value. It contains two per cent. of potash, and a trace of phosphoric acid. It cannot be called a fertilizer, but where it can be got at small expense of labor, it may be put on sandy soils to improve their texture, and make them more retentive of manure.

8. A kind of calcareous marl, consisting of broken shells and bluish mud, more or less sandy, has been found in various places, a few feet above tide-level, in Cape May and Cumberland. A specimen from Heislerville, sent by F. F. Westcott, of Bridgeton, contained fourteen and one-fourth per cent. of

carbonate of lime in shells, but hardly a trace of phosphoric acid. The earthy matter in it was nearly all sand. It can be used to advantage on lands near where it is found, but it would not pay for long hauling.

9. Several inquiries have been made for sand for glass making. The inquiry is difficult to answer, there being a general opinion among those experienced in glass making that sand from some localities melts easier than that from others. There is an abundance of excellent sand in southern New Jersey that is approved by glassmakers, and nearly half the window glass made in the United States is made from it. And the great manufactories of window glass and common hollow-ware are located near the beds of this material. The Columbia Glass Works, formerly located at Columbia, in Warren county, got their supplies of sand from the Blue mountain, near their works, and from Flanders, in Morris county. There is an abundance of clean and fine grained sand in some of the layers of the plastic clay series; and it has been tried for glass making, but at present it is not in demand for that purpose. The preference given by glassmakers to our South Jersey sand seems justified by experience, though the chemical or physical difference between this and other sand is not apparent or easily explained.

It is worthy of further investigation.

The United States Census Report, for 1870, gives the following statistics of glass-manufacture for New Jersey :

	Houses.	Hands.	Capital.	Ann. Products.
Hollow ware, - -	8	1627	\$1,277,000	\$1,564,127
Window glass, - -	11	1116	1,164,500	1,241,599

Water Supply.

Another of our natural products that is coming to be of great value, is pure and wholesome water. When our country was first settled, a sufficient supply of good water for family use was obtained from wells and springs. But wherever the same

location was occupied by dwellings for a long series of years, the ground gradually became saturated with impurities from the waste and decaying matters, and the filth which necessarily was thrown upon the surface or deposited in pits, sinks and cess-pools. Especially was this the case in villages, towns and cities, and as the supply of water for wells and springs is nothing but that which has fallen in rain, and then soaked into the ground and so into the wells and springs, it must carry with it the impurities of the soil through which it has strained. Such water may be clear, cool and sparkling, but it is impure and unwholesome, and it is only too common to find its use attended with severe and even fatal sickness. This has been experienced in all our large towns and cities, and efforts have been made to supply the increasing population with water from streams and lakes. The Delaware furnishes the water-supply of Trenton and Camden, and will furnish an abundance for all who can avail themselves of it. The cedar swamps of Southern New Jersey supply Mount Holly with excellent water, and many other of our towns are supplied from brooks and larger streams of pure water. The portion of the State adjacent to New York City, comprised within the counties of Essex, Hudson and Union, and having an area of only one hundred and fifty square miles, or about one fiftieth part of the State, includes the cities of Newark, Jersey City and Elizabeth, besides a large number of towns and villages, and has a population of three hundred thousand, which is one third of that of the whole State. In these larger cities liberal and expensive provision has been made by which Newark and Jersey City are supplied with water taken from the Passaic, just above Newark, and Elizabeth from Elizabeth Creek, near that city. But the densely peopled country adjoining, and the numerous manufacturing establishments located everywhere around these cities, are making the water of these streams more impure and disagreeable, and causing uneasiness among those who have to use it, in regard to its quality and influence on health.

The future of this portion of the State is most promising,

and should the rate of growth which has gone on for forty years past continue for forty years to come, it will contain more than a million inhabitants. With such a prospect in view it is of the highest importance to plan early for an unfailing supply of water of unquestioned purity.

The mountain streams which drain the counties of Morris, Passaic and part of Bergen, and adjoining parts of Rockland and Orange in New York, are amply sufficient to meet the requirements of the case. When united they form the Passaic river and drain an area of seven hundred and fifty square miles, above Little Falls. This area is high ground, much of it is rocky, rough, thinly peopled, and a large part of it still covered with woods. On all of this area there is a fall of rain which in the course of the year amounts to a depth of from thirty to fifty inches; varying in different years. For water supply it is only safe to calculate upon the smaller depth, thirty inches. Of this quantity, from fifteen to twenty inches is evaporated from the surface and never gets into the large rivers. It is safe and convenient to estimate the quantity of water carried down to the streams, and so available for water supplies at twelve inches or a foot in depth. An acre of ground is forty-three thousand five hundred and sixty square feet, and of course would supply forty-three thousand five hundred and sixty cubic feet, or three hundred and twenty-six thousand seven hundred gallons a year, or nine hundred gallons a day.

The quantity of water consumed daily by each person in a community, is extremely variable. Where it has to be drawn or pumped from wells it does not amount to more than two or three gallons, but where it can be drawn from pipes, and is used freely for all purposes, and where much is consumed for manufacturing or other branches of industry, the quantity is much greater. In cities like New York, which are closely built up, and are entirely dependent on the water works, the daily consumption rises as high as sixty gallons a day, while in others which are more thinly built up, or where less water is used in manufactories, it falls as low as twenty gallons for each inhabi-

tant. Forty gallons a day is a liberal estimate of the quantity required for each person in a district like this, in which much of the ground is occupied for residences only.

The nine hundred gallons daily supply from each acre is, at this rate, sufficient for twenty-two and a half persons, and a square mile would supply six hundred and forty times as many, or fourteen thousand four hundred persons. The whole area, seven hundred and fifty square miles, would, at the same rate, supply (10,800,000) more than ten million inhabitants.

Taking the parts of this area drained by different streams:

The Ramapo drains one hundred and forty-eight square miles, and would supply two million one hundred and thirty-one thousand two hundred people.

The Ringwood drains one hundred and four square miles, and would supply one million four hundred and ninety-seven thousand six hundred persons.

The Pequannock drains eighty-two square miles, and would supply one million one hundred and eighty thousand people.

The water from these streams unites at Pompton, which is one hundred and seventy-five feet above the sea level, and either of them is sufficient to supply all the water needed for a long time to come. There are a number of ponds and lakes which help to store the waters of these streams, and to equalize their flow, the largest of which is Greenwood lake, or Long Pond, at the head of the Ringwood.

The area of the Rockaway drainage, above Boonton, is one hundred and forty square miles, which would furnish a water supply for two million sixteen thousand persons. The stream at the above named place is four hundred and ninety feet above the sea level. Lake Hopateong, Green Pond, and other ponds in the mountains, are reservoirs in which a large amount of water is stored to feed this stream and equalize its flow.

The portion of the Passaic which flows through the valley inclosed between the Second mountain and the main Highland range, above Little Falls, drains two hundred and seventy-six square miles, which would supply three millions nine hundred

and seventy-four thousand and four hundred people. Of this area the Whippany drains fifty-nine square miles. This stream above Little Falls is one hundred and sixty-two feet above mean tide. The water in this district is not stored in ponds or lakes, but is held back in the Great Swamp, and in the swamps and low meadows along its course.

The water in these streams is of singular purity, coming as it does from mountains which are all composed of granitic rocks. It has been carefully analysed within the last two years by Prof. Henry Wurtz, and elaborate reports upon it have been made by him for the city authorities of Jersey City and Newark. His results show that the water is of extraordinary purity.

The whole amount of water needed for present household and manufacturing supplies in the district mentioned, is not a fiftieth part of that which is carried off in the streams, and but a small part of what could be saved above any present use, by a judicious system of storage in reservoirs. And a supply can be brought, with a head of near three hundred feet, within ten or even eight miles of Newark and Elizabeth.

MINING STATISTICS.

IRON ORE.—Amount Mined in Various Years, in Tons.

Year.	Tons.
1790.	10,000, estimated from statement in Morse's Geography.
1830.	20,000, estimated from statement in Gordon's Gazetteer.
1855.	100,000, Dr. Kitchell's Report, 1855.
1860.	164,900, U. S. Census Report, 1860.
1864.	226,000, Annual Report of Geol. Surv. of N. J., 1864
1867.	275,067, " " " " " " 1867
1871.	450,000, " " " " " " 1871
1872.	600,000, " " " " " " 1872
1873.	665,000, " " " " " " 1873
1874.	525,075, ³ " " " " " " 1874

The falling off in the product of our iron mines during the past year is owing to the depression in the general business of the country. That it is not greater is due to the large amount of ore containing manganese, and which is free enough from phosphorus to be used for making Bessemer steel. The demand for our ores for making steel is constantly growing, as their good qualities become better known.

ZINC ORE.—There has been mined in 1874, 13,500 tons of zinc ore, against 17,500 tons last year.

GREENSAND MARL.—The statistics of marl have not been collected this year. They do not vary largely from those of last year, when 134,734 tons were carried on railroads, in addition to the amount hauled away from the pits by teams.

LIME.—No attempt has been made to collect full returns of the amount of lime burned in the State. The New Jersey Central Railroad has carried 86,250 bushels in 1874, but this is only a fraction of the whole amount.

This amount is made up from railroad and canal returns, received since the *estimated* amount of 450,000 tons was furnished to Governor Parker for his message.

PUBLICATIONS OF THE GEOLOGICAL SURVEY OF NEW JERSEY.

Geology of New Jersey, 899 pages large octavo, illustrated by 108 photolithographic engravings and wood cuts, and six mine maps; and accompanied by a portfolio containing the following maps, in sheets:

1. Azoic and Paleozoic Formations, including the Iron-ore and Limestone districts; colored—scale, 2 miles to an inch.

2. Triassic Formation, including the Red Sandstone and Trap-rocks of Central New Jersey; colored—scale, 2 miles to an inch.

3. Cretaceous Formation, including the Greensand Marl Beds; colored—scale, 2 miles to an inch.

4. Tertiary and Recent Formations of Southern New Jersey; colored—scale, 2 miles to an inch.

5. Map of a Group of Iron Mines in Morris county; printed in two colors; scale, 3 inches to 1 mile.

6. Map of the Ringwood Iron Mines; printed in two colors; scale, 8 inches to 1 mile.

7. Map of the Oxford Furnace Iron-ore Veins; colored; scale, 8 inches to 1 mile.

8. Map of the Zinc Mines, Sussex county; colored; scale, 8 inches to 1 mile.

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The prices are fixed to merely cover the price of paper, printing and binding; the expenses of the Survey and preparing book and engravings being paid by the State.

