GEOLOGICAL SURVEY OF NEW JERSEY.

FINAL REPORT

OF THE

STATE GEOLOGIST.

VOL. I.

TOPOGRAPHY.

MAGNETISM.

CLIMATE.

TRENTON, N. J.:
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1888.

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GEO. H. COOK,

State Geologist.

* Died October 20th, 1888. † Died February 28th, 1888.

NEW BRUNSWICK, N. J., October 10th, 1888.

To His Excellency Robert S. Green, 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 the first volume of my final report as State Geologist. It contains an account of the Geodesy, Topography, Magnetism and Climate of the State of New Jersey.

With high respect,

Your obedient servant,

GEO. H. COOK,
State Geologist.

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INTRODUCTION.

This is the first volume of the final report upon the Geological Survey of New Jersey. The Survey was authorized by the act of the Legislature passed March 30th, 1864, entitled "An act to complete* the Geological Survey of the State."† Under this act and its

* Prof. Henry D. Rogers made a Geological Survey of New Jersey in 1836-40, and published his first report in the former year, and his final report in the latter year. Dr. William Kitchell began a Geological Survey of the State in 1854, which was continued through 1855 and 1856, and reports of its progress were published for each of those years, but the work was suspended at the end of that period.

† "AN ACT to complete the geological survey of the state."

"WHEREAS, The senate and general assembly of the state, by an act passed March second, eighteen hundred and fifty-four, authorized a geological survey of the state to be made, which survey was subsequently suspended by the state; *and whereas*, the state agricultural society, under the authority granted to it by the act of February twenty-fifth, eighteen hundred and sixty-three, has shown a laudable zeal in continuing the said survey; *and whereas*, it appears by the report of Robert C. Bacot and Jacob Herbert (committee of the legislature), made March eleventh, eighteen hundred and fifty-seven, that of the former appropriations made by the state there was, at that date, an unexpended balance amounting to eight thousand and ninety-seven dollars and thirty-one cents, which balance still remains to the credit of that account; *and whereas*, it is the duty of the state to develop and render available to the fullest extent the facts relative to its great natural resources, as also of its agricultural, mining, mechanical and other industrial interests; therefore,

"1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That the duty of completing the said survey be and is hereby resumed by the state, said survey to be completed within a period not to exceed four years, and at an expense not to exceed the sum of twenty thousand dollars, aside from the cost of publication, and all laws conferring on the state agricultural society authority to continue the survey, or transferring to it the state property used by the survey, be and the same are hereby repealed.

"2. *And be it enacted*, That the sum of twenty thousand dollars, of which the unexpended balance of former appropriations shall be part, be and is hereby appropriated to carry out the provisions of this act.

"3. *And be it enacted*, That the appointment of George H. Cook, by the state agricultural society, is approved of, and that the said George H. Cook is hereby appointed

several supplements, the Survey has been continued to the present time. A general report on the "Geology of New Jersey" was published in 1868, in an 8vo. of xxiv. and 900 pages, with portfolio of 8 maps. Yearly reports of its progress have been made to the Governor, and have been printed in liberal editions by the Legislature, and have been widely distributed among our citizens. The annual reports have been somewhat miscellaneous in the subjects discussed, being directed in some measure by the wants of the people for their industrial and economic interests. The various branches of the Survey have, however, been kept advancing, and now that the Geodetic and Topographic Surveys of the State are completed, the final report of the Geography of New Jersey is presented in this volume.

At the beginning of the Survey no such work as is here given entered into our plans. But as the successive reports appeared, and as the attempts at descriptive geology were made, it became apparent that for the study and preparation of useful geological reports it was necessary to have accurate maps—maps which would show the location of all the important geographical points, and also the outlines

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state geologist, with authority to receive from the state agricultural society the state property used by the survey, and employ, control and use the same; to employ such assistant or assistants as shall seem to him necessary for the proper prosecution of the survey; and it shall be lawful for the said George H. Cook and the person or persons employed by him, to enter, without molestation, upon any lands in this state which he or they may deem necessary to further the object of the said survey; and it shall be the duty of the state geologist, on or before the first day of January of each year, to furnish to the president of a board of managers (hereinafter to be created) a detailed statement of his expenditures, with the vouchers therefor, and also a report of his operations for the preceding year.

"4. *And be it enacted*, That to promote the objects which this act has in view, there shall be a board of managers of the same, to consist of eleven members, one of whom shall be the governor of the state, who also shall be president of the board, and two members from each of the five congressional districts of the state; and the state geologist shall make his annual report to the president, who shall appoint from the members of the board a committee to examine the annual accounts of expenditure, and the president shall submit the same and all matters pertaining to the survey at the first following session of the legislature; and it shall be lawful for the president and board of managers, or a majority of them, to make yearly agreements with the state geologist as to his own and the salaries of his assistant or assistants, but such temporary assistance as may be needed, the purchase of the necessary implements and materials, the means necessary for transportation and all other incidental expenses shall be under the control of the state geologist; and it shall be the duty of the members of the board, in addition to those already specified, to furnish from time to time to the state geologist, any and all information which will contribute to the more full

and elevations of the hills and valleys, and their heights above the sea level. There were no such maps of New Jersey in existence, nor, indeed, of any others of the United States. In the first attempts to prepare such it was considered doubtful whether the expense could properly be incurred, but when they were issued the approval they met, both from the people and the Legislature, gave assurance that they supplied a felt want. Since that time the various surveys and explorations needed for the maps have been carried forward with all the accuracy that was deemed necessary for the end in view, and some of those first made have been revised and brought up to the present time.

Several circumstances have favored the prosecution of the Survey and have served to render its expenses less burdensome. The United States Coast and Geodetic Survey, which is carried on at the expense of the general government, has authority to assist States which are conducting Geological or Topographical Surveys, by furnishing them with the exact latitude and longitude of numerous points within the State, and in that way providing for the proper location upon the

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and complete development of the facts relating to the agricultural, mining, mechanical and other industrial interests of the state.

"5. *And be it enacted*, That the governor of the state is hereby authorized, by his draft in favor of the state geologist, to draw on the treasurer of the state for such sum or sums of money as may be called for by the state geologist; *provided*, the several sums so called for shall not in any one year exceed the one-fourth part of the appropriation made in section two of this act, to wit, twenty thousand dollars.

"6. *And be it enacted*, That it shall be lawful for the state geologist to take from the first yearly installment a sum not to exceed five hundred dollars, to reimburse himself for the expenses incurred in prosecuting the survey the past year.

"7. *And be it enacted*, That the board created by this act shall be a committee of publication, with authority to print and publish the annual and final reports of the state geologist, and also to direct the distribution of suites of the geological, mineralogical and other specimens collected in the survey, to such literary, scientific and other institutions as will best conduce to the interests of the citizens of the state.

"8. *And be it enacted*, That the following-named persons are hereby appointed and shall constitute the board of managers of the geological survey of the state, viz.: president, Joel Parker; managers, David Potter, of Cumberland; Andrew K. Hay, of Camden, in the first district; William Parry, of Burlington; John A. Roebling, of Mercer, in the second district; Isaac R. Cornell, of Somerset; Henry Aitkin, of Union, in the third district; Abraham S. Hewitt, of Passaic; Andrew B. Cobb, of Morris, in the fourth district; William M. Force, of Essex; J. R. Wortendyke, of Hudson, in the fifth district; and power is hereby given to the said board, or a majority of them, to fill any vacancies which may occur.

"9. *And be it enacted*, That this shall take effect immediately.

"Approved March 30, 1864."

map of all minor and more detailed surveys. This work has been continued from year to year till the whole State is covered with their net-work of triangles, in which the geographical position of each angle has been computed with so much care that there cannot be an error in their locations of more than a few inches. This work, so essential to the accurate drawing of reliable maps, has been done without expense to the State.

When the Topographic Survey was about half done at the expense of the State, the further expense of completing the work was assumed by the United States Geological Survey. This arrangement greatly relieved the funds of the Survey, and facilitated the early completion of the topographic work. This joining of the two Surveys was profitable for the United States, in that it furnished the materials for a complete map of the State, at half its cost, and to the State it became a relief to its finances. The work was done under the direction of the State Geologist, and the methods which were adopted at first were continued throughout, and the assistants who were engaged in the work for the State continued on in the service of the United States until the whole was done; and at the end, both Surveys were supplied with copies of all the field-notes taken, and all the maps drawn.

A further advantage has come to the Survey from the long-continued tidal observations made at Sandy Hook by the United States Coast and Geodetic Survey. These observations gave the mean level of the Atlantic ocean, and furnished a datum plane of reference to which all the elevations could be referred, and which are so referred to on all the maps.

The Survey, in its progress, has received the hearty support of the successive Governors of the State who have held office since 1864, viz., Governors Parker, Ward, Randolph, Parker, Bedle, McClellan, Ludlow, Abbett and Green.

The Board of Managers of the Survey have given to it their strong support and their active interest in all its affairs.

GOVERNORS OF THE STATE OF NEW JERSEY AND EX-OFFICIO PRESIDENTS OF THE BOARD OF MANAGERS SINCE THE PASSAGE OF "AN ACT TO COMPLETE THE GEOLOGICAL SURVEY OF THE STATE."

JOEL PARKER	1864 to 1866.
MARCUS L. WARD	1866 to 1869.
THEODORE F. RANDOLPH	1869 to 1872.
JOEL PARKER	1872 to 1875.
JOSEPH D. BEDLE	1875 to 1878.
GEORGE B. McCLELLAN	1878 to 1881.

GEORGE C. LUDLOW	1881 to 1884.
LEON ABBETT.	1884 to 1887.
ROBERT S. GREEN	1887 to 18—.

Original List of Members of the Board of Managers.

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Gen. DAVID POTTER. — Hon. ANDREW K. HAY.

II. CONGRESSIONAL DISTRICT.

WILLIAM PARRY. — JOHN A. ROEBLING.

III. CONGRESSIONAL DISTRICT.

ISAAC R. CORNELL. — HENRY AITKIN.

IV. CONGRESSIONAL DISTRICT.

Hon. ANDREW B. COBB. — Hon. ABRAM S. HEWITT.

V. CONGRESSIONAL DISTRICT.

WILLIAM M. FORCE. — J. R. WORTENDYKE.

*Full List of Members of the Board of Managers.**

I. CONGRESSIONAL DISTRICT.

Gen. DAVID POTTER, Bridgeton	1864.	Deceased, 1865.
Hon. ANDREW K. HAY, Winslow	1864.	Deceased, 1881.
Hon. ROBERT MATLACK, Woodbury	1865.	Deceased, 1867.
CHARLES E. ELMER, Bridgeton	1867.	
Hon. CLEMENT H. SINNICKSON, Salem	1881.	

II. CONGRESSIONAL DISTRICT.

Hon. WILLIAM PARRY, Cinnaminson	1864.	Deceased, 1888.
JOHN A. ROEBLING, Esq., Trenton	1864.	Deceased, 1869.
Hon. H. S. LITTLE, Trenton	1869.	

III. CONGRESSIONAL DISTRICT.

ISAAC R. CORNELL, Esq., Weston	1864.	Resigned, 1866.
HENRY AITKIN, Esq., Elizabeth	1864.	
SELDEN T. SCRANTON, Esq., Oxford	1866.	1875.
Dr. JOHN VOUGHT, Freehold	1875.	Deceased, 1882.
Hon. WM. H. HENDRICKSON, Middletown	1882.	

IV. CONGRESSIONAL DISTRICT.

Hon. ANDREW B. COBB	1864.	Deceased, 1872.
Hon. ABRAM S. HEWITT, Ringwood	1864.	Resigned, 1874.
Hon. AUGUSTUS W. CUTLER, Morristown	1872.	1875.

* In 1875, the number of Congressional Districts in the State was changed from five to seven, making necessary the appointment of four new members to the Board, and some changes in the distribution of the members.

Col. Benj. Aycrigg, Passaic	1874.	1875.
Hon. Thomas Lawrence, Hamburg	1875.	
Selden T. Scranton, Esq., Oxford.	1875.	

V. CONGRESSIONAL DISTRICT.

William M. Force, Esq., Newark	1864.	1875.
J. R. Wortendyke, Esq., Jersey City	1864.	Deceased, 1869.
Hon. Joseph P. Bradley	1869.	Resigned, 1870.
Thomas T. Kinney, Esq., Newark	1870.	1875.
Hon. Augustus W. Cutler, Morristown	1875.	
Col. Benj. Aycrigg, Passaic	1875.	Resigned, 1885.
George Richards, Esq., Dover	1885.	

VI. CONGRESSIONAL DISTRICT.

William M. Force, Esq., Newark	1875.
Thomas T. Kinney, Esq., Newark	1875.

VII. CONGRESSIONAL DISTRICT.

Benj. G. Clark, Esq	1875.	1885.
Wm. W. Shippen, Esq	1875.	Deceased, 1885.
Lebbeus B. Ward, C.E., Jersey City	1885.	
Rev. Samuel B. Dod, Hoboken	1885.	

The legislation needed for the establishment and continuance of the Survey has been promptly given, and to the full extent that has been asked, and with practically unanimous votes.

With all these circumstances in its favor, the work has been comparatively easy and pleasant.

Of those who have taken part in carrying out the details of this Survey, it is proper to make honorable mention.

Prof. John C. Smock, Assistant Geologist, in the Survey from its beginning in 1864 to 1885, and who, from the first, urged the importance of an accurate and detailed topographic map of the State as necessary, before any detailed geological description could be written.

Prof. Edward A. Bowser, who, in the service of the United States Coast and Geodetic Survey, has been occupied every year since 1874 in fixing with care and accuracy the geographic points which form the basis of all our maps.

Jas. K. Barton, who began the first of these Surveys, in making the map covering the Raritan clay beds, in 1877.

Geo. W. Howell, who made the levels and sketched the contour-lines for the map of Northern New Jersey, in 1877 and 1878.

C. C. Vermeule, who has conducted all the Topographic Surveys from 1879 to the present time, and who has prepared most of this report.