These publications can be had from Prof. George H. Cook, State Geologist, New Brunswick, on remitting the price, or through the booksellers. They are also kept for sale at these prices by M. R. Dennis & Co., of Newark, and D. Van Nostrand, of New York city.

Annual reports for the years 1869, 1870, 1871, 1872 and 1873 have also been printed. These can be had by application to the State Geologist.

The publications are in the following public libraries, where they can be consulted :

In all the State Libraries; in some other of the large public libraries in different parts of the United States, and in all the public libraries in New Jersey and the cities of New York and Philadelphia. That of 1868 is also in the offices of most of the County Clerks of New Jersey.

REPORT
ON A
Survey of the Boundary Line
BETWEEN
NEW JERSEY AND NEW YORK

MADE IN JULY AND AUGUST, 1874.

GEORGE H. COOK,
State Geologist.

TO HIS EXCELLENCY JOEL PARKER, Governor of
the State of New Jersey, and *ex-officio* President of the Board
of Managers of the State Geological Survey.

SIR:—I have the honor herewith to submit my report upon
the Survey of the Boundary or "Partition" line between New
Jersey and New York.

With high respect,

Your obedient servant,

GEORGE H. COOK,

State Geologist.

NEW BRUNSWICK, N. J., Sept. 8, 1874.

REPORT.

From the beginning of the Geological Survey it has been noticed that the mile monuments, which mark the line of division between this State and New York, are not well protected, or fixed so as to ensure their permanency. Several of them were not to be found; of these one or two were reported to have been burned into lime. Three others were found lying on the ground not far from the line. It is also suspected that some of those now standing have been moved from their original locations by land owners, for dishonest purposes. And it was known by local surveys that the monuments were not all in a straight line.*

These particulars have been brought to the attention of the Board of Managers in former reports of this Survey. And in view of the doubtful accuracy of the monuments as they now stand, and the important questions of property as well as jurisdiction, depending on the correct location of this line, a vote was passed by your Board at its meeting in December, 1872, authorizing the State Geologist to have the line, as the monuments now mark it, surveyed. This Survey has been made and the results are herewith presented.

A short account of the boundary itself, the questions which have arisen regarding it, and the means heretofore taken to ascertain and mark it, seems important for the proper understanding of this Survey.

*The late Capt. H. L. Southard, in 1859, surveyed the line across the Ringwood Tract, from the 19th to the 25th mile-stone, and showed that the monuments there were not set in a straight line.

New Jersey was first constituted and named as a distinct colony or province in the year 1664, when its territory was sold by James, Duke of York, (afterwards King James Second) to Lord Berkeley and Sir George Carteret. In the deeds of lease and release, dated respectively 23d and 24th of June, 1664, it is described as "That tract of land adjacent to New England, lying west of Long Island and Manhattan Island; and bounded on the east, part by the main sea, and part by Hudson's River; and hath upon the west, Delaware Bay or River; and extendeth southward to the main ocean, as far as Cape May, at the mouth of Delaware Bay; and to the northward as far as the northernmost branch of the said bay or river Delaware, which is in 41 deg. 40 min. of latitude; and crosses over, thence, in a straight line, to Hudson's River, in 41 deg. of latitude; which said tract of land is hereafter to be called Nova Casarea, or New Jersey." In this description, all the boundaries are natural features except the straight line which separates it from the State of New York.* But differences of opinion arose very soon, in regard to the precise meaning or intent of several of the words used in the description, and at least two questions of public interest have been involved in them.

Staten Island, though to the west of Long Island, and only separated from the main land of New Jersey by a small and indirect channel, while the deep and direct channel of the Hudson is to the east of it, and though none of the water of that river finds its way behind the Island to the main sea, was early claimed as a part of New York. And her title to it was finally confirmed by the action of the Legislatures of the two States, and of the U. S. Congress in 1834.

*Wm. A. Whitehead, Esq., of Newark, contributed a paper to the N. J. Historical Society on "The circumstances leading to the establishment, in 1769, of the Northern Boundary line between New Jersey and New York," which was read May 19th, 1859, and printed in the proceedings of the Society for that year, pp. 159-186. Much of the material for the historical matter of this report is taken from Mr. Whitehead's paper, and where other facts have been obtained, it is his preparatory work which has pointed out the way to secure them.

The terminal points for the Northern Boundary were also the subjects of controversy very soon after the first settlements were begun; the proprietors of East and West Jersey and the patentees of land in the adjoining parts of New York having different views in regard to the extent of each other's rights. The eastern extremity of the boundary was first determined to be at the mouth of Tappan Creek, afterwards it was claimed that it properly began opposite the mouth of Spuyten Duyvil Creek, and still other claims were presented for its location at various points between these extremes. The western end of the boundary was proposed by some to be fixed at the head of Delaware Bay, and by various others at the mouths of the Lehigh, the Navesink, the Popaxton, and the Mohawk branches of Delaware river, and at the lower end of Minisink Island. Many attempts were made to reconcile these conflicting claims, and to ascertain and mark the line.

Among these is the following, which is on record in the office of the Secretary of State of New Jersey, Book F 2 Deeds, p. 435.

“By His Excellency Lewis Morris, Esq., Captain General and Governor in Chief of His Majesty's Province of New Jersey and Territories thereon depending in America, and Vice Admiral in the same, &c.

“I do hereby certify that sometime in or about, as I believe the year 1685 or 1686, Colonel Thomas Dongan then Governor of New York with some of the gentlemen of the Council of New York and others, met with Gawen Lawrie then Governor of New Jersey and some of the gentlemen of the Council of New Jersey and others, at a place which stood afterwards the house of Col. William Merret on the west side of Hudson's River, where an observation was there made of the latitude, and marked with a pen knife on a beech tree standing by a small run or spring of water that runs down on the north side of the place where, I think, Merret's house afterwards stood. Some time early in the beginning of the year 1691, I went and remarked the said tree, but do not remember what was the lati-

tude that was marked thereon. They went afterwards to a house to the southward of a place called Verdrictige Hook, and from thence southerly to a farmer's house to the northward of the Tapan meadow, at the bottom of the Bay. I cannot particularly remember whether observations were made at one or both these places, but I was told they then did agree that the mouth of Tapan Creek, should be the point of partition on Hudson's River between the Province of New York and that of New Jersey.

LEWIS MORRIS.

"Be it remembered that on the 28th of February 1744-5 before Robert Hunter Morris, Esq. Chief Justice of New Jersey, His Excellency Lewis Morris, Esq. aforesaid, acknowledged the preceding certificate to be his act and deed.

ROBERT H. MORRIS."

Though no record of the fact is known, the latitude of 41 deg. 40 min. on the Delaware must have been found at this time for the division line between the Provinces of East and West Jersey, which depended on the location of this point, was run by Geo. Keith in 1687.

Nothing satisfactory to the parties interested was however accomplished as appears by the following Act passed in 1718.*

"An Act for running and ascertaining the division line betwixt this Province and the Province of New York.

"SEC. 1. Whereas, many disputes and controversies have of late happened betwixt the proprietors and owners of land in this Province of New Jersey, and the owners of land in the Province of New York, which lie near to or adjoining upon the division line, as well as between the officers of the government, and a number of lawless men there, who elude the laws of both Provinces, and pay taxes and obedience to neither, pretending to be situate in each of them, to serve their evil purpose of disobedience to the lawful commands and demands of the officers of the government. To prevent which for the future, and in

* Laws of New Jersey, 1718, Neville, chap. 27, p. 77.

order that such of the inhabitants of this colony whose estates or habitations are adjacent to or border on the said Partition line, may peaceably and without molestation, enjoy the fruits of their labor, and the government may not be defrauded of the public taxes that are or may arise and become due from the said inhabitants, by their pretending that they do not dwell within this colony :

“SEC. 2. Be it enacted, by the Governor, Council and General Assembly, and it is hereby enacted and declared by the authority of the same, that there shall be two or more commissioners, with the Surveyor General appointed by His Excellency, the Governor of this Province, or the Governor or Commander-in-Chief of this Province, for the time being, by and with the consent of the Council who shall be empowered by a commission under the great seal of this Province, to join with such commissioners and surveyors as shall be appointed and commissioned as aforesaid, shall on the part and behalf of this Province of New Jersey, run, survey, agree on, and ascertain the said line-limits and boundaries betwixt this Province of New Jersey, and the said Province of New York, according to the true limits thereof as near as can conveniently be done.

“SEC. 3. And be it further enacted, by the authority aforesaid, that when such commissioners as shall be appointed, by His Excellency the Governor, or the Governor or Commander-in-Chief for the time being, by and with the advice and consent of the Council, with the Surveyor General of this Province have joined with such commissioners and surveyors as shall be appointed for and on behalf of the Province of New York, and have ascertained, run, and agreed on the line of partition or division betwixt this Province and the Province of New York, they shall make return of the same, under their hands and seals, to His Excellency the Governor, or the Governor or Commander-in-Chief of this Province for the time being, which return shall be filed and recorded in the Secretary's office of this Province, which said line of division or partition betwixt this Province and the Province of New York, being ascertained,

run, and agreed on, and recorded as aforesaid, shall forever after be deemed, taken, be, remain and continue the partition line, limit and boundary betwixt this Province and the Province of New York; and all bodies politic and corporate, and all other persons whatsoever within this Province, or claiming any right or property therein, shall be concluded by the same; any law, usage, custom, or pretence to the contrary in anywise notwithstanding.

(Confirmed May 29th, 1719.)

A corresponding act was passed by the Legislature of New York,—and under these acts:—Robert Walters, of the City and Province of New York; Isaac Hicks, of Queens county and Province of New York; Allane Jarrat, of the City and Province of New York, and Surveyor for and in behalf of said Province; John Johnson and George Willocks, of the Eastern Division of the Province of New Jersey; James Alexander, Surveyor General of the Eastern and Western Divisions of said Province, and Joseph Kirkbride and John Reading, of the Western Division of New Jersey, were appointed commissioners.