Irving S. Upson, who has attended to the clerical duties of the Survey from 1881 to the close of the work.

There have been employed, as assistants in the topographic field and office work, the following-named persons:

WM. F. GREGORY	Surveying, 1876.
WM. E. KING	Leveling, 1876.
PETER D. STAATS	Odometer Surveying, 1881.
	Surveying and Leveling, 1882–84.
	Topography, 1884–87.
JOHN T. MARSHALL	Leveling and Topography, 1881.
FREDERICK W. BENNETT	Leveling and Topography, 1881–86.
	Topography and Magnetic Observations, 1887.
PHILIP H. BEVIER	Leveling and Topography, 1881–83, '85.
	Running Primary Levels, 1885–86.
	Setting Bench-Marks, 1886.
	Topography and Triangulation, 1887.
SOLOMON LE FEVRE	Leveling and Topography, 1881–82.
N. D. VAN SYCKEL	Rodman, 1881.
CYRUS W. F. SPROUL	Leveling and Topography, 1881, '83, '84, '86.
	Draughting, 1885, '87.
WM. MCKELVEY	Rodman, 1881.
NATH. B. K. HOFFMAN	Surveying, 1882, '86–87.
	Odometer Recorder, 1886.
GEORGE W. BLAKELEY	Rodman, 1882.
H. R. WORRALL	Rodman, 1882.
FRANK VAN BRAKLE	Rodman, 1882–84.
	Draughting, Miscellaneous Office Work, 1884, '87.
WM. L. HAYNES	Rodman, 1882–83.
PHILIP LINDSLEY	Draughting, 1882.
——— DE MOTT	Rodman, 1882.
GEO. HILL	Leveling, Topography and Mapping, 1883–85.
JOHN G. TAIT	Rodman, 1883.
	Field Aid, 1885.
	Office Work, 1886.
CHARLES DESHLER	Rodman, 1883.
ARTHUR C. PAYNE	Rodman, 1883.
	Surveying Roads, 1884.
WM. F. MARVIN	Rodman, 1883–85.
	Draughting, 1884–85.
	Surveying Roads, 1885–86.
GEO. E. JENKINS	Mapping and Office Duties, 1885.
JOHN E. HILL	Surveying Roads, 1884.
	Mapping and Triangulation, 1885–86.
LOUIS F. RUF	Surveying Roads, 1884.

George G. Earl	Rodman Topography, 1884, '85.
Wm. H. Luster, Jr.............	Rodman and Draughtsman, 1884.
	Surveying Roads, 1885.
	Leveling and Sketching Topography, 1885-87.
Asher Atkinson	Rodman and Draughtsman, 1884.
	Odometer Recorder and Surveying Roads, 1885.
	Topography and Magnetic Observations, 1886-87.
Joseph B. Reynolds	Rodman and Draughtsman, 1884.
	Field Aid, 1885-87.
Geo. D. Smith..................	Rodman, 1884.
David L. Bruce	Rodman, 1884.
Jackson Jaques	Rodman, 1884.
Clarence M. Du Bois.	Rodman, 1884.
	Field Aid, 1886-87.
Wm. H. Barnes..................	Mapping and Office Duties, 1885.
Leaming M. Rice, Jr............	Field Aid, 1885-87.
Harry S. Sproul................	Field Aid, 1885 86.
Harry J. Sherman...............	Field Aid, 1885.
Thos. T. Watson................	Field Aid, 1885.
Prof. A. A. Titsworth..........	Triangulation of Southern New Jersey, 1886.
H. M. Veghte...................	Field Aid, 1886.
C. B. Marshall.................	Field Aid, 1886.
H. L. Lehr.....................	Field Aid, 1886.
H. A. Irick....................	Field Aid, 1886.
Wm. C. Ogden	Field Aid, 1887.
Harry J. March.................	Field Aid, 1887.
I. L. Winckler.................	Field Aid, 1887.

The topographic and magnetic descriptions of the report have all been written by Mr. Vermeule, and constitute a fitting conclusion of the work which he has done so faithfully and well.

The meteorology of the State here given has been prepared by Prof. Smock, who was so long connected with the Geological Survey. He has given attention to the subject for many years, and here sums up the result of his studies. For the records of 1887 and 1888 and their combination with those of an earlier date, he has had the assistance of Sergeant E. W. McGann, of the United States Signal Service and the New Jersey State Weather Service.

It is only just to add that for the beautiful and accurately-executed maps of the Survey we are indebted to the taste and skill of Messrs. Julius Bien & Co., lithographers and cartographers, of New York city. It is to them that we owe the ability to bring out a series of maps such as no others of the United States have secured, and which stand as a monument to the enterprise and public spirit of New Jersey.

But in undertaking to mention those who have taken an active part

in this public work, it is not easy to stop. Assistance in securing and preparing the materials for the report has been cheerfully and liberally rendered by all who have been asked, and the list must be closed with this general and public acknowledgment. The following is a list of the titles of the sheets, with their numbers:

No. 0. New Jersey State Map. Scale, 5 miles to an inch. Geographic.

No. 1. Kittatinny Valley and Mountain, from Hope to the State line.

No. 2. Southwestern Highlands, with the southwest part of Kittatinny valley.

No. 3. Central Highlands, including all of Morris county west of Boonton, and Sussex south and east of Newton.

No. 4. Northeastern Highlands, including the country lying between Deckertown, Dover, Paterson and Suffern.

No. 5. Vicinity of Flemington, from Somerville and Princeton, westward to the Delaware.

No. 6. The Valley of the Passaic, with the country eastward to Newark and southward to the Raritan river.

No. 7. The Counties of Bergen, Hudson and Essex, with parts of Passaic and Union.

No. 8. Vicinity of Trenton, from New Brunswick to Bordentown.

No. 9. Monmouth Shore, with the interior from Metuchen to Lakewood.

No. 10. Vicinity of Salem, from Swedesboro and Bridgeton, westward to the Delaware.

No. 11. Vicinity of Camden, to Burlington, Winslow, Elmer and Swedesboro.

No. 12. Vicinity of Mount Holly, from Bordentown southward to Winslow and Woodmansie.

No. 13. Vicinity of Barnegat Bay, with the greater part of Ocean county.

No. 14. Vicinity of Bridgeton, from Alloway, Elmer and Newfield, southward to the Delaware bay shore.

No. 15. Southern Interior, from Millville to Atco and Egg Harbor City.

No. 16. Egg Harbor and Vicinity, including the Atlantic shore from Barnegat to Great Egg Harbor.

No. 17. Peninsula of Cape May, with the country westward to Maurice river.

New Jersey Relief Map. Scale, 5 miles to the inch. Hypsometric.

THE GEODETIC SURVEY OF NEW JERSEY.

BY PROF. EDWARD A. BOWSER, LL.D., ASSISTANT IN THE UNITED STATES COAST AND GEODETIC SURVEY.

The Geodetic Survey of the State was made in order to fix accurately the latitudes and longitudes of points in the various parts of the State. They were necessary for furnishing correctly-located points about which the Topographical Surveys could be arranged and located. This work was done under the direction of the United States Coast and Geodetic Survey, and by its officers, and at its expense. Being for the special use of New Jersey, it was, however, always directed so as to meet the needs of its Topographical Survey.

RECONNOISSANCE.

This Survey was begun in June, 1875. The primary stations, Mount Rose, in New Jersey, and Newtown, in Pennsylvania, accurately-known stations of the United States Coast and Geodetic Survey, were chosen for the starting points. Several months were passed in making a reconnoissance for stations suitable for this Survey. In the following summer this reconnoissance was improved by slightly altering the position of some of the stations and selecting new ones. By continuing the reconnoissance from season to season, it was made, finally, to include the northern part of New Jersey, from the Coast Survey primary triangulation, at Mount Rose and Newtown, northward to the northern boundary of the State, the stations being from 10 to 30 miles apart.

In the latter part of 1875, I obtained the services of Mr. A. A. Titsworth, a graduate of Rutgers Scientific School, of the Class of 1877, and now Professor of Graphics and Mathematics in Rutgers College. Prof. Titsworth has been with me from that date to the present, excepting the two years, 1885 and 1886, when I was assisted by Mr. John E. Hill, a graduate of the same institution, of the Class of 1884.

The labor involved in making a reconnoissance over a thickly-wooded country, containing no prominent elevations, is very considerable. The uniformity in height of the hills and ridges, their sameness in contour, and the consequent difficulty of identification, added to the dense undergrowth through which lines of sight must be cut, greatly increase the hardships of the work. An essential point in reconnoissance is to determine, beyond the possibility of doubt, the intervisibility of every primary line essential to the scheme. In the case of lines 20 or 30 miles long, and in hazy weather, this is often very difficult. The greatest care has to be taken to obtain only "well-conditioned" triangles. In the older works on Geodesy, 30° is prescribed as the smallest admissible angle in a primary chain of triangles, but in the case of triangles forming parts of quadrilaterals, the above rule need not be rigidly adhered to.

TRIANGULATION.

Early in August, 1876, scaffolds and tripods were erected at Mount Rose and Goat Hill, each 40 feet high, to support the theodolite and observer, and in order to see over the intervening ridges without laborious and expensive cutting through the timber. The signals observed on were poles, either black or white, or with alternate bands of each, depending upon the background, or upon the atmospheric difficulties. In the case of long lines, or those rendered difficult by haze or smoke, the heliotrope was used. When the scaffolds and signals were built, Goat Hill and Newtown were occupied, and all the angles at these stations were measured in the course of the season. The instrument used was a 14-inch repeating theodolite with a large telescope. In measuring the primary angles, each one was determined by not less than 6 sets of measurements, each set consisting of 6 repetitions in the direct and 6 in the reversed position of the telescope, thus making 72 measurements in all. In the triangles belonging to the tertiary series, such as those for determining the position of church-steeples, chimneys and other auxiliary points, to facilitate the topographical work, 2 sets of measurements were taken, each of 3 repetitions in the direct and 3 in the reversed position, making 12 measurements. All these observations had to be taken only under the most favorable conditions, when the air was clear and steady. The probable error of an angle in the primary triangulation was in no case allowed to exceed $0''.3$. To attain this degree of accuracy,

days were frequently spent without a single satisfactory observation, and sometimes whole weeks. Patient waiting, so as to observe under no doubtful conditions of the atmosphere, however annoying, or whatever hardship it may entail, is better than to allow any doubt to cloud the results.

In the following seasons of 1877, 1878, 1879, 1880, 1881, 1882 and 1883, the stations Mount Rose, Pickles, Mount Horeb, Mount Olive, Haycock, Montana, Culver's Gap, High Point, Hamburgh, Bear-Fort, Bald Hill, High Mount and High Torne, were occupied, and all the angles measured, primary and tertiary.

In the season of 1883 the Survey was begun in the southern part of the State. Nine stations were selected, starting with the line Mount Holly, Apple-pie Hill, and extending southward. As the country is flat and thickly covered with tall timber, high scaffolds had to be built at nearly all the stations, from which to observe. In the seasons of 1884, 1885, 1886 and 1887, the stations Mount Holly, Apple-pie Hill, Berlin, Martha, Blangie, Hammonton, Richland and Newfield, were occupied, and all the angles measured, besides a great many observations for determining the positions of tertiary points.

OFFICE WORK.

At the close of each summer, the computations were made of the field-work of that season. These computations were carried on with all the refinement that the present condition of the science of Geodesy will permit. The observed angles were adjusted by the "Method of Least Squares;" the spherical excess was computed, and the difference between this and the observed excess was divided among the angles proportionally; then the triangle sides, and the geodetic latitudes, longitudes and azimuths, were computed of all the lines and stations in the chain of triangles. These computations, with a sketch showing the progress of the Survey, and a report of the season's work, and the records, were sent to the Superintendent of the United States Coast Survey, at Washington.

Primary geodetic work is executed with the greatest possible accuracy. Primary triangulation over any extended area must be so laid out and conducted that its results shall approach as near to absolute precision as the present condition of scientific research, theoretical, instrumental and practical, will permit. No refinement in observation or reduction must be omitted which it is possible to supply. The

uncertainty in the resulting linear measures of primary geodetic work "may be less than about $\frac{1}{1000000}$ of the length, and is rarely as great as $\frac{1}{60000}$ (which represents an error of about one inch to the mile). To reach a higher standard of excellence, as, for instance, $\frac{1}{2000000}$, or even a smaller fraction, requires the application of the most refined means at our disposal." In the Survey of Northern New Jersey, in closing the hexagon at Montana, with Pickles for center, the following four equations had to be satisfied: First, the *length* of the connecting side, Pickles-Montana, must come out the same, when arrived at by computation in either of the triangles, Pickles, Montana, Mount Olive, or Pickles, Montana, Haycock. Second, the resulting *azimuths* of this line must be the same. Third and fourth, the *latitude* and *longitude*, respectively, of Montana, must show no discrepancy. As the computation of these two triangles was nearing completion, considerable anxiety was felt as to how the work was coming out. The hexagon closed as follows: The azimuths of the connecting side, Pickles-Montana, as arrived at from opposite directions, agreed within 1″. The lengths of this line agreed within $\frac{1}{10}$ of a metre (or about $\frac{1}{4}$ of an inch to the mile). The latitude of Montana agreed within 0″.006. The longitude agreed within 0″.001.

MONUMENTS.

With a few exceptions, each primary station is marked with a granite post, 4 feet long, dressed 6 inches square at one end, and for a length of 6 inches, with the letters "U. S." cut in each of the four faces, and a triangle on the top. This post is set in hydraulic cement, to within 6 inches of the top. In the case of a few stations selected on the solid rock, the mark is a copper bolt, driven into a hole which is drilled into the rock.

The tertiary points are not generally well marked. Each of them should have a durable stone post for the security and identification of the station. I have several times suggested that an appropriation be made for marking them, but no provision has yet been made for this purpose. It is of the highest importance that each triangulation point, whether primary or tertiary, shall be so marked, and the record of the marking made so clear and definite that the exact position can be found at any future time.