They were to “determine which of the streams is the northernmost branch of the river Delaware—and to find out that place of the said northernmost branch of Delaware river that lies in latitude 41 deg. 40 min., which is the north partition point of New York and New Jersey.”

They located the point at Cohecton, on the east bank of the Delaware, 38 chains north of the middle of the mouth of Station Brook, and their report, which is dated July 25th, 1719, and signed by all the commissioners, is recorded in the office of the Secretary of State at Trenton, Book D 2 of Deeds, p. 230, &c., and their map is in Book G 2 of Deeds.

Latitude 41 degrees on the Hudson's River was also determined, and the line joining the two points was traced through; but the report upon them is said not to have been signed by the New York commissioners.

From this time onwards no progress was made in settling the

questions in controversy, until 1764, when the following act was passed.*

“An Act for submitting the property of lands which are held or claimed by any of His Majesty’s subjects as lying within this colony and are affected by the controversy about the boundary or partition line between this colony and the colony of New York, to such a method of decision as His Most Gracious Majesty shall think proper by His Royal commission or otherwise, to appoint.

“Whereas, the Boundary or Partition line between this colony and the neighboring colony of New York, has not hitherto been duly ascertained, and by reason of the unsettled state of the limits of the two colonies, not only the extent of their respective jurisdictions remain uncertain, and the due and regular administration of government in both colonies is by that means greatly impeded ; but also frequent and dangerous riots have been occasioned and are still likely to arrive between the borderers, as well concerning the extent of the respective jurisdictions as the property of the soil, to the great disturbance of the public peace, and the manifest discouragement of His Majesty’s good subjects in the settlement and improvement of that part of the country ; and whereas the Governor, the Council and the General Assembly of the Province of New York, did at their session held A. D. 1762, pass a law entitled an ‘Act for submitting the property of lands which are held or claimed by any of His Majesty’s subjects as lying within this colony, and are affected by the controversy about the boundary or partition line between this colony and the colony of New Jersey to such a method of decision as His Most Gracious Majesty shall think proper by His Royal commission or otherwise to appoint, and for defraying the expenses to accrue on the part of this colony on the final settlement of the said line ;’ wherein full and adequate provisions are made on the part of that Province for the purpose of settling and adjusting the said partition line and putting an end to a

*Laws of New Jersey, 1764—Allinson, chap. 396, p. 263.

controversy dangerous to the peace of both colonies ; and whereas the property of all the lands within this colony are held or claimed by some or other of His Majesty's subjects, in consequence of divers grants and mesne conveyances from and under His Royal Highness James, Duke of York, (afterwards King James the Second) the original proprietor thereof. To the intent therefore, that the salutary work so well begun on the part of the colony of New York, might have a happy issue, the legislature of this colony did, at their session in June last, pass a law entitled "An act for submitting the property of lands which are held or claimed by any of His Majesty's subjects as lying within this colony and are affected by the controversy about the boundary or partition line between this colony and the colony of New York, to such a method of decision as His Most Gracious Majesty shall think proper, by His royal commission, or otherwise to appoint ; but there arising some difficulties at the Plantation office about one of the agents therein appointed, and another of them being since deceased, it is thought most expedient to annul the said law, and by a new one to appoint other agents ; which said law and every part thereof is hereby declared null and void to all intents and purposes : but that the said controversy, as far as it concerns the lands held and claimed by any of His Majesty's subjects as lying and being within this colony, may, together with the boundary or partition line between the two colonies, be finally settled and determined.

SEC. 1. Be it enacted by the Governor, Council and General Assembly, and it is hereby enacted by the authority of the same, that all and singular the messuages, lands, tenements, and hereditaments, and all right, title, interest and property, in and to the same which are held or claimed by any of His Majesty's subjects, as lying and being within this colony, and are, can, shall or may be in anywise affected by the said controversy concerning the boundary or partition line between this colony and the colony of New York, are hereby fully and absolutely, to all intents, constructions and purposes in the law whatsoever, submitted and made subject to the same method of decision as His

Most Gracious Majesty shall think proper by His Royal Commission or otherwise to institute and appoint for the final settlement and determination of the boundary or partition line between the said two colonies; and all and every determination and determinations, to be made by any persons whatsoever by authority derived from His Most Gracious Majesty, by His Royal Commission or otherwise, that shall in anywise concern the said line, or the controversy that has heretofore subsisted relating to the same, and whereby the right, title, interest and property of the said messuages, lands, tenements, and hereditaments so held and claimed as aforesaid, as lying and being within this colony, or any part or parcel thereof, shall be intended to be bound and determined shall fully, completely and absolutely bind and forever determine the right, title, interest, and property of the said messuages, lands, tenements, and hereditaments to all interests, constructions and purposes in the law whatsoever; any law, usage, or custom to the contrary thereof in any wise notwithstanding.

SEC. 2. And to the end that sufficient provision may be made on the part of this colony, for the payment of the one equal half part of the joint expense to accrue on the final settlement of the said controversy and the boundary line between the said colonies; and also for paying of the particular expenses that shall or may accrue on the part of this colony in prosecuting the said controversy to a final settlement. Be it enacted by the authority aforesaid, that John Stevens, James Parker, Henry Cuyler Junior, William Donaldson, and Walter Rutherford, Esquires, or the majority of them, or the majority of the survivors of them, are hereby nominated and appointed agents, to manage the said controversy on the part and behalf of this colony; and also that the said agents or the major part of them, and the major part of the survivors of them, shall and are hereby authorized to pay, lay out, and expend from time to time, from and out of the public moneys in the treasury of this colony, all such sum and sums of money as shall from time to time be necessary to defray as well the one-half of the said joint expense, as the particular

expenses aforesaid; which sum and sums of money shall from time to time, on application of the said agents, or the major part of them, or the major part of the survivors of them, as occasion shall require, be drawn out of the said treasury by warrant or warrants of His said Excellency, or the Commander-in-Chief of this colony for the time being, by and with the advice of His Majesty's Council in favor of the said agents, or the major part of them, or the major part of the survivors of them, and also that the said agents and the survivors of them shall from time account from time to time upon oath for and concerning the execution of the trust hereby reposed in them to His said Excellency or the Commander-in-Chief for the time being, His Majesty's Council or the General Assembly of this colony when by them, or any of them, they shall be thereunto required.

Passed February 23d, 1764.

N. J. Laws, 1764, Allinson, p. 265, chap. 397.

An act for subjecting the estates of the general proprietors of the Eastern Division of this colony to the indemnification of this Province from any expense in running the line between New Jersey and New York.

Whereas, by an act of the General Assembly of the Province of New Jersey, passed in the 4th year of His present Majesty King George Third, entitled An Act for submitting the property of lands which are held or claimed by any of His Majesty's subjects, as lying within this colony and are affected by the controversy about the Boundary or Partition line between this colony and the colony of New York, to such a method of decision as His Most Gracious Majesty shall think proper by His Royal Commission or otherwise to appoint, wherein among other things it is enacted that John Stevens, James Parker, Henry Cuyler, Junior, William Donaldson, and Walter Rutherford, Esquires, or the majority of them, or the majority of the survivors of them, are nominated and appointed agents to manage the said controversy on the part and behalf of this colony, and also that the said agents or the majority of them, or

the major part of the survivors of them, are thereby authorized to pay, lay out and expend from time to time, from and out of the public moneys in the treasury of this colony, all such sums of money as shall from time to time be necessary to defray as well the one-half of the said joint expense as the particular expenses thereof, which sums of money shall from time to time, upon application of the said agents or the major part of them, as occasion shall require, be drawn out of said treasury by the warrant or warrants of His Excellency the Governor, or Commander-in-Chief of the colony for the time being; but the Legislature having received assurances from the general proprietors of the Eastern Division, that the Province should be indemnified of all demands for the purposes aforesaid:

SEC. 1. Be it therefore enacted, by the Governor, Council and General Assembly, and it is hereby enacted by the authority of the same, that all and singular the lands, tenements, hereditaments and other estates of the said John Stevens, James Parker, Henry Cuyler, Junior, William Donaldson, and Walter Rutherford, Esquires, and all others who are general proprietors of the Eastern Division of New Jersey, and of each and every of them, jointly and severally, and be subjected and made liable to indemnify and save harmless this colony of New Jersey of and from any money being demanded or drawn out of the treasury of this Province by virtue of any power granted in the before recited Act of General Assembly.

Passed February 23d, 1764.

In accordance with this act a Commission was issued under the privy seal, dated October 7th, 1767.* The following gentlemen were named in the writ: Charles Stewart, John Temple, and Peter Randolph, Surveyors-General of the Customs for the District of Quebec and of the Northern and Southern Districts of America respectively. Andrew Elliot, Receiver General of the Quit Rents in the Province of New York; Chambers Rus-

* C. 2 Commission, p. 331, &c., July 25th, 1768.

sell; Judge of the Court of Vice Admiralty for the Province of Massachusetts; William Allen, Chief Justice of Pennsylvania; Samuel Holland and William DeBrahm, Surveyors General of lands for the Northern and Southern Districts of America; Andrew Oliver, Secretary of the Province of Massachusetts; Charles Morris, Surveyor of lands and one of the Council of Nova Scotia; Peyton Randolph, Attorney General and one of the Council of Virginia; Benjamin Franklin of the Province of Pennsylvania, and Jared Ingersoll of the colony of Connecticut. John Jay was their Secretary. The Commissioners met in the room of the Chamber of Commerce in New York, on the 18th of June, 1769, and continued their sessions until the 7th day of October, when their decision was rendered.

The agents of the Provinces, assisted by able counsel, presented their respective cases, testimony, surveys, maps, and arguments, fully and at great length, and it would seem that every effort was made to get a perfect understanding and just conclusion in the case. The decision was as follows:

“At a meeting of the Commissioners appointed by His Most Gracious Majesty’s Commission to settle the Boundary line between the colonies of New York and New Jersey, held at the Long Room, called the Chamber of Commerce, in the City of New York, the 7th day of October, 1769.

PRESENT:

CHARLES STEWART, ESQ., *President.*
 ANDREW ELLIOT, “
 SAMUEL HOLLAND, “
 ANDREW OLIVER, “
 CHARLES MORRIS, “
 JARED INGERSOLL, “

“The Agents on the part of both Colonies, having offered to the Court all that they thought necessary or proper in Support of their respective Claims, and the Court having considered the Same, *Do find,*

“That King Charles the Second by his Letters patent bearing date the twelfth day of March, 1664, did Grant and Convey

to his Brother the Duke of York, All that Tract of Country and Territory now called the Colonies of New York and New Jersey; and that The said Duke of York afterwards by his Deed of Lease and Release bearing date the 23d and 24th Days of June, 1664, did Grant and Convey to Lord Berkley of Stratton and Sir George Carteret, that part of the Aforesaid Tract of Land Called New Jersey. The Northern Bounds of which in said Deed are described to be 'to the Northward as far as the Northernmost Branch of the said Bay or River Delaware which is in 41 deg. 40 min. of Latitude and Crosseth thence in a Straight Line to Hudson's River in 41 deg. of Latitude.'

"We further find among the many Exhibits a Certain Map compiled by Nicholas John Vischer, and published not long before the aforesaid Grant from the Duke of York, which we have reason to believe was Esteemed the most Correct Map of that Country at the time of the said Grant, on which Map is Laid down a Fork or Branching of the River then Called Zuydt River or South River now Delaware River, in the Latitude of 41 deg. and 40 min., which Branch we Cannot doubt was the Branch in the Deed from the Duke of York Called the Northernmost Branch of the said River, and which in the Deed is said to lye in the Latitude of 41 deg. and 40 min. And from a Careful Comparison of the several Parts and Places Laid down on the said Map, some of which, more Especially towards the Sea Coast and on the Hudson's River we have reason to believe were at the time well known. The Distance of the said Branch from the Sea Shore on the South, and the Relative situation of the same with regard to other places and the lines of Latitude as they appear to be laid down on the said Map at that and other places in the Inland Country: We are of opinion that the said Branch so laid down on the said Map, is the Fork or Branch formed by the Junction of the Stream or Water Called the Mahaackamack, with the River Called Delaware or Fishkill, and that the same is the Branch Intended and referred to in the before mentioned Deed from the Duke of York, as the Northern Station at the River Delaware, which Fork or Branch we find

by an observation taken by the surveyors appointed by the Court, to be in the Latitude of 41 deg. 21 min. and 37 seconds.*

"We are further of opinion that the Northern Station at Hudson's River, being by the words of the said Deed from the Duke of York, Expressly limited to the Latitude of 41 deg. should be fixed in that Latitude, which Latitude we have caused to be taken in the best manner by the Surveyors appointed by the Court, and which falls at a Rock on the West side of Hudson's River marked by the said Surveyors, being 79 Chains and 27 Links to the Southward on a Meridian from Sneydon's House, formerly Corbet's.

"*It is Therefore* the final Determination of the Court That the Boundary or Partition Line between the said Colonies of New York and New Jersey, be a direct and straight Line from the said Fork at the Mouth of the River Mahackamack, in the Latitude of forty-one deg. twenty-one min. and thirty-seven sec. to Hudson's River at the said Rock, in the Latitude of forty-one degrees as above described.

(Signed)

CHARLES STEWART,
ANDREW ELLIOT,
ANDREW OLIVER,
JARED INGERSOLL."

"Samuel Holland and Charles Morris, Esquires, two of the members of the Court not Concurring in a part of the foregoing determination, viz., That part respecting the Station at Hudson's River, desired to have their Reasons for such their Dissent entered on the Minutes of our Proceedings, which was allowed, and they are as follows:

"The Northern Boundary of the Province of New Jersey, is the matter Submitted to our Consideration and to Ascertain the Extremities of the Partition Line upon Hudson's and Delaware Rivers.

The Astronomical observations and computations for determining the Latitudes here given, are said to have been made by David Rittenhouse, of Philadelphia, at that time one of the ablest Astronomers in America.

"In doing this We are to proceed upon Principles of Justice and Equity, having respect to the Proofs. This we apprehend to be [the] Language and Intent of [our] Commission and It is necessary It should be so because the Country was but little known at the Time The Grants to the Duke of York were made, and We must of necessity have recourse to the ancient Maps which were in being at Time of making these Grants.

"It is difficult to ascertain with precision what Lands passed to the Duke of York by his Grant, Either from the Express Words of the Grant or by any Maps of the Country that appear to us to have been then extant. Nor is it probable that the Duke or his Grantees were better Informed when He Conveyed New Jersey to Berkley and Carteret; the best Lights We have on this Matter are the Maps of Vischer.

"The words relative to the Latitude in the Grants to Berkley and Carteret, are words of Description concerning the Northernmost Branch of Delaware, and We do not find upon Inquiry any Branch in the Latitude mentioned. A Branch nevertheless Seems to be Intended. The Branch nigh to that Latitude is Mahackamack and which, from a view of this Ancient Map we are Induced to believe was the North Partition point intended by the Partiès, and think in Justice and Equity ought to be so determined, because a Line from Hudson's River to the Branch at Easton, claimed on the part of New York, or to that of the Poughpaxtonk and Mohawk Branches claimed by New Jersey, would Involve many of his Majesty's subjects in Absolute Ruin who hold respectively under Each Government.

"It is therefore upon this principle The Point on Hudson's River we apprehend ought also to be fixed, for as It appears by Vischer's Map that the Latitude of forty-one on Hudson's River, which Map We apprehend was the Guide and direction to the Duke in forming his Grants to Berkley and Carteret. This Map, ascertains the Latitude of forty-one on the upper part of the Manhattan's Islands.

"If the Country therefore was vacant we should not Hesitate in Declaring that the Latitude of forty-one as laid down in the

Ancient Maps would in Equity be the Station on Hudson's River, and more Especially because We have had abundant Experience in our own Departments to Observe that the Ancient Geographers find their Latitudes in these parts of the Continent Several Miles more Southerly than they are found to be by more modern Observations. In Tenderness therefore to the New Jersey Settlers, We are Inclined to a more Northern Station and in settling the place where, Consider that before the Contested Territory was planted a Place due West of Frederick Phillips Mills gained the Reputation as the Station Point upon Hudson's River, and a Line from this Station which appears to be Anciently fixed by the Governments concerned will be the Least detrimental to the Settlers, and one more Northerly will Comprehend many Farms in a populous Neighborhood held under New York by Ancient Patents. We Cannot help being of Opinion That a Line thence to the Mahaekamack Branch will be the most Just and Equitable of any We can fix upon agreeable to the design of the Royal Commission which We imagine will be most Conformable to His Majesty's Gracious Intentions to His Subjects in both Provinces.

(Signed) SAMUEL HOLLAND,
CHARLES MORRIS."

This decision did not satisfy either of the parties and strenuous efforts were made to appeal from it, but these met such discountenance in England, that the agents of the two Provinces finally agreed to accept it as appears from the following extract from the Proprietor's Minutes vol. B, p. 91.

"At a Council of Proprietors of the Eastern Division of New Jersey, held at Perth Amboy, Sept. 14th, 1770.

"The agents for managing the controversy on the boundary line between this Colony and the Colony of New York, delivered in a report in the following words :

"The agents for managing the controversy of settling the division line, with the colony of New York, Do Report that immediately after the last stated meeting Messrs. Stevens, Cuyler and Rutherford met the agents of New York and signed

the agreement, a copy of which had been laid before the Board with the only alterations respecting the manner of applying for the acts of the Legislature, and inserting the names of Messrs Stevens, Parker and Rutherford as the persons who were to attend the running of the line on the part of New Jersey, and Messrs Wickham and De Noyelles on the part of New York.

"That in consequence thereof the 22nd of May last Messrs Stevens and Parker with Anthony Dennis their Surveyor, met Messrs Wickham and De Noyelles with James Clinton their Surveyor at Orangetown, where many of the adjacent inhabitants were assembled and were utterly averse to having the proposed line run, but on the contrary with many threats declared they were determined to prevent it, on which being apprehensive they might be obstructed if they begun on Hudson's River and Mr. De Noyelles declaring if they were he would proceed no further, they all agreed to begin on the Station Mahackamack hoping the people opposing would be better informed on their return. Accordingly they set out but from the badness of the weather did not begin before the 25th in the evening when they set off from the Station aforesaid and proceeded on a course S. 53 deg. 15 min. E. from day to day to the 7th of June when they were stopped a few chains across Saddle River by at least 50 men. They then concluded to set over to the line run and measured last summer by Clinton and Dennis, from Phillips' Mill to Minisink Island, which was done. They afterwards crossed Hudson's River and being shown the latitude of 41 deg. observed last summer, they finished the traverse from thence to the Mills, and returned to Garret Hoppen's to protract their work. On the 14th, Mr. Wm. Bayard, met them at Orangetown and the inhabitants at last agreed that the line should be run, on which the Surveyors began where they left off and fell about seventy links southward of the marked rock at the latitude of 41 degrees.

"Accordingly on the 20th they set off from the said rock on a course N. 54 deg. 35 min. W. and continued running the same to the day of July when they finished at Mahackamack,

and fell four chains and fifty links southwards of the Station, and as a mark is set up at every mile, offsets can be easily made to the true line. The Surveyors in company with Messrs Rutherford and Wickham then went to Goshen where they finished two maps of their work, signed by them both, one of which is now laid before the Board. And further report that during the running of said line they had frequent meetings with the inhabitants near the same and took an account under what government and by what title they held their possessions, and that the New Jersey agents have the accounts of the possessions under New Jersey to the northwards of the line, and the New York agents have the account of the New York possessions to the southward of said line. They now beg leave to observe to the board that as by agreement application is to be made to the Legislature for a law in conformity to the same and as the assembly is now called to meet at this place the 26th instant they request the opinion of the board in what manner further to proceed.