E. A. BOWSER.

LIST OF GEOGRAPHICAL POSITIONS.

The following table has been prepared from published reports of the United States Coast and Geodetic Survey, from manuscript furnished by that organization, and from work done by Acting Assistant Prof. E. A. Bowser, for that survey, since 1875.

The primary stations are printed in small capitals in the table. Most of the stations can be found on the two State maps which accompany this report. So far as it can be done without interfering with other details, the points are shown on the sheets of the Topographical Atlas, and parties wishing to find them should consult these maps first.

Many of the points are prominent spires, chimneys or other structures which may be readily found by any one; many others are marked by conspicuous stone monuments; some only by buried marks; while still others were never permanently marked, being only intended for immediate use by topographical parties. Many of the older points have not been found during the prosecution of the Topographical Survey; these are followed by an interrogation point (?). Some of these were located near enough for topographical purposes by witness-marks, etc., without the actual station-mark being recovered, while others were utilized through the medium of United States Coast and Geodetic Survey plane-table sheets. As a rule, the stations will be found upon the highest or most commanding ground in the vicinity.

The name by which the station is known to the Survey is first given; this is followed by a short description as full as space permits; and, as the description will often be unintelligible without, it is followed by the date of selecting or determining the point. When this is not exactly known, the date of the report in which it first appeared is given; thus (a. 1851) signifies that the point antedates 1851, etc. Those determined since 1875, by Prof. Bowser, are indicated by (B.)

The stations are arranged by counties geographically. Under each county the older points, computed on the Bessel spheroid, are given first. Following these, under the heading *Clarke's Spheroid*, are the later points computed from the latest and best data as to shape and size of the earth, and with corrected telegraphic longitudes. Many of the stations in the first list are repeated in the second. At the head of the second list under each county, in the columns of seconds, are given the average differences of latitude and longitude between the two lists. Any one desiring the latest and most accurate locations, correct to one-tenth of a second, should add these quantities to the

figures in the list preceding. This should always be done when the stations are to be used for constructing maps.

Following this table is a supplementary table of latitudes and longitudes determined by the Topographical Survey, which will be found to include many prominent spires and buildings not given in the first.

The total number of points utilized in making the Topographical Survey of the State is 457. Excluding the close tertiary triangulation along the Hudson and Delaware rivers and the sea-coast, they average one to each 25 square miles. In one or two cases where unusually large intervals occur between stations, the topography has been laid down by means of transit traverses.

Table of Geographical Positions.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
ATLANTIC COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Leed's Point. ½ mile S. of hotel (?) (a. 1851)	39	28	58.63	74	25	39.63
Little Egg Harbor Light. (a. 1851)	39	30	18.41	74	16	48.02
Brigantine Beach (?) (a. 1851)	39	25	48.98	74	19	37.01
Absecom. On point, 1 mile S. E. of Absecon village (?) (a. 1851)	39	25	08.55	74	29	06.57
Peter's Beach. 1 mile N. E. of Absecon Inlet (?) (a. 1851)	39	23	16.50	74	24	01.60
Risley's Landing. On Lake's Bay (?) (a. 1851)	39	22	48.75	74	31	11.49
Dry Inlet (?) (a. 1851)	39	20	31.28	74	27	57.42
Leedsville. Near edge of upland, E. of Linwood. (a. 1851)	39	20	52.82	74	33	19.98
New Inlet (?) (a. 1851)	39	19	08.49	74	30	30.65
Somers' Point (?) (a. 1851)	39	18	38.78	74	35	02.95
Clarke's Spheroid. Difference.			*+03.7*			*+20.3*
Oyster Creek (?) (1867)	39	30	27.04	74	24	35.04
Leed's Point (?) (1867). (See above)	39	29	02.37	74	26	00.00
Absecom (?). (See above.) (1867)	39	25	12.43	74	29	27.03
Ryon (?) (1867)	39	22	45.09	74	31	33.70
Absecom. Light-house. (1867)	39	21	58.74	74	24	52.27
Leedsville (?) (1867)	39	20	55.88	74	33	39.42
Grove (?) (1867)	39	20	03.74	74	30	17.18
Linwood (?) (1867)	39	20	54.06	74	33	38.76
Fish (?) (1867)	39	18	39.50	74	32	34.26
Somers' Point (?) (1841)	39	18	41.90	74	35	22.46
Somers (2) (?) (1867)	39	18	42.68	74	35	23.39
River. (1883)	39	18	23.07	74	37	12.11
Ocean. (1883)	39	17	18.69	74	34	13.14
New Inlet (?)	39	19	11.58	74	30	50.17
HAMMONTON. Stone monument, on hill S. side of C. & A. R. R., 1¼ miles N. W. of village	39	38	48.05	74	49	19.29

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
ATLANTIC COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
BLANGIE. Stone monument on summit, 2¾ miles N. E. of May's Landing.	39	28	44.36	74	41	16.71
Richland	39	29	18.96	74	51	12.59
Elwood	39	34	40.33	74	42	55.55
New Germany	39	36	26.48	74	50	49.07
Weymouth	39	31	02.18	74	46	48.46
Doughty's Tavern	39	26	53.96	74	51	46.69
BERGEN COUNTY.						
Cherry Hill. N. of Highland, on hill (?)	40	54	43.31	73	57	52.37
Banta. Summit of Hackensack and Tea Neck road (?)	40	53	09.94	74	00	39.66
Terhune. Hill W. of Corona (?)	40	51	38.11	74	04	36.76
Bury. Hill N. of Carlstadt	40	50	26.17	74	05	02.57
Vreeland. At Ridgefield cross-roads (?)	40	49	58.12	74	00	19.67
Kingsland. On ridge, ½ mile S. of village (?)	40	47	45.16	74	07	12.75
DIDERY. Yonkers, N. Y.	40	57	59.98	73	50	13.95
Bald Mountain. Summit Ramapo Mountain, ½ mile S. of State line. (B.)	41	07	11.94	74	11	43.11
Ramsey's. Church tower. (B.)	41	03	31.01	74	08	12.30
Wykoff. Church cupola. (B.)	41	00	25.13	74	10	06.18
Allendale. Church spire. (B.)	41	01	46.96	74	07	14.94
Paramus. Church spire. (B.)	40	59	04.52	74	05	13.48
Hackensack. Church spire. (B.)	40	53	15.95	74	02	12.85
Palisade. (B.)	40	59	50.33	73	53	57.69
Englewood. (B.)	40	53	25.56	73	57	56.25
Bergen Fields. Church spire	40	55	43.04	73	59	53.38
Coytesville	40	51	34.99	73	58	25.47
Schraalenburg. Church spire	40	56	22.48	73	59	20.53
HIGH TORNE. Summit, 1 mile N. of Ramapo, N. Y.	41	09	02.79	74	09	27.53
Clarke's Spheroid. Difference			*+02.6*			*+19.8*
PIERMONT. N. Y.	41	02	57.26	73	55	38.52
DIDERY. Yonkers, N. Y.	40	58	02.57	73	50	33.88
BUTTERMILK. N. Y.	41	06	36.44	73	48	38.90
Bury. Hill N. of Carlstadt	40	50	28.80	74	05	22.41
Fort Lee flag-staff	40	50	49.00	73	57	53.76
State Line, New York and New Jersey. Stone on bank of Hudson river.	40	54	50.10	73	55	28.95
Duer. N. Y.	40	59	53.46	73	54	10.37
BURLINGTON COUNTY.						
Bordentown Observatory. (1840)	40	09	17.57	74	42	24.14
Bordentown flag-pole. (1840)	40	08	49.95	74	42	29.99
White Hill (?) (1840)	40	08	19.49	74	43	33.66

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
BURLINGTON COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
STONY HILL. Buried cone, with locust post at surface, on hill 1 mile S. of Ellisdale. (1840)	40	07	09.59	75	34	33.06
Clay banks (?) (1840)	40	07	11.49	74	47	33.41
King (?) (1840)	40	01	18.05	74	56	10.10
MOUNT HOLLY. Granite monument, top of mount. (1840)	40	00	06.12	74	46	59.70
Arney. Summit of Arney's Mount (?) (1840)	40	00	25.66	74	41	53.02
Woodside (?) (1840)	40	03	44.52	74	49	14.43
Moorestown spire. Episcopal Church. (1840)	39	57	42.27	74	56	42.09
Evesham. Summit of Mt. Laurel (?) (1840)	39	56	00.45	74	53	20.81
Rancocas (?) (1840)	40	02	33.10	74	58	20.84
Washington Hunter (1) (?) (1840)	40	00	52.51	74	58	48.73
Washington Hunter (2) (?) (1840)	40	00	52.73	74	58	57.20
Tuckerton. Near edge of upland E. of village (?) (a. 1851)	39	36	06.69	74	19	27.59
Cedar Hummock. On a well-known small island in the marsh, 2½ miles S. of Tuckerton (?) (a. 1851)	39	34	07.05	74	20	19.06
Clarke's Spheroid. Difference			*+03.0*			*+19.6*
Collegeville, Pa. (?) (1878)	40	02	44.22	75	01	01.96
Partridge, Pa. Jack Island, bank of Delaware. (1878)	40	03	16.62	74	58	33.33
Delanco Church spire. (1878)	40	02	58.11	74	57	25.15
Delanco. Bank of Delaware at village. (1878)	40	02	46.15	74	57	46.20
Harrison's house cupola, Pa. (1878)	40	02	22.67	74	59	47.93
Pennypack, Pa. (?) (1878)	40	02	11.35	75	00	00.32
Hawk. S. W. end of Hawk Island, Riverside. (1878)	40	02	35.95	74	58	39.21
Fisher, Pa. Fisher's wharf, S. of Torresdale. (1878)	40	02	37.01	74	59	15.71
Plum. At water-edge on Plum Point. (1878)	40	01	56.99	74	59	26.61
Saint Vincent's school cupola, Pa. (1878)	40	01	21.10	75	01	53.09
House of Correction flag-staff, Pa. (1878)	40	01	43.63	75	00	58.73
House of Correction chimney, Pa. (1878)	40	01	48.94	75	01	04.44
Ten-Mile Point, Pa. (1878)	40	01	26.06	75	01	04.88
Tacony water tower. (1878)	40	01	42.92	75	02	41.24
Tacony. Methodist Church spire, Pa. (1878)	40	01	28.92	75	02	34.55
South's house cupola, Pa. (1878)	40	01	26.18	75	02	24.01
Bristol. Stone at Bristol street and Delaware avenue, Bridesburg, Pa. (1878)	39	59	22.64	75	04	13.22
Washington. Washington street and Delaware avenue, Tacony, Pa. (1878)	40	01	07.64	75	02	11.75
Disston's flag-staff, Tacony, Pa. (1878)	40	01	07.15	75	02	14.71

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
BURLINGTON COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Disston's chimney, Tacony, Pa. (1878).....	40	01	05.93	75	02	23.04
Fitler's chimney, Pa. (1878)	40	00	39.22	75	03	36.95
Frishmuth. On river bank, S. end of Riverton. (1878)	40	00	45.49	75	01	27.16
House of Correction, Tacony, Pa. Near S. corner of wharf. (1878)	40	01	30.72	75	00	52.76
Hunter's house. N. chimney of Clayton Cole's house, 1½ miles S. E. from Riverton. (1878)................................	40	00	47.91	74	59	07.46
Lenning's round chimney, Pa. (1878)	40	00	21.34	75	03	40.29
Bridesburg, Pa. S. W. corner of Bridesburg wharf. (1878)	40	00	02.75	75	03	42.51
Lenning's square chimney, Pa	40	00	15.74	75	03	36.57
Van *Kirk*. Van *Kirk street, 370 feet* S. E. of N. W. side of Delaware avenue, Bridesburg, Pa. (1878).............	40	00	33.06	75	03	21.12
MOUNT HOLLY. Granite monument on top of the mount. (1840)...........	40	00	09.10	74	47	19.35
APPLE PIE HILL. Stone monument on summit of hill, 3 miles S. W. of Shamong R. R. station. (1871)	39	48	26.62	74	35	23.83
Tuckerton. (See above.) (1866)............	39	36	10.16	74	19	47.82
Cedar Hummock (2). (See above.) *(1866)*..	39	34	10.58	74	20	39.31
MARTHA. Stone monument on summit, 2¼ miles E. of Martha Furnace. (B.)....	39	40	35.87	74	28	13.12
CAMDEN COUNTY.						
Fishcove (Hatchis) (?) (a. 1851).	39	58	20.87	75	03	33.67
Woods Point (?) (a. 1851).................	39	57	25.27	75	05	19.23
Walnut Street Ferry (?) (a. *1851*).	39	56	34.08	75	07	27.22
Kaighn's Point (?) (a. 1851)	39	55	42.89	75	07	33.04
Cooper's Point (?) (a. 1851)	39	57	12.58	75	07	22.69
Haddonfield. Hill 1 mile S. of village (?) (a. 1851).	39	52	50.37	75	02	03.80
Gibbsboro (?) (a. 1851)	39	50	17.57	74	56	39.88
PINE HILL. Granite monument N. W. brow of hill, ½ mile S. of Clementon. (1840)..	39	47	51.03	74	59	16.50
Morris Hill (?) (a. 1851).........	39	59	21.78	75	02	17.26
Camden Church spire. (a. *1851*)............	39	56	41.06	75	07	10.19
Gloucester Point (?) (a. 1851).................	39	53	46.11	75	07	27.36
Fish Club flag staff (?) (a. 1851)	39	53	13.54	75	07	24.32
Powder Wharf (?) (a. 1851).....................	39	54	10.47	75	07	43.73
Mickle (?) (a. 1851).	39	54	37.24	75	07	02.97
Girard College, Philadelphia, Pa. (a. 1851)	39	58	23.58	75	09	54.09
State House spire, Philadelphia, Pa.(a. 1851)	39	56	52.61	75	08	41.90
Clarke's Spheroid. Difference			*+03.0*			*+19.5*
Frankford Pumping Station ch'y, Pa. (1878)	40	00	50.61	75	03	51.83
Frankford Catholic Church cross, Pa. (1878)	40	00	42.48	75	05	25.03

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
CAMDEN COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Horner. Buried terra-cotta pipe, 800 yards N. E. from Camden Water Works and 150 yards back from river bank. (1878)	39	57	40.85	75	05	42.31
Jenks. Jenks street and Delaware avenue, Bridesburg, Pa. (1878)	39	59	52.82	75	03	53.26
Morris (2). On hill just E. of Morris R. R. station. (1878)	39	59	23.70	75	02	36.51
Tioga (2), Pa. S. W. butting pile, end of Elevated R. R. track, Gas Works wharf, Tioga street, Philadelphia. (1878)	39	58	45.36	75	05	14.26
Fairview. Terra-cotta pipe, *buried 170 feet* N. E. of Hatch Bros.' brick-yard chimney, E. side of R. R. cut, Fish House station. (1878)	39	58	28.13	75	03	56.89
Pike, Pa. Pike street and Delaware avenue. (1878)	39	59	05.80	75	04	45.48
BERLIN. Stone monument, on summit, 2 miles N. E. of village. (B.)	39	48	55.85	74	54	45.07
CAPE MAY COUNTY.						
Stipson (?) (1842)	39	11	51.41	74	54	18.31
Ludlam's Landing. N. side of Dennis Creek (?) (1842)	39	10	38.46	74	50	50.00
McCrea (?) (1842)	39	09	49.32	74	50	26.09
Goshen (?) (1842)	39	07	36.35	74	53	10.93
Pierce's Landing (?) (1842)	39	04	54.33	74	54	05.78
Fishing Creek (?) (1842)	39	01	04.08	74	56	32.26
Higbee (?) (1842)	38	57	14.12	74	57	31.95
Cape May Old Light-house. (a. 1851)	38	55	48.64	74	57	38.90
Cape May New Light-house. (a. 1851)	38	55	50.42	74	57	15.57
Congress Hall. (a. 1851)	38	55	51.01	74	55	09.77
Week's Landing (?) (1851)	38	58	55.59	74	52	49.60
Two-Mile Beach (?) (a. 1851)	38	57	26.13	74	50	40.10
Leaming's Point (?) (a. 1851)	39	00	56.64	74	50	58.48
Town Bank (?) (a. 1851)	38	58	36.94	74	57	21.96
Crese (?) (a. 1851)	39	03	00.05	74	49	28.91
Nummy's Island (?) (a. 1851)	39	01	39.50	74	47	09.31
Cyrus (?) (a. 1851)	39	04	28.55	74	44	01.20
Eldridge (?) (a. 1851)	39	06	03.41	74	47	17.07
Holmes (?) (1840)	39	07	32.71	74	45	53.73
Leaming's Beach North (?) (1840)	39	06	26.06	74	42	12.54
Townsend (?) (1840)	39	10	23.84	74	43	09.98
Ludlam's Beach (?) (1840)	39	08	41.50	74	41	29.69
Corson (?) (1840)	39	13	41.40	74	40	35.77
Mountain Creek (?) (1840)	39	11	42.80	74	38	51.74
Weakfish Creek (?) (1840)	39	13	28.80	74	37	38.73
Blackman (?) (1840)	39	15	04.74	74	39	13.93
Beasley's Point (?) (1840)	39	16	46.91	74	37	21.48

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
CAPE MAY COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Peck's Beach (?) (1840)	39	16	11.77	74	34	51.52
Cape Henlopen Light-house, Del. (a. 1851)	38	46	38.35	75	04	43.24
Clarke's Spheroid. Difference			*+03.2*			*+19.6*
Beasley's Point (?) (1840)	39	16	50.07	74	37	41.01
Beasley's (2). (1884)	39	17	02.53	74	37	00.20
Blackman (?) (1840)	39	15	07.92	74	39	33.47
Corson (?) (1884)	39	12	01.01	74	39	21.35
Corson (?) (1840)	39	13	44.60	74	40	55.32
Stipson Island (?) (1842)	39	11	54.67	74	54	38.00
Ludlam's Landing (?) (1842)	39	10	41.75	74	51	09.74
McCrea. (1842)	39	09	52.62	74	50	45.96
Goshen. (1881)	39	07	39.64	74	53	30.63
Public. (1884)	39	09	03.43	74	44	48.17
Tatham. (1884)	39	06	20.34	74	43	31.72
View. (1884)	39	10	39.38	74	43	11.40
Isle. (1884)	39	10	36.65	74	40	32.66
Marshall. (1884)	39	12	13.47	74	41	47.00
Sea. (1884).	39	08	59.50	74	42	15.64
Town Bank. Hotel cupola. (1881)	39	59	14.32	74	57	30.84
Hammock. (1881)	39	07	00.00	74	53	30.65
Young. (1884)	39	13	48.24	74	40	19.20
Cedar. (1884)	39	13	34.08	74	38	12.08
Heart. (1884).	39	15	34.23	74	38	35.80
Road. (1884)	39	15	05.28	74	36	53.77
Eldridge (2). Cedar stub, Ephraim Eldridge's bay front. (1881)	39	06	06.63	74	47	36.46
Limerick chimney. Tallest on old dwelling, Tatham's Beach. (1881)	39	05	43.37	74	43	23.69
Peck's Beach (?) (1840)	39	16	14.93	74	35	11.10
Cape May Court-house spire	39	04	53.00	74	49	29.00
CUMBERLAND COUNTY.						
Barker (?) (1839).	39	26	16.76	75	21	45.94
PINE MOUNT (?) (1839).	39	25	00.57	75	19	56.46
Harris (?) (1839)	39	25	06.89	75	17	16.25
Hann (No. 2) (?) (1839).	39	25	24.01	75	15	07.01
Buck (?) (1839)	39	25	07.50	75	13	16.99
Greenwich (?) (1839)	39	23	24.39	75	20	21.71
Davis (?) (1839)	39	22	37.32	75	20	11.84
Heusted (No. 2) (?)	39	22	55.14	75	18	38.64
Wheaton (?) (1839).	39	23	26.60	75	19	05.89
Mount Pleasant. N. side Cohansey Creek, 3 miles below Bridgeton. (1839) (?)	39	23	21.96	75	15	02.76
Bush Hill (?) (1842)	39	23	56.56	75	15	23.71
Garrison (?) Hill E. side of Bridgeton and Fairton road. (1840)	39	23	33.66	75	13	02.91
Dunck's Beach (?) (1839)	39	20	32.91	75	21	50.90
Dayre (?) (1839)	39	21	44.55	75	19	53.57

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
CUMBERLAND COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Sheppard (?) (1839)	39	22	38.22	75	21	03.34
Cohansey Light-house. Old light-house. (1840)	39	20	18.39	75	21	17.48
Big Island. Buried cone. (1839)	39	19	45.61	75	18	14.08
West Point (?) (1840)	39	19	03.05	75	15	10.69
Ben Davis (?) (1839)	39	17	12.09	75	17	09.57
Eagle Island (?) (1840)	39	17	46.00	75	14	07.56
Nantuxent (?) (1840)	39	16	33.54	75	14	25.95
Flax Farm (?) (1840)	39	16	33.25	75	12	54.39
JOSCELYNE (?) (1840)	39	18	37.02	75	08	03.49
Turkey Point (?) (1840)	39	14	55.97	75	07	21.46
Fortesque (?) (1840)	39	14	09.39	75	09	59.99
Egg Island Point (?) (1841)	39	10	23.53	75	07	49.00
Egg Island Light-house. (1840.) Old light-house, now destroyed.	39	10	30.89	75	08	01.74
Oranoken (?) (1840)	39	12	04.47	75	06	24.62
Egg Island Point (2) (?).	39	10	21.79	75	07	45.94
Dividing Creek. Buried cone, S. side of creek, ¾ mile below bridge. (1840).	39	15	16.96	75	05	04.11
Port Norris (?) (1839).	39	14	33.03	75	00	57.47
East Point (?) (1840)	39	11	28.35	75	00	58.06
Elder Point (?) (1842)	39	12	39.59	75	02	32:32
Bird Island (?) (1842).	39	11	44.34	75	01	09.96
Tomlin (?) (1842)	39	13	43.58	74	59	49.96
Wiggins (?) (1842)	39	14	33.23	74	59	47.70
Robinson (?) (1842)	39	11	23.73	74	59	22.90
West Creek (?) (1842)	39	10	27.02	74	54	44.79
Carlisle (?) (1842)	39	12	03.25	74	56	48.15
Bombay Hook Light-house, Del. (1840)	39	21	46.22	75	30	18.92
Mahon's River Light-house, Del. (1840)	39	10	16.40	75	23	43.43
Clarke's Spheroid. Difference			*+03.1*			*+19.4*
Barker (?) (1839).	39	26	19.96	75	22	05.40
PINE MOUNT (?) (1839)	39	25	03.79	75	20	15.94
John Dayre. Buried cone, 1½ miles N. E. of Bridgeton (?) (1840)	39	26	23.79	75	12	46.93
Hawkins (?) (1839)	39	25	35.42	75	20	40.87
Hann. Buried cone, S. side of Bridgeton and Bowentown road. (1839)	39	25	27.09	75	15	26.63
Buck (?) (1839)	39	25	10.71	75	13	36.54
Harris (?) (1839)	39	25	10.11	75	17	35.77
Wheaton (?) (1839)	39	23	29.83	75	19	25.40
Hann (2). (Same as Hann, nearly) (?)	39	25	27.22	75	15	26.55
Greenwich (?) (1839)	39	23	27.61	75	20	41.20
Bush (?) (1839)	39	23	59.79	75	15	43.25
Sheppard (?) (1839)	39	22	41.43	75	21	22.81
Davis (?) (1839)	39	22	40.55	75	20	31.34
Heusted (?)	39	22	58.37	75	18	58.15
Heusted (2) (?)	39	22	58.36	75	18	58.15
Mt. Pleasant (?)	39	23	25.17	75	15	22.30
Bridgeton spire. (1840)	39	25	46.48	75	13	57.71

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
CUMBERLAND COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Laurel (?)	39	26	21.44	75	13	43.04
Woodruff. N. side of Bridgeton and Millville road, 1 *mile W. of Millville* township line (?) (1840)	39	24	49.75	75	08	47.25
Cedarville spire. (1840)	39	20	01.99	75	12	07.72
Cedarville. Summit, N. E. of new brick church (?) (1840)	39	20	38.48	75	11	50.65
Fairton. Buried cone on Theoph. Harris' land. (1839) (?)	39	22	33.37	75	13	12.26
Ogden (?) *(1839)*	39	22	06.57	75	15	28.23
Jacob's Creek (2). 1½ miles N. of Cohansey Light-house. Cedar stub. *(1875)*	39	21	40.07	75	23	38.25
Jacob's Creek (?)	39	21	37.25	75	23	36.45
Dunck's Beach. On sand ridge, ½ mile N. of Cohansey Light-house	39	20	36.17	75	22	10.38
Dunck's Beach (2)	39	20	36.34	75	22	10.63
Dayre (?)	39	21	47.78	75	20	13.07
Cohansey Light-house. (1840). Disused	39	20	21.64	75	21	36.98
Big Island. Buried cone. *(1839) (?)*	39	19	48.86	75	18	33.60
Sea Breeze. Warner House flag-staff. (1882)	39	19	26.71	75	19	14.83
Garrison (?) (1840). (Same as previous)	39	23	36.88	75	13	22.47
West Point (?) (1840). (Same as previous)	39	19	06.31	75	15	30.23
Ben Davis (?) (1839). (Same as previous)	39	17	15.36	75	17	29.10
Ben Davis (2) (?)	39	17	18.36	75	17	26.98
Eagle Island (?) (1840). (Same as previous)	39	17	49.26	75	14	27.10
Nantuxent (?) (1840). (Same as previous)	39	16	36.81	75	14	45.49
Flax Farm (?) (1840). (Same as previous)	39	16	36.52	75	13	13.95
JOSCELYNE *(?) (1840). (Same as previous)*	39	18	40.25	75	08	23.09
Ben. Drain-pipe sunk in sand at extreme high-water mark, Ben Davis Point. *(1882)*	39	17	18.47	75	17	26.97
Nan. Drain-pipe and cement, below mouth of Nanticoke Creek. (1882)	39	16	40.53	75	14	46.80
Dyer's Cove. Drain-pipe planted in marsh. (1882)	39	16	06.54	75	13	42.42
Turkey Point (?) (1840). (Same as previous)	39	14	59.23	75	07	41.06
Bradford's Point. Terra-cotta pipe, ¼ mile below Padget's Creek. *(1881)*	39	15	56.35	75	11	53.95
Fortesque. Pavilion flag-staff. (1882)	39	14	12.23	75	10	19.14
Fortesque. Big flag-staff. (1882)	39	14	15.38	75	10	14.22
Fortesque (?) (1840)	39	14	12.65	75	10	19.60
Fortesque (2). Terra-cotta pipe on sand *hill, 332 feet S. E. of pavilion.* (1881).	39	14	07.19	75	10	16.10
Dividing Creek (?) (1840). (Same as previous)	39	15	20.22	75	05	23.72
Oranoken (?) (1840). (Same as previous).	39	12	07.74	75	06	44.21
False Point (?) (1840)	39	12	00.55	75	10	17.92
False Egg Point, at high-water mark. (1882)	39	12	01.23	75	10	11.92
Egg Island Light-house. (1882)	39	10	43.82	75	08	13.22