“Which (report) being considered is approved and the board is of opinion that advertisement be immediately inserted in the Newspapers and set up in the most public places on the line in the counties of Bergen and Sussex, of the intended application to the General Assembly for obtaining an act to confirm said agreement and Lord Stirling is requested to prepare a draft of a petition to the Assembly for that purpose. It is recommended to the above agents to meet the agents on the part of New York to confer with them, that their actions may be similar in their application for the like law.”

The law was prepared, passed, and approved, as appears from the following, which is on file in the Secretary's office at Trenton :

*“At the Court of St. James, the 1st day of September, 1773.**

PRESENT.

“The Kings Most Excellent Majesty, Arch Bishop Canterbury, Earl of Pomfret, Hans Stanley, Esq., Lord Chamberlain,

* Book C, 3 Commissions, p. 11.

Viscount Barrington, Richard Rigby, Esq., Earl of Rochford, Lord North, Sir John Goodricke.

“Whereas the Governor of his Majesty’s Colony of New Jersey with the Council and Assembly of the said Colony did in September 1772, pass an Act which hath been transmitted in the words following, viz :

“An Act for establishing the boundary or partition Line between the Colonies of New York and Nova Cæsarea or New Jersey, and for confirming the titles and possessions ;

“Whereas the Boundary or Partition line between the Colonies of New York and Nova Cæsarea or New Jersey from the Station of Hudson’s River to the Station on Delaware River not being duly ascertained and the extent of their respective jurisdictions remaining uncertain and the due and regular administrations of government in both Colonies being by that means greatly obstructed the respective Legislatures of both the said Colonies did by acts for that purpose passed concur in submitting the title and property of the lands affected by the said boundary or partition line, in both Colonies to such a method of decision as his most gracious Majesty should think proper by his royal commission or otherwise to institute and appoint, of which acts his majesty was pleased to declare his approbation and by his royal commission under the great seal of Great Britain bearing date the seventh day of October in the seventh year of his reign did authorize and appoint certain persons therein named or any five of them to be his majesty’s Commissioners for ascertaining, settling and determining the boundary aforesaid between the said Colonies, and Whereas, a sufficient number of Commissioners named in the said Commission on the seventh day of October in the year of our Lord one thousand seven hundred and sixty-nine, did determine that the boundary or partition line between the said colonies of New York and New Jersey should be a direct and straight line from the fork or branch formed by the junction of the stream or waters Mackackamack with the river called Delaware or Fishkill in the latitude of forty-one degrees twenty-one minutes and thirty-seven

seconds as found by the Surveyors appointed by the said Commissioners to a rock on the west side of Hudson's River marked by the said Surveyors in the latitude of forty-one degrees being seventy-nine chains and twenty-seven links to the southward on a Meridian from Sneydon's house formerly Corbet's from which determination the agents of both the said Colonies appealed to his Majesty in his privy Council; And Whereas several tracts of land to the Northward of the said partition line so decreed by the said Commissioners have been heretofore taken up or sold and hitherto and still are held and possessed by virtue of titles derived from and under the government of New Jersey or the general proprietors of the same or some or one of them, to wit; one tract of land on the 6th day of November 1718, surveyed and afterwards returned for John Decker for 1000 acres with the usual allowance for highways; Another tract on the 11th day of October, 1711, surveyed and afterwards returned for William Tidsworth for 350 acres with the usual allowance for highways, Another tract on the 29th day of July, 1731, surveyed and afterwards returned for Samuel Green for 783 acres with the usual allowance and two other tracts mentioned to contain together 500 acres, besides the usual allowance for highways, surveyed and returned for Johannes Westphalia, Claus Westphalia, Simon Westphalia, Tunis Quick, Remora Quick and Cornelius Doucher, only about 100 acres of which last mentioned two tracts are now held and possessed by virtue of the said survey, the remainder thereof being now held and possessed by persons claiming under the colony of New York. Another tract of land at the northeast end of the Long Pond surveyed and returned for or at the request of Peter Schuyler, containing 402 acres and 49-100ths of an acre strict measure, which after allowance for highways was to remain for 383 acres and 32-100ths of an acre, and also another small tract of land surveyed the 12th day of July, 1763, for John and Gertrude Schuyler situate adjoining the tract last above mentioned and containing 13 acres and 59-100ths of an acre; several other tracts of land sold and conveyed by the devises of James and Mary Alexander to sundry persons on the 13th day of De-

cember, 1762 to wit, to Elijah Inman 101 acres and 7-100ths of an acre, to Hannah Ferguson 123 acres and 51-100ths of an acre, to George Kimber 161 acres and 74-100 parts of an acre, to Hezekiah Lorin 97 14-100ths acres, to Inman Wallin 66 93-100ths acres, to Benjamin Van Vleet 104 35-100th acres, to Bryant Hammell 135 acres, to James Clark 104 56-100ths acres, to Jacobus Rosenkrans 173 35-100ths acres, to Johannes Westbrook 100 acres, to John Davis 152 acres, to Jacob Middagh 213 76-100ths acres, and to Josias Cole 100 acres; and another tract of 50 acres sold and conveyed by Andrew Johnson, to George Kember on the 8th day of August, 1759, a part of which lays to the southward of the said partition line. Another tract of 87 56-100ths acres sold and conveyed by Benjamin Thompson to Johannes Westbrook, on the 4th of May, 1763. Two other tracts of land sold and conveyed by James Alexander, William Burnet and James Parker to Richard Gardner, on the 30th day of March, 1753, the one tract containing 170 acres and the other 8 acres. Another tract of 40 63-100ths acres sold and conveyed by the devisees of James and Mary Alexander to the said Richard Gardner, on the 3d day of January, 1763, and another tract of 173 acres sold and conveyed by the said devisees of the said James and Mary Alexander to Joseph Barton, on the 16th of December, 1762, part whereof lays to the southward of the said partition line. Another piece of land containing about one acre sold and conveyed by David Ackerman to Jacobus Van Buskirk, on the 12th of February, 1762. And also several other tracts of land purchased, surveyed and located for the proprietors of the Sterling Iron Works, to wit, one tract containing 50 acres surveyed the 10th of November, 1736, to Cornelius Board and Timothy Ward. Six small tracts containing in the whole 27 72-100ths acres surveyed February 12th, 1738, to the said Board and Ward. Six other tracts of land containing in the whole 371 53-100ths acres surveyed the 23d of July, 1740, to Timothy Ward, William Smith and Company, And another tract of 10 80-100ths acres surveyed the 29th of November, 1757, to William Hawkhurst. Three other tracts containing

in the whole 131 25-100ths acres surveyed to James Burling, the 17th of May, 1750, And another tract containing 10 29-100ths acres surveyed to William Hawkhurst, the 20th of July, 1761, One other tract of land sold and conveyed by John Barberie and Peter Fauconier to John Sobrisco, on the 6th of November, 1724, containing 630 acres, One other tract of land sold and conveyed by Magdalane Valleau to Coenradt Wana-maker, on the 23d of May, 1753, containing 105 acres, One other tract of land sold and conveyed by Richard Gardner to Elijah Reeve, on the 8th of June, 1762, containing 127 48-100ths acres, Also three other tracts of land surveyed the 13th of April, 1768, to William Hawkhurst, containing 100 98-100ths acres strict measure after the usual allowance for highways.

“AND WHEREAS several other tracts of land to the southward of the said partition line so decreed by the said commissioners have been heretofore patented and hitherto and still are held and possessed by virtue of titles derived under the government of New York to wit, sundry tracts of land included in the following bounds, beginning at the aforesaid rock on the west side of Hudson’s River in the latitude of 41 deg. and runs from thence southerly along the Hudson’s River to the southeast corner of the land now in possession of Mattys Bogert, and from thence westerly along the south side of the said Mattys Bogert’s land and along the lines of the lands now in the possession of Isaac Westervelt and Garret Westervelt, to the Tiene Kill and then along the said Kill to the Dwars Kill, and from thence along the said Dwars Kill to Demarests Kill on Hackensack River, and from thence along the said river to the mouth of Pascack River and then along the said Pascack River till it comes to the lands of David Demarest whereon the said David Demarest’s mill stands, and then westerly around his lands and including the same to the said Pascack River to the said partition line decreed as aforesaid, and then along the said partition line to the place of beginning; And another tract of land sold and conveyed by Benjamin Ask and Lancaster Symes to Thomas De Kay,

containing 1320 acres, part of which lies to the northward of the said partition, and two other tracts of land sold and conveyed by Hendrick Vãnderlinda to Frederick Ortendike, by deed bearing date the 30th of May, 1735, the one containing 285 acres and the other containing 180 acres, and another tract of land sold by Abraham Van Horn and Catherine his wife, to John Fasheur and Cornelius Haring, by deed bearing date the 22nd of May, 1752, containing 185 acres be the same more or less, And another tract of land sold and conveyed by Samuel Verbryek and Susannah his wife, to John Fasheur, by deed bearing date the 19th day of May, 1759, containing 265 $\frac{3}{4}$ acres good measure, part whereof lies to the northward of said partition line; And another tract of land sold and conveyed by Benjamin Van De Linde to William Haldron, by deed bearing date the 18th of December, 1760, containing 258 acres; And another tract of land being the remainder of the unsold lands of so much in Samuel Bayard's patent as is contained in a deed from Hendrick Van De Linde to Roelof Van De Linde, Benjamin Van De Linde, and Samuel Verbryek bearing date the 30th of June, 1760; And another tract of land sold and conveyed by Robert Campbell to Andries Pieterse, by deed bearing date the 21st of August, 1762, containing 150 acres; And another tract of land sold and conveyed by Henry Van De Linde and Arientje his wife, to Abraham Post, by deed bearing date January 12th, 1760, containing 150 acres; And another tract of land sold and conveyed by Benjamin Van De Linde to Gerret Ackerson, and Gerret Haring, by deed bearing date the 4th of May, 1759, containing 348 acres; And also a piece of land now in the possession of William Bayard, Esq., being part of a tract of land formerly granted by letters patent under the great Seal of the Province of New York, to Daniel Honan and Michael Hawden lying adjoining to the south side of the said partition line and bounded to the southeast by the land in possession of John Fasheur and to the southwest by the land of William Haldron; And Whereas it is conceiv'd just and equitable that the present possessors of the said lands on each side of the said partition line:

who have not only purchased the same for a valuable consideration but many of them have laid out all their substance in the improvement thereof should be secured in the enjoyment of the fruits of their labor and industry. Be it therefore enacted by His Excellency the Governor, the Council and the General Assembly, and it is hereby enacted by the authority of the same that the said partition line so decreed by the said Commissioners is and shall forever hereafter remain and be the boundary and line of partition between this Colony and the Colony of New York.