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
CUMBERLAND COUNTY.—*Continued.*	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Port Norris. Buried cone, land of Harriet Ogden. (1839)	39	14	36.29	75	01	17.09
Elder Point (?) (1842)	39	12	42.86	75	02	51.93
Bird Island. (1842)	39	11	47.61	75	01	29.58
Wiggins. (1842.) (Same as previous)	39	14	36.49	75	00	07.31
Tomlin. (1842.) (Same as previous)	39	13	46.84	75	00	09.58
East Point. On sand hill, 1½ miles E. of Maurice river (?)	39	11	31.62	75	01	17.70
Tripod (?)	39	12	36.04	75	02	43.10
Maurice River West. Buried cone, W. side of river mouth. (1840) (?)	39	12	43.20	75	02	53.16
Robinson (?) (1842)	39	11	27.01	74	59	42.54
Egg Island (2)	39	10	25.07	75	08	05.52
Maurice River Light-house. (1877)	39	11	45.23	75	01	39.53
Carlisle. Buried cone (1842) on farm of Wm. Carlisle, of Leesburg	39	12	06.52	74	57	07.80
West Creek. (1842)	39	10	30.30	74	55	04.47
West Creek (2). (1881)	39	10	37.79	74	54	58.35
Elmer (?)	39	22	13.17	75	09	09.39
Ship John *Light-house*. (1882)	39	18	19.10	75	22	37.08
Bombay Hook Light-house. (1882)	39	21	49.49	75	30	38.34
Vineland Church.	39	29	10.17	75	01	16.12
Roman Catholic Seminary	39	29	43.26	75	01	37.26
ESSEX COUNTY.						
Crane (2). Summit First Mountain, N. of Montclair (?) (a. 1851)	40	50	05.42	74	12	48.86
Wallace. In Newark city (?) (a. 1851)	40	44	30.41	74	10	56.09
Newark Neck (?) (a. 1851)	40	42	44.97	74	08	00.00
Fairfield. Reformed Church spire. (B.)	40	53	01.94	74	16	38.13
Caldwell. Church spire. (B.)	40	50	18.38	74	16	14.02
Caldwell. *Iron bar, projecting 3 inches, 1 mile E. of village, near top of hill.* (B.)	40	50	21.69	74	15	04.77
Newark. First *Presbyterian Church* spire. (a. 1859)	40	44	01.18	74	10	02.26
Newark. Methodist Church spire. *Broad* street. (a. 1859)	40	44	03.58	74	09	52.60
Newark Bay Light or Passaic Light. (a. 1859)	40	41	43.69	74	07	19.23
Newark Bay Beacon. (a. 1859)	40	42	05.60	74	07	07.97
Clarke's Spheroid. Difference			+*02.6*			+*19.9*
Newark. Episcopal Church spire	40	44	25.42	74	10	10.35
GLOUCESTER COUNTY.						
Big Timber Creek (?) (a. 1851)	39	52	42.68	75	07	45.54
Red Bank flag-staff. (a. 1851)	39	52	17.35	75	11	01.59
Woodbury Creek (?) (a. 1851)	39	51	50.06	75	11	33.29

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
GLOUCESTER COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Mathew (?) (a. 1851)	39	51	16.54	75	12	23.33
Billingsport (?) (a. 1851).	39	51	00.24	75	14	15.88
Isaac (?) (a 1851)	39	50	44.84	75	15	23.37
Chew. Hill, 1 mile N. of Mantua (?) (a. 1851)	39	48	13.89	75	09	42.28
Oldman Creek (?) (a. 1851)	39	47	01.84	75	25	33.11
Opposite Marcus Hook (?) (a. 1851)	39	47	39.07	75	24	02.17
Tonkin's Island. West (?) (a 1851)	39	48	48.96	75	22	31.28
Tonkin's Island. East (?) (a. 1851)	39	49	11.40	75	21	40.94
Man Island (?) (a. 1851)	39	50	19.67	75	19	08.59
Thompson Point (?) (a. 1851)	39	50	31.83	75	18	04.50
Crab Creek (?) (a. 1851).	39	50	36.40	75	17	20.33
Eagle Point (?) (a. 1851)	39	52	39.28	75	09	41.21
Opposite Chester (?) (a. 1851)	39	49	40.27	75	20	20.24
Robbins (2). (1843)	39	44	31.29	75	19	42.75
Scull (1). (1843)	39	43	30.01	75	20	22.73
LIPPENCOTT. On hill, 2 miles S. of Swedesboro. (1843)	39	43	17.44	75	18	30.36
Swedesboro spire. Episcopal Church. (1843)	39	44	58.94	75	18	07.32
Caffery. ½ mile S. E. from Clarksboro. (1843)	39	47	28.44	75	12	59.73
West. 2 miles from Mullica Hill, summit of road to Mantua. (1843)	39	45	36.73	75	12	00.61
Fort Mifflin flag-staff, Pa. (a. 1851)	39	52	28.57	75	12	25.88
Chester Roman Cath. Church, Pa. (a. 1851)	39	51	02.20	75	21	19.52
Clarke's Spheroid. Difference			*+03.1*			*+19.4*
LIPPENCOTT. (See above.) (1843)	39	43	20.56	75	18	49.81
Newfield	39	32	13.84	75	00	16.13
Forest Grove.	39	31	45.77	74	59	21.81
Williamstown Ch.	39	40	54.60	74	59	23.20
Clayton Ch	39	39	26.29	75	05	29.73
HUDSON COUNTY.						
Schuyler. On ridge, E. of Bellville (?) (a. 1851)	40	46	46.28	74	08	10.17
Bergen Neck (?) On ridge in West Hoboken (?) (1818)	40	45	49.40	74	02	16.62
Stevens. In front of Stevens residence, Hoboken. (a. 1851)	40	44	38.49	74	01	06.54
Bergen spire. Old Dutch Reformed Church. (a. 1851)	40	43	39.51	74	03	43.22
Caven Point (?) (a. 1851)	40	41	31.36	74	03	59 07
Palmerpaw (?) (a. 1851).	40	40	38.24	74	05	39.32
Constable's Point (?) (a. 1851)	49	39	23.52	74	05	25.61
Vanhorne (?) (2) (a. 1851).	40	39	05.63	74	08	06.80
Shooter's Island (?) (a. 1851)	40	38	34.24	74	09	20.04
Rowan (?) (a. 1851)	40	38	51.54	74	07	13.72

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
HUDSON COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Bedloe's Island (flag-staff). New York Bay. (a. 1851)	40	41	17.48	74	02	20.85
Gibbet Island (tree). Now Ellis Island, New York Bay. (a. 1851)	40	41	55.72	74	02	05.49
Jersey City (flag-staff). (a. 1851)	40	42	52.43	74	01	57.20
Passionate Fathers' Monastery. West Hoboken. (B.)	40	45	54.38	74	01	52.28
Brooklyn Bridge. New York pier. (B)	40	42	23.57	73	59	35.51
Bergen Point spire. (a. 1859)	40	38	49.58	74	07	19.24
Centerville. Church spire. (a. 1859)	40	40	03.23	74	06	33.26
Kill's Light. Bergen Point. (a. 1859)	40	38	32.23	74	08	35.84
Robin's Reef Light. New York Bay. (a. 1859)	40	39	23.85	74	03	36.78
New York City Hall, N. Y. (a. 1851)	40	42	43.16	74	00	03.09
New York, Trinity Church spire. (a. 1851)	40	42	25.71	74	00	24.29
Brooklyn, Trinity Church spire	40	40	56.33	73	57	43.06
Clarke's Spheroid. Difference			*+02.6*			*+19.9*
Highwood (2) Brick pillar, marble cap in miniature redoubt, near residence of Mrs. James G. King (1867), 2 miles N. of Hoboken.	40	46	12.70	74	01	02.06
Bergen Neck (?) (1818)	40	45	52.06	74	02	36.50
Stevens. (a. 1851)	40	44	41.14	74	01	26.44
Bergen Dutch Reformed Church. (Same as above.) (1885)	40	43	37.14	74	04	04.35
Jersey City. Spire. (a. 1851)	40	42	53.18	74	02	16.75
Oil Co.'s chimney. N. side of Kill von Kull. (1885)	40	39	18.82	74	06	33.44
Shooter's Island. Chimney. (1885)	40	38	32.58	74	09	39.70
HUNTERDON COUNTY.						
Fox Hill. Stone monument on summit, 2 miles N. E. of Califon. (B.)	40	43	56.31	74	47	59.45
Bethlehem. Masonry monument over Lehigh Valley R. R. tunnel. (B.)	40	38	49.95	75	01	18.99
Gravel Hill. Cross cut on rock on summit, 3 miles N. W. of Milford. (B.)	40	35	18.87	75	08	06.80
PICKLES. Stone monument, most southerly summit of mountain. (B.)	40	35	38.26	74	49	06.57
Readington. Reformed Church spire. (B.)	40	34	02.46	74	43	49.59
Cherryville. Stone monument, ¼ mile W. of village. (B.)	40	33	42.45	74	54	11.41
Croton. Stone monument on summit, 2 miles S. E. of village. (B.)	40	29	01.42	74	54	25.95
Three Bridges. Church spire. (B.)	40	31	20.53	74	47	29.89
Flemington. Methodist Church spire. (B.)	40	30	17.53	74	51	10.62
Pleasant Corner. Church spire. (B.)	40	26	25.98	74	51	04.55
Sand Ridge. Baptist Church spire. (B.)	40	25	20.45	74	56	54.99

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
HUNTERDON COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Sourland. White-oak stump, ½ mile W. of Amwell village. (B.)	40	25	48.96	74	45	19.50
GOAT HILL. Stone monument on summit, 1½ miles S. of Lambertville. (B.)	40	20	42.05	74	55	57.45
HAYCOCK, PA. Summit, 2 miles S. of Bucksville. (B.)	40	29	16.09	75	12	50.97
Clarke's Spheroid. Difference			*+02.7*			*+19.6*
MERCER COUNTY.						
MOUNT ROSE. Top of mountain, ¾ mile E. of village. (1840)	40	22	00.56	74	43	06.14
Poplar Ridge (?) (1840)	40	22	14.30	74	42	10.75
Mount Canoe. Buried cone on hill, 1¾ miles N. E. from Titusville (?) (1840)	40	19	37.76	74	51	19.98
Cold Soil (2) (?) (1840)	40	20	37.84	74	42	13.90
Pennington Seminary (cupola). (1840)	40	19	35.36	74	47	18.30
Princeton Seminary (cupola). (1840)	40	20	40.00	74	39	34.26
Princeton College (cupola). (1840)	40	20	52.06	74	39	15.26
Mapleton (2) (?) (1840)	40	21	08.62	74	36	23.83
Lawrenceville. Buried cone. Hill N. W. of village (1840)	40	18	05.01	74	43	48.71
Lawrenceville (spire). (1840)	40	17	51.00	74	43	25.25
Hazel's Farm (2). Middle of New Brunswick and Trenton turnpike, 30 yards N. of Chas. Updeck's house. (1840)	40	18	02.77	74	40	08.69
Trenton. First Presb. Church spire. (1840)	40	13	10.23	74	45	29.54
White Horse (?) (1840)	40	11	10.70	74	42	07.51
Clarke's Spheroid. Difference			*+02.8*			*+19.6*
MIDDLESEX COUNTY.						
Williams (2) (?) (a. 1851)	40	34	51.18	74	12	31.94
Woodbridge (?) (a. 1851)	40	33	22.51	74	14	20.83
Woodbridge. Spire of Presbyterian Church. (a. 1859)	40	33	39.82	74	16	05.95
Zellis (2). On hill, ½ mile S. of Woodbridge (?) (a. 1851)	40	32	43.02	74	16	17.64
Shotwell (?) (a. 1851)	40	32	45.43	74	15	01.06
BLOOMFIELD. Summit of Bloomfield's Hill, 2 miles E. of Metuchen. (a. 1851)	40	32	04.01	74	19	08.84
Perth Amboy. Episcopal Church spire. (a. 1859)	40	30	10.64	74	15	36.15
South Amboy. (a. 1851)	40	28	44.61	74	16	59.98
Morgan (?) (a. 1851)	40	28	01.06	74	15	39.33
Chestnaquack (?) (a. 1851)	40	27	37.43	74	14	43.39
Sandhills. Summit on New Brunswick and Trenton turnpike. (a. 1851)	40	24	27.30	74	32	19.08

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
MIDDLESEX COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Cranbury. Steeple First Presb. Church. (a. 1851)	40	18	23.68	74	30	48.32
New Brunswick. Rutgers Col. cupola. (B.)	40	29	52.73	74	26	28.12
Woodbridge Landing (?) (a. 1859)	40	32	43.23	74	14	59.71
Fire Brick Works. A. Hall & Son's ch'y, Perth Amboy. (a. 1859)	40	30	51.06	74	15	16.06
Perth Amboy. Presb. Church. (a. 1859)	40	30	18.09	74	15	37.80
South Amboy Depot. Pennsylvania R. R. (a. 1859)	40	29	26.32	74	16	15.58
Seward (?) (a. 1859)	40	28	52.90	74	16	13.05
Morgan (2) (?) (a. 1859)	40	28	08.05	74	15	36.15
Morgan (3) (?) (a. 1859)	40	28	05.18	74	15	33.80
Chestnaquack Point (2) (?) (a. 1859)	40	27	36.88	74	14	42.36
Clarke's Spheroid. Difference			*+02.7*			*+20.0*
Bayard. Bank of Arthur Kill, N. of Island View landing. Buried bottle. (1885)	40	35	01.66	74	12	43.94
Sawyer. Tuft's Point, N. bank Arthur Kill. Buried bottle. (1885)	40	33	38.86	74	13	26.27
Woodbridge. Spire of Presbyterian Church. (1885, same as a. 1851)	40	33	42.50	74	16	25.94
Hawk. 18 yards E. of Clark's Creek, (1885)	40	33	41.77	74	14	25.40
Sewaren. Cedar stub, 160 yards N. of Sewaren Hotel. (1885)	40	32	47.50	74	15	18.54
Boynton's Tile Works chimney. Near Woodbridge Landing. (1885)	40	32	26.58	74	15	21.56
MONMOUTH COUNTY.						
Matayan Point (?) (a. 1851)	40	26	50.28	74	12	19.53
Conasconck Point (?) (a. 1851)	40	27	30.90	74	10	24.21
Point Comfort (?) (a. 1851)	40	27	20.79	74	07	45.05
Compton (?) (a. 1851)	40	26	19.74	74	05	09.94
Sandy Hook (?) (a 1851)	40	27	42.18	74	00	04.80
Sandy Hook Light-house. (a. 1859)	40	27	39.49	73	59	48.56
Pigeon Hill (?) (a. 1851)	40	24	24.49	74	04	23.33
Mount Mitchell. N. edge of Highlands. (a. 1851)	40	24	27.77	74	00	06.30
BEACON HILL. Hill 1 mile S. E. of Morganville. (1839)	40	22	23.74	74	13	22.06
Beers. Hill W. side of Keyport and Holmdel road. (1843)	40	23	30.96	74	11	06.29
Navesink (?) (a. 1851)	40	23	45.06	73	58	49.77
Navesink Light-house. (a. 1851)	40	23	42.43	73	58	48.62
Ocean House (flag-staff). (a. 1851)	40	22	51.74	73	58	13.90
Burdge. Hill N. bank of Navesink river. (1843)	40	22	59.43	74	01	25.80
Navesink (2) (?) (a. 1851)	40	23	15.34	73	58	53.50
Garriell. Hill 1 mile S. E. of Red Bank. (a. 1851)	40	20	31.69	74	02	45.79

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
MONMOUTH COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Conover (?) (a. 1843)	40	20	38.28	74	01	07.42
Beach (1) (?) (a. 1851)	40	20	*39.12*	*73*	58	*01.68*
Beach (2) (?) (a. 1851)	40	20	11.87	73	58	02.84
Polhemus. Hill 2½ miles N. E. of Colt's Neck. (1843)	40	19	00.00	74	08	36.62
Shrewsbury spire. (a. 1851)	40	19	22.20	74	03	21.63
Liberty pole. Long Branch village. (a. 1840)	40	17	55.55	73	59	52.30
DISBORO. Hill 1½ miles N. W. of Perrineville. (1840)	40	14	45.43	74	27	06.10
Baird. N. end Pine Hill, 1½ miles N. E. of Perrineville. (1840)	40	14	07.05	74	24	31.26
Debow. Hill 1 mile S. E. of Clarksburgh (?) (1840)	40	10	55.37	74	25	16.89
Freehold. Spire old Court House (?) (1840)	40	15	34.38	74	16	08.50
Grandon. Hill 2 miles E. of Freehold. (1840)	40	15	44.62	74	13	35.86
Throckmorton. Hill 2½ miles S. of Colt's Neck. (1836)	40	15	01.08	74	10	28.68
Lippencott. Hill 1½ miles N. of Shark River R. R. station (?) (1836)	40	15	17.63	74	07	18.27
West. Hill ½ mile N. of Elberon R. R. *station* (?) (a. 1851)	40	16	16.24	73	59	34.71
Red Bog. On hill, 2½ miles W. of Asbury Park. (a. 1851)	40	14	03.28	74	02	54.16
Newell. On hill, 2 miles S. E. of Turkey. (a. 1851)	40	11	41.15	74	14	05.77
Highland of Squan (?) (a. 1851)	40	06	07.68	74	04	17.70
Sandy *Hook Signal* (?) (a. 1859)	40	28	17.05	74	00	03.21
Conasconck Point (2) (?) (a. 1859)	40	27	30.60	74	10	24.74
Wilson's Beacon. *Back of Point Comfort.* (a. 1859)	40	26	35.80	74	07	51.32
Light-house flag. *Near Point Comfort.* (a. 1859)	40	26	50.75	74	06	56.81
Matayan (?) (a. 1859)	40	26	48.87	74	12	18.90
Keyport spire. (a. 1859)	40	26	12.41	74	11	47.24
Conover's Beacon. (a. 1859)	40	25	14.21	74	03	01.39
Hilton (?) (a. 1859)	40	25	17.19	74	03	09.44
Carhart (?) (a. 1859)	40	25	01.13	74	02	11.66
Chapel Hill. Back Light. (a. 1859)	40	23	51.00	74	03	12.76
Chapel Hill. Light-house pole. (a. 1859)	40	23	51.68	74	03	12.67
Wilson (?) (a. 1859)	40	26	18.87	74	05	08.92
Clarke's Spheroid. Difference			*+02.8*			*+19.9*
BEACON HILL. (See above)	40	22	26.55	74	13	41.91
Throckmorton. (See above)	40	15	03.90	74	10	48.57
Garriell. (See above)	40	20	34.44	74	03	05.72
West. (See above)	40	16	18.98	73	59	54.71
Red Bog. (See above)	40	14	06.10	74	03	13.71
Red Bog (2) (?)	40	14	05.81	74	03	13.71

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE		
MORRIS COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
East and West Jersey Line. 1½ miles N. of Budd's Lake. (B.)	40	53	46.46	74	44	34.43
Green Pond. Blazed pine on summit, 1 mile N. of Denmark. (B.)	40	58	31.04	74	31	41.93
Sheep Hill. Cross cut on large rock on summit, 1 mile N. of Boonton. (B.)	40	55	06.58	74	24	04.35
Boonton. Presb. Church spire. (B.)	40	54	20.92	74	24	17.68
Parsippany. Presb. Church spire. (B.)	40	51	50.17	74	24	04.17
Schooley's Mountain. Cross on center one of 3 stones on summit, 1¼ miles S. W. of Drakestown. (B.)	40	49	44.93	74	47	13.45
Watnong. Bar of iron, projecting 6 inches, on summit, 1½ miles N. W. of Morris Plains. (B.)	40	50	52.88	74	29	20.23
Morristown. Presb. Church spire. (B.)	40	47	47.83	74	28	30.19
Mt. Olive. Stone monument on summit, 1½ miles E. of Budd's Lake. (B.)	40	51	59.88	74	42	32.80
Bald Hill. Stone monument, 1 mile S. E. of Brook Valley. (B.)	40	57	37.21	74	20	43.91
Clarke's Spheroid. Difference.			*+02.6*			*+19.7*
OCEAN COUNTY.						
Christopher. On a hill 1¾ miles S. E. of Lakewood, now a cemetery (?) (a. 1851)	40	04	10.42	74	11	36.75
Green Island (?) (a. 1851)	40	00	32.22	74	06	06.49
Fleming (?) (a. 1851)	40	00	12.97	74	03	11.79
Page (?) (a. 1851)	39	59	06.18	74	06	48.18
Stout (?) (a. 1851)	39	57	34.71	74	04	15.43
Goose Creek (?) (a. 1851)	39	57	04.97	74	06	20.38
Cranberry (?) (a. 1851)	39	56	37.21	74	03	58.55
Good Luck Point (?) (a. 1851)	39	55	18.58	74	06	47.10
Philipp (?) (a. 1851)	39	53	50.37	74	04	25.90
Cedar Creek (?) (a. 1851)	39	51	44.44	74	07	52.94
Forked River (?) (a. 1851)	39	49	19.83	74	09	08.41
Island Beach (?) (a. 1851)	39	49	02.52	74	05	08.73
Barnegat Inlet (?) (a. 1851)	39	45	55.47	74	05	55.43
Barnegat Light-house (a. 1851), old position; for new light-house, see below	39	45	57.21	74	06	02.20
Double Creek (?) (a. 1851)	39	44	24.84	74	10	20.39
Hickory Island (?) (a. 1851)	39	41	11.94	74	12	43.12
Great Swamp (?) (a. 1851)	39	40	39.53	74	08	39.32
Dinner Point (?) (a. 1851)	39	37	57.40	74	14	54.94
Hickey (?) (a. 1851)	39	37	34.20	74	11	03.36
Cramer (?) (a. 1851)	39	35	09.24	74	12	52.76
Long Beach (?) (a. 1851)	39	33	15.89	74	14	21.23
Clarke's Spheroid. Difference			*+03.0*			*+20.0*
Whitings Hotel flag-staff. (1873)	39	57	13.04	74	22	46.62

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
OCEAN COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
BALCONY. Buried jug at summit, 2 miles S. W. of Whitings. (1871)	39	55	27.09	74	23	40.94
RIDGEWAY. Summit, N. side of Cedar Bridge road, 5½ miles N. W. from Barnegat. (1872)	39	46	34.43	74	19	33.26
BARNEGAT LIGHT-HOUSE. Present light-house. (1873)	39	45	51.61	74	06	23.78
Barnegat. Methodist Church spire. (1873)	39	45	09.81	74	13	20.04
Gowdy's house. Cupola of Mr. J. G. Gowdy's residence, 1 mile E. of Toms River. (1873)	39	57	11.73	74	10	34.90
PASSAIC COUNTY.						
Van Riper. Summit, S. edge of Paterson (?)	40	53	34.04	74	08	04.34
Weasel. Copper bolt in ledge First Mountain, N. of Great Notch	40	52	34.18	74	10	52.41
Aquackanonk. Summit of hill, Passaic City (?)	40	51	01.13	74	07	25.80
Beach Mountain. Summit, near State line, E. of Greenwood Lake. (B.)	41	09	57.56	74	17	20.29
Dunker Pond. Blazed oak on summit, ¼ mile S. W. of pond. (B.)	41	04	55.90	74	28	37.23
BEAR FORT. Copper bolt in ledge on summit, 1½ miles N.W. of West Milford. (B.)	41	08	23.55	74	23	11.70
Macopin. Blazed chestnut on summit, ¼ mile E. of pond outlet. (B.)	41	02	53.61	74	23	43.79
HIGH MOUNTAIN. Copper bolt in ledge on summit, 4 miles N. W. of Paterson. (B.)	40	58	11.52	74	11	35.58
Powder Mills. Machine shop chimney. (B.)	40	55	27.51	74	16	13.59
Greenwood Lake, N. Y. Bearfort Mountain, N. of State line. (B.)	41	11	38.07	74	20	02.88
Clarke's Spheroid. Difference			*+02.6*			*+19.8*
WEASEL. (Same as Weasel above)	40	52	36.81	74	11	12.21
SALEM COUNTY.						
Oldman's Point (?) (1843)	39	45	37.24	75	27	21.92
Penn's Grove (?) (1843)	39	43	59.74	75	28	19.10
Church Landing Point (?) (1843)	39	39	36 75	75	31	00.37
Allen. Buried cone, on hill 1½ miles S. W. of Auburn. (1843)	39	41	14.14	75	22	28.26
Scull (2). Buried cone, 2 miles N. from Sharpstown (?)	39	40	56.57	75	20	32.89
Ellet. Buried cone, 2½ miles from Sharpstown, on land of Widow Ellet. (1843)	39	38	19.55	75	23	37.05
Reeves (?) (1843)	39	39	03.38	75	22	46.20
Acton. Buried cone, 2 miles E. of Sharpstown, on land of Widow Acton (?) (1843)	39	38	08.61	75	22	45.32

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
SALEM COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Big Mannington Hill. Buried cone, 3 miles S. W. of Woodstown (1843)	39	36	54.09	75	21	21.79
Kinsey (?) (1843)	39	38	03.11	75	33	02.74
Finn's Point. Bank of Delaware (?) (1841)	39	35	58.11	75	32	45.92
Penn's Neck (?) (1843)	39	35	38.05	75	32	16.88
Fort Delaware, Del. (1839)	39	35	18.79	75	33	49.20
Salem spire, Episcopal Church. (1841)	39	34	25.42	75	27	37.98
Elsinborough Point. In old Swedish fort. (1841) (?)	39	32	21.74	75	31	44.41
Alloway's Point. Buried cone, 147 yards N. of mouth of Alloway's Creek (?) (1840).	39	30	04.77	75	31	30.83
BURDEN. 2½ miles S. E. from Quinton, and 300 yards W. of the cross-roads (?) (1840)	39	31	45.74	75	22	33.40
Stony Point (?) (1840)	39	27	29.89	75	30	49.85
Round Island (?) (1840). (See below)	39	25	18.79	75	27	13.74
Arnold (?) (1840)	39	23	14.78	75	25	40.49
Wilmington Light-house. (1841)	39	43	15.25	75	30	55.69
Wilmington Town Hall, Del. (1841)	39	44	26.56	75	32	42.43
Delaware City. Presbyterian Church spire, Del. (1841)	39	34	38.14	75	35	17.59
New Castle. Episcopal Church spire, Del. (1841)	39	39	35.71	75	33	27.34
Clarke's Spheroid. Difference			*+03.2*			*+19.4*
Finn's Point (2). Bank of Delaware (1875)	39	36	00.15	75	33	02.57
Finn's Point. Bank of Delaware (?) (1841)	39	36	01.32	75	33	05.22
Salem Presbyterian Church spire	39	34	24.10	75	27	59.28
Salem Episcopal Church spire. (See above)	39	34	28.58	75	27	57.30
Elsinborough. (See Elsinborough above) (1841)	39	32	24.91	75	32	03.76
Elsinborough (2) (1875). Pine stub, near old Elsinborough (?)	39	32	26.33	75	32	03.54
Elsinborough (3) (1881). 90 yards N. of last point	39	32	27.48	75	32	03.46
Alloway. (See Alloway above)	39	30	07.97	75	31	50.20
Alloway (2). Pine stub, 174 yards above mouth of Alloway's Creek	39	30	08.53	75	31	48.25
Alloway (3)	39	30	15.97	75	31	48.92
BURDEN. (See Burden above)	39	31	48.93	75	22	52.85
Stony (?)	39	27	33.11	75	31	09.25
Stony (2) (?)	39	27	47.42	75	31	12.55
Stony (3). Drain-pipe planted 5 feet from high-water mark. Stony Point. (1882)	39	28	01.83	75	31	16.12
Round Island. Buried cone in marsh. (1840) (?)	39	25	22.02	75	27	33.17
Round Island (2)	39	25	27.04	75	27	36.01
Sneed (?) (1882)	39	27	32.96	75	31	01.94
Cove (?) (1882)	39	26	13.73	75	28	18.14
Pot. Drain-pipe 20 feet back from high-water mark. (1882)	39	29	06.11	75	31	27.73