“AND BE IT FURTHER ENACTED by the authority aforesaid that James Parker, John Stevens and Walter Rutherford, Esquires, or any two of them shall be and hereby are appointed Commissioners to join with such as are appointed on the part of the Colony of New York to ascertain and mark the said partition line so that it may be sufficiently known and distinguished. And the said Commissioners are hereby directed and required to mark the before mentioned rock on the west side of Hudson's River marked by the surveyors in the latitude of 41 deg. with a straight line throughout its surface passing through the places marked by the surveyors and with the following words and figures to wit; Latitude 41 deg. North, and on the South side thereof the words New Jersey and on the north side thereof the words New York, and to mark every tree that may stand in the said line with five notches and a blaze on the northwest and southeast sides thereof and to put up stone monuments at one mile distance from each other along the said line, and to number such monuments the number of miles the same shall be from the before mentioned rock on the west side of Hudson's River, and mark the words New Jersey on the south side and the words New York on the north side of every of the said monuments; the one-half the expense whereof shall be paid by the Colony out of any moneys which may be in the treasury upon warrants to be issued by the Governor or Commander-in-Chief of this Colony for the time being, with the advice of Council, provided the whole expense to be paid by this Colony shall not exceed

the sum of fifty pounds. And be it further enacted by the authority aforesaid, that the several patentees, vendees, possessors and claimants of all and every the said tracts of land to the southward of the said boundary or partition line which are now held and possessed in virtue of titles derived under the government of New York as above described, and their heirs and assigns shall severally hold and forever enjoy the property of all and any and every of the said tracts of land so as aforesaid respectively purchased and possessed as fully and in the same manner to all intents and purposes whatsoever as if the same had by virtue of this act been determined to be within the Colony of New York, without let, suit, disturbance or molestation of the general proprietors of New Jersey or any of them or any person or persons claiming or to claim by from or under the said general proprietors or any or either of them or by virtue of any title derived under the said government of New Jersey, Provided always And be it further enacted by the authority aforesaid that it shall and may be lawful to and for any persons claiming titles under the said government of New York to any of the aforesaid lands or tenements hereby intended to be secured to the purchasers and possessors under the said government of New York to the southward of the said Boundary or Partition line to commence, sue, prosecute and maintain any writ, suit or action for the recovery of their rights, this act being only designed to confirm the titles to such lands lying to the southward of the said Partition line as are in manner aforesaid actually held and possessed under the government of New York, against all claims under the general proprietors or Government of New Jersey but not to determine the particular rights of the claimants of such lands under the government of New York; Provided always that this act shall not be in force or take effect until His Majesty shall have given His Royal assent both to this act and a similar act passed by the Governor or Commander-in-Chief and the Council and the General Assembly of the Colony of New York the 16th day of February, in the 11th year of His Present Majesty's reign entitled An Act for establishing the Boundary

or Partition line between the Colonies of New York and Nova Caesarea or New Jersey and confirming titles and possessions.

“Council Chamber, September 25, 1772.

This bill having been three times read in Council—Resolved that the same do pass.

By order of the House.

DAVID OGDEN, Speaker.

House of Assembly, Sept. 23, 1772.

This Bill having been three times read in the House of Representatives, Resolved that the same do pass.

By order of the House.

CORT'D SKINNER, Speaker.

“Council Chamber, September 26, 1772.

I assent to this Bill, Enacting the same and order it to be enrolled.

WM. FRANKLIN.

“Which act together with a representation from the Lords Commissioners for Trade and Plantations, thereupon having been referred to the Consideration of a Committee of the Lords of His Majesty's Most Honorable Privy Council for Plantation affairs, the said Lords of the Committee did this day report as their opinion to His Majesty that the said act was proper to be approved. His Majesty taking the same into consideration was pleased with the advice of His Privy Council to declare his approbation of the said act and pursuant to His Majesty's royal pleasure thereupon expressed, the said act is hereby confirmed finally enacted and ratified accordingly—Whereof the Governor or Commander-in-Chief of His Majesty's said Colony of New Jersey for the time being, and all others whom it may concern are to take notice and govern themselves accordingly.

STEPHEN COTTRELL.”

The directions to ascertain and mark the division line were carried out, as appears by the following extract from the Proprietors minutes vol. B. pp. 181 and 182.

"At a Council of the Proprietors of the Eastern Division of New Jersey held at Perth Amboy, April 15, 1775.

"Messrs. Stevens and Rutherford, two of the Commissioners on the part of New Jersey for settling the line of division between this Province and the Province of New York delivered in a report in the following words.

"The Commissioners in behalf of the colony of New Jersey appointed to settle the partition or boundary line between the said colony and the colony of New York, do report, that according to appointment made with the Commissioners in behalf of the colony of New York, they arrived at Tappan the 16th day of October last, and having attentively taken their beginning from the rock on Hudson's River marked latitude 41 deg. they proceeded to run a random line calculated by former runnings with all the exactness in their power, and set up a post at each mile. That at Mahackamaek they again calculated a course which they also run, and together with the former running corrected each station, and according to law set up stone monuments at every mile's distance until their return to the rock on Hudson's River which they also marked, and further that the Commissioners of both colonies executed a joint instrument in writing, certifying the final settlement of the said line of partition, which they now deliver to the Board, together with the accounts of expenses attending the said settlement, all which they now submit to the consideration of the board.

JOHN STEVENS, .

WALTER RUTHERFURD."

"Which being considered the said report is much approved of and it is ordered that the joint instrument certifying the final settlement of the line together with the surveyors certificate be proved and recorded both in the Proprietors and Secretary's offices, and that the accounts be referred to Messrs. Cuyler, Bland and John Johnston or any two of them to examine and report thereon."

The Commissioners Report was proved in 1785, and is

recorded in the Proprietors book D, of Miscellaneous Records, p. 63—The Surveyors Certificate was not found on the Proprietors Records but it is on file with the Commissioners Report in the office of the New York Secretary of State at Albany.—And they are as follows:

COMMISSIONERS REPORT.

“In pursuance of an Act of Assembly of the Colony of New York entitled an Act for establishing the Boundary or Partition line between the Colonies of New York and Nova Cæsarea or New Jersey, and for confirming Titles and Possessions, And of one other Act of Assembly of the Colony of New Jersey entitled An Act for establishing the Boundary or Partition line between the said Colonies of New York and Nova Cæsarea or New Jersey, and for confirming the Titles and Possessions. We William Wickham and Samuel Gale, two of the Commissioners in the first of the said Acts mentioned, and John Stevens and Walter Rutherford two of the Commissioners in the other of the said Acts mentioned, Do hereby certify that we have ascertained and marked the Partition line in the said Acts mentioned so that it may be sufficiently known and distinguished. In doing this business we have been greatly assisted by James Clinton and Anthony Dennis, Surveyors, by us appointed for that purpose, as will more particularly appear by their certificate hereunto annexed.

“That the rock on the west side of Hudson’s River marked by the surveyors in the said Acts mentioned, in the latitude of 41 degrees, we have marked with a straight line through its surface passing through the place marked by the said surveyors with the following words and figures to wit: *Latitude 41 deg. North*, and on the South side thereof the words *New Jersey*, and on the North side thereof the words *New York*. That we have marked trees, agreeable to the said Acts, standing in the said line, with a blaze and five notches under the same. And that we have erected stone monuments at one mile distance from

each other along the said line, except the monument number twenty-six which by reason of the Long Pond we were obliged to place one chain further from the Station on Hudson's River. And we have numbered the said monuments from the West side of Hudson's River, beginning with Number One, and ending with Number Forty-eight, and have marked the words *New York*, on the North side of each of said monuments, and the words *New Jersey* on the South side of each of the said monuments.

"In witness whereof we have hereunto set our hands and seals, the thirtieth day of November, one thousand seven hundred and seventy-four.

"Scaled and signed in presence of	}	(<i>Signed</i>)
ROBERT HALL,		W. WICKHAM,
CHARLES WICKHAM CROOKE,		SAMUEL GALE,
JOHN STEVENS, JR.,		JOHN STEVENS,
WM. S. LIVINGSTON.		WALTER RUTHERFURD.

SURVEYORS CERTIFICATE.

"We James Clinton, of Ulster County, in the Province of New York, and Anthony Dennis of Monmouth County in the Province of New Jersey, Surveyors employed by the Commissioners appointed by Acts of the Assembly of the said Provinces for ascertaining and marking the Partition line between the said colonies Do certify that we have run the said Partition line with the utmost care and exactness we were capable of. That in Running Said Line we found in several parts thereof the needle attracted which we corrected by staking, That from the Station Rock marked on the west side of Hudson's River, in the latitude of Forty-one Degrees to the fork or branch formed by the junction of the stream or waters called the Machackamaek with the River called Delaware or Fishkill the course according to the best of our judgment is North Fifty-four Degrees and Forty minutes West as the Magnetic needle now points, and that the distance between the two stations is Forty-eight miles and

was, however, a mark on the bare limestone rock at the junction of the Nevesink and the Delaware. It was on the nearly flat rock; below high water mark, but usually uncovered. It was in the form of a crow-foot, and was plainly cut into the rock, and worn smooth by long exposure to the stream and the weather. It was recognized by those living near there as the point of meeting of the New Jersey, New York and Pennsylvania boundaries. Its location in regard to the streams was in accordance with the decision of the Royal Commission, and it was in a line with several of the mile monuments.

Considering these two points to be the ones agreed upon by the Commission in 1769, and determined by the Astronomers and Surveyors at that time, the work to be done now, was to trace a *straight line* from one of these to the other; and then to measure the distance of each of these mile monuments from the line now traced, and make the proper description and report.

For ascertaining the Geographical positions of these points, and the direction and length of the straight line between these, we are indebted to the Superintendent of the United States Coast Survey, who, at the request of this Board, detailed officers to make the necessary observations and computations, and has now furnished us the results of the work as embodied in the following communication.

"U. S. COAST SURVEY OFFICE,
Washington, May 18th, 1874.

"Prof. GEORGE H. COOK, New Brunswick, N. J. :

"DEAR SIR—I have the pleasure of sending you herewith the results of the determination of latitude and longitude made near the northwest corner of the State of New Jersey, together with the computation of the direction and length of the boundary line, and the requisite data for tracing the line.

Yours very truly,

C. P. PATTERSON,
Superintendent.

"U. S. COAST SURVEY OFFICE,
Washington, May 14th, 1874.

"C. P. PATTERSON, Esq., Supt. U. S. Coast Survey :

"DEAR SIR—I have the honor to submit the following statement relative to the northern boundary line between New Jersey and New York for communication to Prof. George H. Cook.

"1. Position of terminal point near Hudson River.

Latitude 40 deg., 59 min., 51.20 seconds.

Longitude, 73 deg., 54 min., 11 seconds.

Azimuth of boundary line 121 deg., 16 min., 54 seconds.

"2. Position of Tri-states Rock, N. W. terminus.

Latitude 41 deg., 21 min., 22.63 seconds.

Longitude 74 deg., 41 min., 40.70 seconds.

Azimuth of boundary line 300 deg., 45 min., 38 seconds.

"3. Length of line 84,730 yards, or 48½ miles.

"The accompanying memoranda give all the information requisite for tracing the line.

Yours respectfully,

J. E. HILGARD,

Asst. in charge of Office."

The work of tracing the straight line, and making the proper surveys and computations on the position of the monuments, has been done by Prof. Ed. A. Bowser, during the present summer, and his report is presented here.

PROF. BOWSER'S REPORT.

"NEW BRUNSWICK, N. J., Aug. 28th, 1874.

"DR. GEO. H. COOK :

"DEAR SIR—I have the honor to submit the following report of the survey of the Northern Boundary of New Jersey, made in the months of July and August of the present year.

"I was instructed to run a straight line from the Tri-states-rock at the northwest terminus of the boundary, to the eastern terminus at the Hudson River ; and to locate the present monu-

ments and describe the mile-stones. My instructions required me also to find the variation of the needle at different points, to ascertain where there was local attraction, to examine the topography of the country in the neighborhood of the line, and to take barometric heights.

"To assist me in this work, I fortunately obtained the services of Mr. Jas. K. Barton, of the class of 1871, Rutgers Scientific School, and a careful and accurate surveyor. I was assisted, also, by several of the students of the Scientific School. The instrument used was an 8-inch theodolite, which was loaned by the Superintendent of the U. S. Coast Survey. This instrument was placed in charge of Mr. Barton.

"The work was begun at the northwest terminus of the boundary. The instrument was set up on the Tri-states-rock, and the angle between the meridian and the boundary, as computed by the Coast Survey, was turned off. From this station, a point on our line was determined on the westerly edge of the summit of the Blue Mountain. The instrument was then moved forward to this point, and after running to the easterly edge of the summit, we sighted to the top of Pochuck Mountain, a distance of about ten miles. From the station on the Pochuck we sighted to the top of Warwick Mountain, a distance of eight miles. From this station we could see our back stations on the Pochuck and the Blue Mountain in the same vertical plane—the latter being eighteen miles off. Three sights more brought us to the high mountain west of Suffern's station, and distant from our station on Warwick Mountain eleven miles; the two intermediate stations being on Rough Mountain and Cedar Pond Mountain. From the station near Suffern's we sighted to a point eight miles ahead, which was nine miles from the Hudson river; and from this last station we reached a point on the Palisades, about three-quarters of a mile from the Hudson river. From this point we could look back and see our station at the nine-mile stone, and also the one west of Suffern's, in the same vertical plane; the latter being seventeen miles off. Three sights more brought us to the Hudson river, which we reached

at a distance of 15 63-100ths feet north of the eastern terminus of the boundary. With a very few exceptions, our sights were several miles in length, and all of them were made with several repetitions, and with the utmost care. The offsets were then computed, in order to locate exactly the straight line joining the east and west ends of the boundary. We then ran from the Hudson back to the Delaware, and located the present boundary, by measuring the distance of each mile-stone from our line and subtracting the offsets. These distances, together with the present boundary and the straight line just run, are shown on the map which accompanies this report. With the exception of stations 10, 15, 22, 26, 27, 30, 31, 34, 36, 41, 43, 46, 47, and 48, thirteen in all, there is a stone monument standing at every mile, with the words *New York* and *New Jersey*, and the *number* of miles the stone is from the west edge of the Hudson river, cut in it. Stations 15, 22, 26, 36, 41, 46, 47, and 48 were located by ascertaining from farmers living in the neighborhood where the line had 'always run' at these points. At many of the stations were piles of stones, while at others the wood was cut on one side of the line, and standing on the opposite side. At stations 15 and 41, the monuments are broken down, and lying a short distance away; station 10 is lying down, having been plowed up this spring. At station 26, the monument is probably below the surface of Greenwood lake, as it was placed in 1774 on the western edge, and the water is now several feet higher than it was then. At stations 31, 34, and 43, are blazed trees, which are said to be on the line, and are so recognized in deeds. At station 30, neither the stone monument nor the line could be found. It will be seen on the map that the present boundary is crooked, swinging down into New Jersey, and quite regular, except in the mountain region, between the 16th and 29th mile-stones; and that midway it deviates from the straight line about 2400 feet.

We found the variation of the needle at the east end to be about 2 deg. more than at the west end, and the variation about the 40th mile-stone is 1 deg. less than at Tri-states-rock.

"At a number of places in the mountain region between the 16th and 29th mile-stones, at the Pochuck Mt., and also on the Palisades, there was some local attraction.

"It becomes interesting to know why the line we have just run should differ so much from the present boundary. The line we have just run is a straight line; in other words, it is an arc of a great circle, which is the shortest distance between two points on the surface of a sphere. The present boundary, which was run in 1774, was run with the compass, and therefore would be approximately a rhumb line, and the shorter the sights, the closer the approximation: that is, it would everywhere have the same course. Now if there had been no variation of the needle, or if the variation had been everywhere the same, the line run would have been approximately a true rhumb line, which would differ a little from an arc of a great circle; it would be slightly curved, swinging down into New Jersey. But because there was a variation of the needle, and because this variation—although different in amount from what it now is—must have been about 2 deg. more at the east than at the west end; the line run must have been approximately a magnetic rhumb line, which would curve much more than a true rhumb line; that is, it would swing down into New Jersey much more than a true rhumb line would. And because there was local attraction at many points, the curve would be likely to have irregularities in it, notwithstanding the care that might be taken to eliminate all errors: for example, the irregularity between the 18th and 19th mile-stones. Up to the 18th, the distances of the stones from the straight line increase pretty regularly, by a little less than a hundred feet, whereas, the distance of the 19th mile-stone from the line exceeds that of the 18th by 469 feet.

"To ascertain how much the present 'Boundary' differs from a magnetic rhumb line on the supposition that the variation of the needle when the line was run was 2 deg. more at the east than at the west end, I have made several computations. The following are the results:

"The true course at the east end of *an arc of a great circle*

running from the terminal point on the Hudson river to the Tri-states rock on the Delaware is N. 53 deg., 43 min., 06 seconds W.

“The *true* course of a *true rhumb line* connecting the same points; that is a line cutting every astronomical meridian at the same angle is about N. 53 deg., 57 min., 11 seconds W.

“The *true* course of a *magnetic rhumb line*, that is a line cutting every magnetic meridian at the same angle, owing to the change of variation of the needle between the east and west ends, is about N. 59 deg., 50 min., 11 seconds W.

“The present *magnetic* bearing of this line, is about N. 51 deg. W.

“The middle *point* of a *true* rhumb line would be south of the middle point of an arc of a great circle by 1-3 seconds, or 133 feet.

“The middle point of a *magnetic* rhumb line would be south of the middle point of a true rhumb line by 16.6 seconds, or 1702 feet.

“The middle point of a *magnetic* rhumb line would be south of the middle point of the arc of a great circle by 17.9 seconds, or 1835 feet.

“By comparing this magnetic rhumb line with the present ‘Boundary,’ as represented on the map, it will be seen that with the exception of the part through the mountain region between the 16th and 29th mile-stones, the Boundary coincides tolerably well with a magnetic rhumb line. The conclusion therefore is, if there had been no local attraction in 1774, the Surveyors, Clinton and Dennis, instead of running a straight line would have run a magnetic rhumb line from the Hudson River to the Delaware. But because there was local attraction at different points, the line then run and marked has in it several irregularities; and this is probably the reason why the present crooked line forms the “Northern Boundary of New Jersey.”

“I append the following Notes in regard to the several monuments on the Boundary or Partition line:

“EASTERN TERMINUS.—The rock on the bank of the Hudson

which marks the eastern terminus of the Division line, is a block of trap from the Palisades at the foot of which it lies. It is an undressed but nearly rectangular mass; its lower face almost level and about six inches above extreme high water mark; and its eastern side facing the river. Its dimensions are nearly 7 feet 6 inches along the river, 3 feet 10 inches from front to rear, and 3 feet 2 inches high; and it weighs more than six tons. It is marked on its eastern face with a chisel-cut as follows: across the upper part LATITUDE 41 DEG. NORTH; a vertical line is cut down the face under this, and 2 feet from the north end, and the words NEW YORK on the north side of the line, and NEW JERSEY on its south side. It is S. 18 deg., 44 min. W. 313.21 feet from the U. S. Coast Survey Station DUER.

1st. *Mile Stone*.—Red Sandstone post, 32 inches high, 15 inches wide and 7 inches thick: (this is nearly the size of all of them): stands in woods on land of J. Moore: 60 feet south of straight line.

2nd. Red Sandstone: stands nearly plumb; in swamp in woods; 93 feet south of straight line.

3d. Red Sandstone; stands a little inclined but firm: in open field on land of J. Barton; offset from straight line 163 feet.

4th. Red Sandstone; stands firm though a little inclined: in open field on land of A. Blauvelt; offset 215 feet.