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
SALEM COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Arnold. Arnold's Point (?) (1840)	39	23	18.03	75	25	59.93
Arnold (2)	39	23	17.37	75	25	55.00
Arnold (3). Arnold's Point. Drain-tile planted in marsh 80 yards back from shore-line. (1881)	39	23	18.65	75	25	54.34
Round. Drain-tile planted in marsh. (1882)	39	25	36.85	75	27	39.52
Fort Delaware (2), Del. (1875)	39	35	20.30	75	34	04.05
Stow (?) (1882)	39	22	50.27	75	24	51.89
New (?) (1882)	39	24	09.65	75	26	35.13
Fort Delaware, Del. (See above)	39	35	22.04	75	34	08.60
Reedy Island Light-house (1881)	39	30	03.37	75	34	08.76
Delaware City Presbyterian Church spire, Del. (1840)	39	34	41.37	75	35	37.30
SOMERSET COUNTY.						
Bound Brook. Pile of stones on brow of First Mountain. (a. 1851)	40	34	56.66	74	31	37.57
Mine Mount. Bar of iron projecting 3 inches on summit, 2 miles W. of Bernardsville. (B.)	40	43	16.35	74	36	00.58
North Branch (?) (B.)	40	35	52.65	74	40	33.58
MT. HOREB. Copper bolt in ledge on summit, ½ mile S. W. of church. (B.)	40	36	39.37	74	33	56.57
Raritan. Woolen mill chimney. (B.)	40	33	52.02	74	37	37.32
Somerville. First Ref. Church spire. (B.)	40	34	03.78	74	36	21.72
Middlebush. Church spire. (B.)	40	29	47.17	74	31	23.11
East Millstone. Ref. Church cupola. (B.)	40	30	07.44	74	34	27.65
Clarke's Spheroid. Difference			*+02.7*			*+19.7*
SUSSEX COUNTY.						
HIGH POINT. Copper bolt in ledge on summit of Blue Mountain, 1¼ miles from New York line. (B.)	41	19	12.74	74	39	23.38
Centerville. On hill, ¾ mile W. of village. (B.)	41	12	51.57	74	50	09.99
CULVER'S GAP. Copper bolt, first summit, S. W. of gap. (B.)	41	10	18.49	74	47	22.43
Deckertown. Presb. Church spire. (B.)	41	12	36.60	74	36	03.87
Decker Pond. Blazed spruce on hill, E. side of pond. (B.)	41	12	11.84	74	31	42.65
Glenwood. Blazed spruce on hill, 1 mile N. W. of village. (B.)	41	15	24.81	74	29	57.91
Hamburgh. Church spire (B.)	41	09	06.48	74	34	13.69
Beaver Run. Blazed hickory on hill, 1½ miles W. of village. (B.)	41	09	18.50	74	38	27.17

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
SUSSEX COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
East and West Jersey Line (on Blue Mountain). (B.)	41	08	44.15	74	50	40.08
Smith's Hill. Blazed chestnut on summit, 1½ miles N. of Newton. (B.)	41	04	55.05	74	44	30.17
Lafayette. A summit, 2 miles N. of village. (B.)	41	07	51.01	74	41	07.16
HAMBURGH. Copper bolt in ledge on summit, 2½ miles E. of village. (B.)	41	08	50.85	74	31	30.18
Franklin Furnace. Stack. (B.)	41	06	29.72	74	35	01.74
Catfish Pond. Summit, E. of pond. (B.)	41	01	54.92	74	59	30.59
Newton. Presbyterian Church spire. (B.)	41	03	24.80	74	44	59.00
Woodport. Cross on boulder on summit, ½ mile W. of Dodge mine. (B.)	41	00	37.55	74	35	10.36
Sparta. Cross on rock on summit, 1½ miles S. of Sparta. (B.)	41	00	55.96	74	37	56.04
Clarke's Spheroid. Difference			*+02.5*			*+19.6*
UNION COUNTY.						
SPRINGFIELD. Pile of stones just E. of old fence line, Roll's Hill, 2 miles S. of summit. (1817)	40	41	19.44	74	21	05.44
Sayre. Hill, 2 miles N. E. of Cranford (?) (a. 1851)	40	40	43.56	74	16	57.58
Elizabethtown. Spire of First Presbyterian Church. (a. 1851)	40	39	42.84	74	12	36.97
Randolph. On drift hill, E. of Plainfield (?) (a. 1851)	40	36	41.81	74	23	20.32
Rahway. Spire of First Presbyterian Church. (a. 1851)	40	36	51.04	74	16	32.11
Wynant. (a. 1859)	40	32	55.28	74	13	58.89
Bird (?) (a. 1851)	40	39	03.13	74	10	08.69
Elizabethport. Presbyterian Church, white spire. (a. 1859)	40	38	49.75	74	11	08.24
Clarke's Spheroid. Difference			*+02.7*			*+19.7*
SPRINGFIELD. Roll's Hill, as above. (1817)	40	41	22.15	74	21	25.19
Sayre. (a. 1851)	40	40	46.27	74	17	17.35
Elizabethtown. Presb. Church, same as above. (1885)	40	39	45.55	74	12	56.77
Oil Cloth Co.'s chimney. Southern part of Elizabethport. (1885)	40	38	45.96	74	11	45.84
Staten Chemical Co.'s chimney. Near Bay Way, west bank of Arthur Kill. (1885)	40	37	55.90	74	12	15.47
Standard Chemical chimney. West bank of Arthur Kill. (1885)	40	36	54.00	74	12	21.73
Wynant (2). Hickory stub and buried bottle, Wynant's land, near Tremley R. R. station. (1885)	40	36	27.11	74	13	11.48

Table of Geographical Positions.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
WARREN COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Delaware Water Gap. Brow of Mount Tammany. (B.)	40	58	05.12	75	06	23.27
Danville. Blazed white-oak on summit, 1 mile W. of village. (B.)	40	52	09.43	74	55	53.36
Hackettstown. Blazed rock-oak on summit, 2 miles W. of town. (B.)	40	51	05.48	74	51	59.91
MONTANA. Stone monument, ½ mile S. E. of village. (B.)	40	45	50.08	75	03	17.38
Clarke's Spheroid. Difference			+*02.6*			+*19.5*

Geographical Positions Determined by the State Survey.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
ATLANTIC COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Elwood. Spire	39	34	40.3	74	42	55.6
Weymouth. Stack	39	30	23.5	74	46	36.0
Richland. On hill, 1 mile S. E. of village	39	29	19.0	74	51	12.6
New Germany. Spire	39	36	26.3	74	50	49.2
Doughty's. Flag north of tavern	39	26	54.0	74	51	46.6
Buena Vista. Flag opposite R. R. station	39	30	50.6	74	55	29.7
Russia. Flag	39	22	46.2	74	48	32.9
Estellville	39	22	21.4	74	45	44.1
Miry Run	39	23	26.5	74	41	35.6
English Creek	39	22	18.3	74	39	18.3
BERGEN COUNTY.						
To reduce to Clarke's Spheroid add			*02.6*			*19.8*
Darlington. E. edge of Ramapo Mountain	41	04	40.1	74	12	13.0
Ramsey's. Church tower	41	03	31.0	74	08	12.4
Wykoff. Church spire	41	00	25.1	74	10	06.2
Paramus. Church spire	40	59	04.5	74	05	13.6
Midland Park. Church tower	40	59	24.2	74	08	11.8
Schraalenburg. Church spire	40	56	22.5	73	59	20.7
BURLINGTON COUNTY.						
Bordentown. Baptist Church spire	40	08	48.7	74	42	50.1
Bordentown. Presbyterian Church spire	40	08	36.5	74	42	37.1

Geog. Positions Determined by the State Survey.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
BURLINGTON COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Crosswicks. Spire	40	09	16.3	74	39	02.1
Florence. Foundry chimney	40	07	31.1	74	49	05.6
Burlington. St. Mary's spire	40	04	37.8	74	51	43.6
Bishop's barn. E. of Columbus	40	03	47.4	74	41	38.0
Columbus. West spire	40	04	25.0	74	43	31.4
Taylor's Mount, S. of Cookstown	40	02	03.6	74	33	01.9
Lewistown. Wind-mill	39	59	26.9	74	37	11.7
Smithville. Mill tower	39	59	10.7	74	44	54.7
Brown's Mills. (Observatory)	39	58	09.5	74	34	53.3
Mt. Laurel. (Summit)	39	56	03.5	74	53	39.3
Marlton Church tower	39	53	26.3	74	55	10.7
Medford	39	54	55.3	74	51	13.5
Retreat. Hill, 1½ miles S. E. of school-house	39	53	52.2	74	41	47.7
Huckleberry Hill. 1¾ miles N. W. of Tabernacle	39	51	24.5	74	44	15.7
Four Mile. At cross-roads	39	53	08.7	74	34	11.6
Taunton. Hinchman's store cupola	39	51	12.1	74	51	21.4
Jemima Mount. 2½ miles E. of Quaker Bridge	39	43	43.0	74	27	04.1
CAMDEN COUNTY.						
Haddonfield. White spire	39	53	59.3	75	01	45.7
Atco. Richards' house cupola	39	46	17.7	74	53	08.2
Atsion. Mill tower	39	44	21.5	74	43	30.6
Waterford. Spire	39	43	23.9	74	51	09.4
Merchantville. East spire	39	57	00.6	75	02	57.0
CAPE MAY COUNTY.						
Tuckahoe. Spire	39	17	32.4	74	45	17.6
CUMBERLAND COUNTY.						
Vineland. Church spire	39	29	10.2	75	01	16.1
Bridgeton. Chas. R. Elmer's house cupola	39	25	37.2	75	12	50.5
Bridgeton. Baptist Church spire	39	25	43.2	75	13	58.1
Deerfield	39	32	32.2	75	13	24.2
Dividing Creek	39	18	33.7	75	05	15.1
Fairton	39	22	13.9	75	09	09.6
Woodruff	39	24	49.1	75	08	46.9
Millville. Stand-pipe	39	24	15.1	75	02	52.7
Kellogg	39	26	00.5	74	59	09.8
Pine Mount	39	25	06.4	75	20	11.5
Dutch Neck	39	23	24.1	75	15	13.0
Mulford's Landing	39	22	21.1	75	19	26.0
Muskee Hill	39	18	42.2	74	57	08.2

Geog. Positions Determined by the State Survey.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
ESSEX COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
To reduce to Clarke's Spheroid add			*02.6*			*19.8*
Fairfield. Church spire	40	53	01.8	74	16	38.2
Caldwell. Flag	40	50	21.5	74	15	04.9
GLOUCESTER COUNTY.						
Stringtown (Lincoln)	39	40	13.3	75	14	18.8
Glassboro. White spire	39	42	00.7	75	06	46.7
Clayton. Spire	39	39	26.3	75	05	29.4
Iona. Tall pine in swamp, S. W. of R. R. station	39	36	10.2	75	04	38.2
Williamstown. Spire	39	40	54.6	74	59	23.2
Piny Hollow	39	35	09.9	74	55	39.7
Forest Grove. Church spire	39	31	45.8	74	59	21.8
Newfield. On hill, 1¼ miles S. E. of village	39	32	13.8	75	00	16.1
HUNTERDON COUNTY.						
To reduce to Clarke's Spheroid add			*02.7*			*19.6*
Pottersville	40	42	22.1	74	43	46.5
Readington. Church spire	40	34	02.5	74	43	49.6
Cherryville. Spire	40	33	42.0	74	53	55.9
Quakertown. Spire	40	33	50.2	74	56	11.9
Cushetunk	40	37	22.1	74	48	07.3
Mechanicsville. Church spire	40	37	08.5	74	44	40.8
Cornhill	40	22	21.08	74	54	23.1
Rosemont. Spire	40	25	36.7	74	59	06.8
MERCER COUNTY.						
Princeton water-tower	40	20	23.5	74	40	03.5
Princeton College cupola	40	20	55.0	74	39	35.1
Lawrenceville stand-pipe	40	17	31.9	74	44	10.9
Ewing Church spire	40	16	14.4	74	48	02.5
East Trenton. Rubber Works chimney	40	14	23.0	74	43	39.0
Trenton. State and Clinton street spire	40	13	16.8	74	45	21.3
Trenton. State House dome	40	13	13.8	74	46	13.1
Trenton. State Street Meth. Church spire	40	13	13.5	74	45	36.7
Trenton. Roman Catholic Church, Broad and Center streets	40	12	51.5	74	45	40.6
Trenton. Bapt. Church, Center and Bridge streets	40	12	41.4	74	45	36.4
Hamilton Square Baptist Church	40	13	46.1	74	39	37.3
Dutch Neck spire	40	16	57.5	74	36	50.3
Windsor spire	40	14	34.5	74	34	57.7

Geog. Positions Determined by the State Survey.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
MIDDLESEX COUNTY.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Menlo Park. Tall iron stack	40	33	49.0	74	20	22.5
Van Keuren's house. 1 mile S. W. of Newtown	40	32	16.4	74	28	06.2
Metuchen. Presbyterian Church spire	40	32	25.7	74	21	34.5
Rutgers College cupola, New Brunswick	40	29	55.4	74	26	47.7
St. James' spire. New Brunswick	40	29	38.0	74	26	53.9
Stelton. Church spire	40	31	01.5	74	24	26.0
Kreicher's chimney, Staten Island	40	31	57.1	74	14	28.8
Tottenville. Cupola, Staten Island.	40	30	30.9	74	14	37.9
State Reform School tower	40	20	35.6	74	23	55.6
Dayton. Church spire	40	22	32.8	74	30	43.7
Cranbury. First Presb. Church spire	40	18	26.4	74	31	08.3
Cranbury. Second Presb. Church spire	40	18	50.4	74	30	51.6
MONMOUTH COUNTY.						
Freehold. Court-house spire	40	15	37.3	74	16	29.6
Freehold. Reformed Church spire	40	15	28.0	74	16	42.4
Key East Hotel, flag-staff	40	11	29.6	74	00	37.8
Colorado House. Ocean Beach	40	10	23.8	74	00	57.5
Beach House, Sea Girt, N. flag-staff	40	07	34.8	74	01	49.9
Disbrow Hill	40	14	48.0	74	27	26.1
Allentown. Reformed Church spire	40	10	27.1	74	35	14.6
MORRIS COUNTY.						
To reduce to Clarke's Spheroid add			*02.6*			*19.7*
Seward's Hill. Chester cross-roads	40	47	10.2	74	40	15.5
Parsippany. Church spire	40	51	50.1	74	24	04.5
OCEAN COUNTY.						
Sea Side Park. Flag-staff at post-office	39	55	15.5	74	04	44.0
Whitings. Hotel flag-staff	39	57	13.1	74	22	46.5
Buckingham, ¼ mile N. of Philadelphia and Long Branch R. R., and just W. of Ocean County line	39	55	57.9	74	28	30.8
PASSAIC COUNTY.						
To reduce to Clarke's Spheroid add			*02.6*			*19.8*
Wayne. Powder Mills chimney	40	55	27.5	74	16	13.7
SALEM COUNTY.						
Eldridge's Hill, 225 yards S. W. of Hayne's house, at Point Airy	39	39	45.3	75	18	24.3
Daretown. Church spire	39	36	05.2	75	15	37.0
Mt. Pleasant. On hill, S. side of East Lake, S. E. of Woodstown	39	38	22.8	75	18	32.0

Geog. Positions Determined by the State Survey.—Continued.