5th. Red Sandstone; leans a little, but firm; in woods of Hiram Slocum; offset 347 feet.

6th. Red Sandstone; a little inclined; in woods of Wm. Van Dyne; offset 373 feet.

7th. Red Sandstone; leans a little; in open field of J. Horn's; offset 453 feet.

8th. Red Sandstone; leans a little; in open field on land of A. Van Blareum; offset 519 feet.

9th. Red Sandstone; slightly inclined; in open field on D. Atkinson's land; offset 601 feet.

10th. Red Sandstone; on Jas. Ledwith's land in open field; 39 inches high, 12 inches wide, and 5 inches thick; it is lying down; offset 677 feet.

11th. Red Sandstone; 36 inches high, 13 inches wide and 6 inches thick; in grove of cedars on J. D. Buskirk's land; slightly inclined; 719 feet south of straight line.

12th. Red Sandstone; 33 inches high, 13 inches wide, and 5½ inches thick; inclines a little; in edge of woods on A. Litchult's land; offset 833 feet.

13th. Red Sandstone; 30 inches high, 14 inches wide, and 8 inches thick; slightly inclined; in open field on land of J. H. Fisher; offset 904 feet.

14th. Red Sandstone; 35 inches high, 13 inches wide, and 8 inches thick; upright; in woods on land of W. W. Way; offset 991 feet.

15th. Red Sandstone; lying a short distance from the station, by the side of a fence; in open field on land of Dr. Zabriskie; offset 1059 feet.

16th. Gneiss Rock; 24 inches high, 18 inches wide at bottom and 9 inches at top, and 4 inches thick, upright; in woods west of Suffern's station; offset 1181 feet.

17th. Red Sandstone; irregular; in woods on mountain west of Suffern's; offset 1269 feet.

18th. Red Sandstone; undressed; in clear, on land of J. L. Pearson; offset 1327 feet.

19th. Gneiss; 24 inches high; a little inclined; in woods on mountain west of Negro Pond; not dressed; offset 1796 feet.

20th. Gneiss; not dressed; in open field on line between J. H. Tidabock and G. Babcock; offset 2024 feet.

21st. Gneiss; not dressed; in woods on land owned by Cooper and Hewitt; offset 2149 feet.

22d. On hill east of Black Rock Hill; original stone could not be found; stone pointed out as the mile-stone had been recently put up; offset 1940 feet (?)

23d. Grey Gneiss Rock; in valley east of the Beech Mountain; edge of woods; near Mrs. Morris' house; offset 2263 feet.

24th. Grit Rock; in woods; offset 2372 feet.

25th. East of Greenwood Lake, in woods; was not found in 1874; offset 2394 feet. (?)

- 26th. Beneath surface of Greenwood Lake, near the west shore; offset 2415 feet. (?)
- 27th. Could not be found; somewhere on Rough mountain; offset 2120 feet. (?)
- 28th. Gritty Sandstone; in woods on Birds-eye Tract; offset 2180 feet.
- 29th. Greyish Grit Rock; in open field, on land of J. Hyatt; upright; offset 1811 feet.
- 30th. Could not be found.
- 31st. Had been removed; measured from a line tree.
- 32d. Red Sandstone; in open field, on land owned by G. Jeffers; upright and firm; offset 1073 feet.
- 33d. Red Sandstone; in open field, on land of J. L. B. Francisco; upright and firm; offset 818 feet.
- 34th. Gone; measured from a line tree; offset 700 feet. (?)
- 35th. Greyish Grit Rock; in open field, on land owned by Mr. Moorhouse; west edge of Pochuck valley; offset 651 feet.
- 36th. Could not be found; somewhere on Pochuck Mountain; measured from a line tree; offset 449 feet. (?)
- 37th. Greyish Grit Rock; in woods on William O. Roe's land; near swamp; piece broken off; offset 478 feet.
- 38th. Greyish Grit Rock; lying at side of fence, on State Line, in open field, easterly edge of Walkill valley; offset 345 feet. (?)
- 39th. Greyish Grit Rock; in stone fence; erect and firm; westerly edge of Walkill valley; offset 279 feet.
- 40th. Greyish Grit Rock; 42 inches high, 30 inches wide and 2 inches thick; in open field, on land owned by Peter Kimber; erect and firm; offset 254 feet.
- 41st. Rough Slate Rock; lying by the side of Mr. Everett's stone fence, a few yards from where it had stood; in open field near Unionville; offset 238 feet. (?)
- 42d. Undressed; leaning against fence on C. Goldsmith's land, in open field, 6 feet south of where it stood two years ago; offset 211 feet. (?)

43d. In swamp; could not be found; measured from "line tree;" offset 167 feet. (?)

44th. Slate; a little inclined; in open field, on land owned by M. D. Martin and I. Winters, (on line); offset 178 feet.

45th. Slate; in open field, on land owned by O. S. Carpenter; lying partly down; firm; offset 153 feet.

46th. Could not be found; on east edge of Blue mountain; measured from pile of stones said to be on "the line;" offset 123 feet. (?)

47th. Could not be found; on west edge of Blue mountain; measured from pile of stones; offset 15 feet. (?)

48th. Could not be found; measured from what is called the line; offset 1 foot. (?)

"WESTERN TERMINUS.—Tri-states-rock was marked by the United States Coast Survey, by drilling a deep hole in the rock at the marked point, and fastening therein a copper pipe filled with lead. It is on the extreme point, near the water.

"The *variation of the magnetic needle* was observed at several points, as follows:

Variation of the needle	at Palisades,	9 deg. 15 min. W.
"	" at Slootsburg,	7 deg. 42 min. W.
"	" on Rough Mountain,	6 deg. 2 min. W.
"	" in Valley between Rough Mountain and Warwick Mountain,	7 deg. 14 min. W.
"	" on Warwick Mountain,	3 deg. 12 min. ?
"	" near the 29th mile-stone,	5 deg. 9 min. ?
"	" at Liberty Corner,	6 deg. 45 min. W.
"	" at Unionville,	6 deg. 3 min. W.
"	" at Tri-States-Rock,	7 deg. 1 min. W.

"The results of these observations are probably not strictly accurate, owing to local attraction. The 5th and 6th in particular, are quite doubtful. If time had permitted, the observations would have been extended to many other places on the line.

"The United States Coast Survey, in June, 1873, found the variation at Carpenter's Point to be 7 deg. 5 min. W.

" I am sorry that, on account of our limited means, we were not able to spend quite as much time as we would like to have done. The greater part of our time was spent in running the straight line. Every care was taken to do this with accuracy. The offsets we could not measure, in the time we had, with quite so much care. They are approximately correct. There are no monuments or marks at the ends of them on the straight line. To set monuments here it would not be necessary to measure the offsets. A better and more accurate way would be to sight from station to station on the straight line, and set the monuments in the line of sight, regardless of their distances from the present boundary.

" Respectfully,

" EDWARD A. BOWSER."

The records cited show that the partition line between the two States, as marked in 1774, was traced with the compass; that it was run from both ends; and that on account of local attraction some parts of the line were traced by *staking*. The work of this summer, as exhibited on the maps herewith presented, shows that the monuments as they now stand, are not in a straight, but in a crooked line, in which every mile-stone is *south* of the straight line. There is no doubt the line was crooked when it was run through in 1774, for a long line upon a single course, traced with the surveyor's compass, would necessarily be crooked. In navigation, where the compass is constantly moving with the vessel, and is kept steadily on any oblique course, the track of the vessel is in a curve, which is called a *rhumb line* or *loxodromic curve*. This is produced by the needle making the same angle with all the meridians it crosses, while the meridians are not parallel to each other, but all converging toward the poles of the earth. In using the compass on land, on long lines, the instrument is set up on the proper bearing of the line, and a mark is fixed as far ahead as clearness of vision or other causes will permit; and the instrument is carried forward to the mark and set up with the same bearing as before, and another mark made

as far ahead as possible, and so on through the whole distance to be run. In this way, the lines from one station to another are straight lines, but making with each other small angles, corresponding to the convergency of the meridians of the stations. In proportion as the number of stations is increased, and the distance between them diminished, so the curvature of this line is increased. It cannot be otherwise than that a long line, on any oblique bearing, run in this way, will be crooked more or less, according to the number of parts in which it has been run ; and it cannot be accurately retraced unless the several stations occupied at the first running are known and used again.

The difference in the variation of the needle at the two ends of a long line, as in the present case, where the difference is 2 deg., and the line $48\frac{1}{2}$ miles long, must also interfere greatly with running a straight line with the compass, as there would necessarily be at least 2 deg. difference in the direction of the line run, if the magnetic bearing was continued the same throughout. The difficulty of the case is still greater, from the variation being irregular—greatest at the east end, less at the west, and least at some intermediate point. See tabular statement of Prof. Bowser.

Local attraction is very common and strong, particularly so in the iron-ore district, traversed by the middle parts of this line ; and from the appearance of the line as the monuments stand, it would seem as if this cause must have interfered to increase the inaccuracy of the work. With all these agencies to affect their work, it will be understood that the surveyors could not, with the instruments then used, trace a long straight line accurately between two given points.

CONCLUSION.

In reviewing this survey and considering its results, the following point stand out clearly as worthy of further attention :

1. The terminal monuments of the line, which are now plainly marked, should be permanently secured and legally protected.

The western terminus, called Tri-states-rock, is on the property of the Laural Grove Cemetery. The eastern terminus, a heavy block of stone, known as the State-line rock, is on private property; a railroad has been graded along the river shore, just east of it, and in the changes continually occurring, the spot occupied by this old land-mark may be needed by its owner for some other use.

2, The partition line, as indicated by the monuments, is not a straight line. Of the 48 mile-stones which originally marked the line, one-third are now gone, and some of the others are exposed in open fields, where they are in danger of being broken down. In cases where these monuments are gone, they cannot, with certainty, be replaced. Some joint action should be had with the State of New York, by which the line could be straightened, and made to accord with its original definitions and descriptions; and when authoritatively defined and retraced, it should be marked by permanent monuments, owned and controlled by the States interested, or by the General Government.

GEORGE H. COOK,

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