NAME OF STATION.	LATITUDE.			LONGITUDE.		
SALEM COUNTY.—Continued.	Deg.	Min.	Sec.	Deg.	Min.	Sec.
Centerton	39	31	45.3	75	07	44.4
Elmer.	39	34	57.5	75	11	12.7
Jericho	39	29	19.8	75	21	50.2
New Boston	39	31	17.9	75	17	10.2
SOMERSET COUNTY.						
To reduce to Clarke's Spheroid add			*02.7*			*19.5*
Lamington. Church spire.	40	39	35.5	74	42	52.7
Pluckamin. Church spire.	40	38	49.9	74	38	13.0
Bedminster. Church cupola	40	40	12.0	74	38	23.5
North Branch. Reformed Church spire	40	35	53.9	74	40	02.7
SUSSEX COUNTY.						
To reduce to Clarke's Spheroid add			*02.5*			*19.6*
Lemon's house. W. of Swartswood.	41	04	50.1	74	51	22.8
Hardwick. Church cupola	40	59	41.6	74	51	19.4
Tranquility. Church spire	40	56	36.2	74	47	54.4
Andover, ¼ mile W. of village	40	59	07.3	74	44	29.8
Milford flag, Pa. Hill just N. E. of village	41	19	42.2	74	47	16.6
(All Stations below are on Clarke's Spheroid.)						
UNION COUNTY.						
Westfield. Presbyterian Church spire	40	39	14.1	74	20	52.7
Cranford. Presbyterian Church spire	40	39	28.1	74	18	11.6
Roselle. Flag-staff	40	39	37.0	74	15	50.4
Elizabeth. First Presbyterian Church spire	40	39	45.6	74	12	56.8
Elizabeth. St. Mary's Church spire	40	39	29.9	74	13	07.8
Washington Rock (North rock)	40	36	45.7	74	28	20.9
Netherwood. Hotel	40	37	33.7	74	24	00.4
Dunellen. Spire	40	35	39.9	74	27	50.2
New Dover. Spire	40	35	07.2	74	20	26.4
Rahway. First Presbyterian Church spire	40	36	53.8	74	16	51.8
Rahway. Second Presb. Church spire	40	36	31.8	74	16	34.1
Linden. Reformed Church spire.	40	38	02.6	74	15	32.2
Linden. Episcopal Church spire	40	37	39.7	74	15	07.0
Bay Way. Staten Chemical Co.'s chimney	40	37	56.0	74	12	15.3
WARREN COUNTY.						
To reduce to Clarke's Spheroid add			*02.6*			*19.5*
Hope. Church spire	40	54	29.3	74	57	52.2
Warrenville. 1 mile S. W. of village.	40	53	50.4	74	50	02.1
Jenny Jump Mountain	40	51	59.6	74	59	01.3
Belvidere. Presbyterian Church spire	40	49	34.0	75	04	23.4
Mt. No More	40	48	01.2	75	01	16.9
White Hall. ¾ mile S. W. of cross-roads	40	42	26.8	74	53	41.1
Easton. Court-house spire	40	41	15.4	75	12	44.2
Washington. Old chimney, bank of canal	40	45	53.0	74	58	57.7
Pohatcong Mountain	40	42	25.8	75	02	45.7

PHYSICAL DESCRIPTION OF NEW JERSEY.

BY C. CLARKSON VERMEULE, C.E.

GEOGRAPHICAL POSITION.

The northernmost point of the State is Tri-States rock, at the forks of the Delaware and Navesink rivers, just south of Port Jervis, New York. It is in latitude 41 deg. 21 min. 22.6 sec., and longitude 74 deg. 41 min. 40.7 sec. The most easterly point is in the middle of the Hudson river nearly opposite Hastings, New York, and due east from the terminal monument of the State line on the west bank of the river. This point is in latitude 40 deg. 59 min. 50.1 sec., and longtitude 73 deg. 53 min. 39 sec. Cape May is the southernmost point of land, and lies in latitude 38 deg. 55 min. 40 sec., and longitude 74 deg. 56 min. 40 sec. In the middle of the Delaware river, just above Pea-patch island, and in latitude 39 deg. 37 min. 00 sec., and longitude 75 deg. 35 min. 00 sec., lies the most westerly point.

The extreme length of the State from Tri-States rock to Cape May is 166 miles, and its narrowest part is at a line drawn from Trenton to Great Beds light-house, in Raritan bay, which is 33½ miles long. The portion lying north of this line is nearly square, measuring about 55 miles from northwest to southeast, and 65 miles from the New York line southwest to the Delaware river. The Delaware forms the northwest and southwest boundaries of this square, the New York and New Jersey line between Tri-States rock and the Hudson the northeast side and the Hudson river, New York bay, Kill van Kull and Arthur Kill the southeast side. This line makes a natural dividing line between northern and southern New Jersey, and marks a decided change in topographic and other physical features. Southern New Jersey measures 36½ miles in width from Bordentown to the seashore, and gradually increases to 57 miles from opposite Chester, Pennsylvania, to Great Egg Harbor inlet. Its length from Raritan bay to Delaware bay is just about 100 miles. Excepting on the above-described line from Trenton to South Amboy, this portion of the State is surrounded by water.

BOUNDARIES.

New Jersey is bounded for a distance of 108 miles on the north and east by the State of New York; for 137 miles on the east by the Atlantic ocean; for 78 miles on the south and west by the State of Delaware, and for a distance of 164 miles on the west by the State of Pennsylvania. Her total frontier measures 487 miles, of which all but 48 miles is defined by natural boundaries—rivers, bays and the ocean.

This area was first constituted and named as a distinct colony or province in the year 1664, when it was sold by James, Duke of York (afterward King James II.) 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, and lying and being to the west of Long Island and Manhitas 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 Cæsarea, or New Jersey." *

This description led to long controversies as to the location of the northern boundary, for subsequent examination showed that there was no important fork of the river Delaware near latitude 41 deg. 40 min. 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 Popaxtun 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.

The commission appointed in 1767, to determine the northern

* Leaming & Spicer, p. 10.

boundary, decided that this description had been based on the map shown on next page, the errors of which account for the vagueness of the description. This map was published shortly before the above grant was made, and it may be noted that it bears a marked resemblance to one published by Van der Donck in his "Description of the New Netherlands as it now is," 1656. It is reproduced because of its interest as the map by which the boundaries of the State were first described, and also as showing what important difficulties may arise from erroneous maps. It will be noticed that its latitudes are about one-quarter of a degree too great at the northern boundary.

This grant clearly includes Staten Island. This, however, 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 Congress of the United States, in 1834.

Various commissions have been appointed since 1718 to fix different portions of the State boundaries, but the work is still incomplete. The work of these commissions is given in detail further on. For the benefit of those who have no need to follow out these details, the following brief descriptions of the State boundaries are given, as near as at present known.

TERRITORIAL BOUNDARIES.

Beginning at Tri-States rock, at the forks of the Delaware and Navesink rivers, the line between New York and New Jersey runs southeast, changing its course slightly at the end of each mile, so that at Greenwood lake it swerves southward 2,415 feet from a straight line, joining its two ends, so continuing to the terminal monument on the west bank of Hudson river opposite Hastings. The line is marked by a granite monument at each highway and railroad crossing, and also at the end of each mile as measured from the bank of the Hudson; thence the line runs east to the middle of Hudson river, and then down the middle of the said river and New York bay to a point midway between the headlands of Constable Hook, New Jersey, and Bay Ridge, Long Island; thence westerly along the middle of Kill van Kull (to the northward of Shooter's island*), and down the middle of Arthur Kill to a point at the mouth of said Arthur Kill. From here it follows a straight line to Great Beds light; thence on a straight line toward Waacake light until it inter-

* So accepted, but open to question.


Milliaria Germanica Communia
0 5 10 15
Wieskottine
Groot Esopus
Cleyne Esopus
Wappinges
Tams Kamir
Waranawankongs
Kaes Eylant
Narratschoen
Visscher Hoeck
Clinkers Bergh
COLONIE VAN DE HEER NEDER HORST
Tappaans
t'Schichte Wacki
Meochkonck
Mechakienkonck
Schoonrheyne Bosch
Haverstroo
Nieuw Amsterdam
Rivier achter Kol
Sanhicans
Lacus
Raritan
Zuydt Rivier
Verhulsten Eylant
Sauwan
Mageckqueshou
Matovancons
Port May of Godyns Bay
Roodenburghs hoeck
Atsayonck
Kemkoekes
Aquauachuques
Pruymenhoeck
Mispenpicke
Ermomex
t'Fort Nassau
Amacaronck
Burndegat
Eyerhaven
t'Fort Elsenburgh
Naraticons
Sewapois
Nieuw Port May
Swanendael
Caep May
Zuydt Rivier
C. Cornelius
Hoere Kill
42
41
40
39
NOVI BELGII
NOVÆQUE ANGLIÆ NEC NON
PARTIS
VIRGINIÆ TABULA

sects a line from United States Coast and Geodetic Survey station "Morgan 2" through Romer Stone beacon; and thence on the same line until it intersects a line drawn from Sandy Hook beacon to United States Coast and Geodetic Survey station "Oriental Hotel," on Coney Island; thence on a line at right angles to this last-mentioned line to the open ocean. Down the coast the boundary is a line three geographical miles from the coast line until we reach a line drawn through the middle of Delaware bay; thence up the middle of the bay and river* to the line between Pennsylvania and Delaware. The line between New Jersey and Pennsylvania follows thence up the middle of the Delaware, leaving the several islands of said river to the State nearest which they lie, to Tri-States rock, the place of beginning.

LIMITS OF JURISDICTION.

The above bounds limit the property rights of the State. In some cases they coincide with the jurisdictional limits, and in other cases they do not. The limits of jurisdiction follow the line from Tri-States rock to the Hudson river as described above; thence due east to the middle of said river, and following the middle of the river to a point opposite the mouth of Spuyten Duyvil creek; thence westward to low-water mark on the western shore of the Hudson. Jurisdiction is limited by low-water mark of the western shore from this point southward along the river and New York bay to Kill van Kull, and changes as the shore line is changed by improvements. Continuing, the limits follow the north shore of Kill van Kull and the west shore of Arthur Kill to the mouth of Woodbridge creek; thence crossing the Kill and following low-water mark of the Staten Island shore around to Prince's Bay light-house. From here they follow a line drawn from Prince's Bay light-house to the mouth of Matawan creek, until said line intersects the previously-described line of territorial limits drawn through the middle of Raritan bay; thence along said line to the ocean, and down the coast to a point midway between the Delaware capes. From here New Jersey claims jurisdiction to the middle of Delaware bay and river as far up as the line between Delaware and Pennsylvania. From this point northward to Tri-States rock the States of New Jersey and Pennsylvania

* This is New Jersey's claim. It has been disputed by the State of Delaware. See Revised Code of Delaware, 1874, chap. 1, sec. 2.

exercise joint jurisdiction over the waters of the Delaware river, offences being tried in that State which first apprehends the offender.

The right to regulate fisheries extends to the property limits so far as the question has been settled by inter-state compacts.

The above description embodies the best understanding which can be reached of the results of the various inter-state commissions. The territorial boundary through New York bay and across Newark bay from the head of Kill van Kull to the head of Arthur Kill has not yet been settled with proper definiteness; and, as before stated, no agreement has been reached with Delaware as to the boundary between that State and New Jersey. For the use of those wishing to pursue the subject further, the results of the various boundary agreements are outlined below.

NORTHERN BOUNDARY BETWEEN NEW JERSEY AND NEW YORK.

The following is on record in the office of the Secretary of State of New Jersey, Book F 2 of 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 nigh 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 re-marked the said tree, but do not remember what was the latitude that was marked thereon. They went afterwards to a house to the southward of a place called Verdrietige 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 an act passed in 1718, entitled "An act for running and ascertaining the division line betwixt this Province and the Province of New York." *

This act sets forth that disputes have "of late happened betwixt the proprietors and owners of land in this Province of New Jersey, and owners of land in the Province of New York, which lie near to or adjoining upon the division line," and enacts that there shall be two or more commissioners, with the Surveyor-General, appointed by the Governor of the Province, to join with commissioners appointed on behalf of the Province of New York to "run, survey, agree on, and ascertain the said line." The act was 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 Cochecton, on the east bank of the Dela-

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

ware, 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. 280, &c., and their map is in Book G 2 of Deeds.

Latitude 41 deg. on the Hudson's river was also determined, and the line joining the two points was traced through; but the report upon them was not confirmed by the State of New York.

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 remains 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 arise 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 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

*Laws of New Jersey, 1761, Allinson, chap. 396, p. 263.

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 anywise 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 to 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 Feb. 23d, 1764."

On the same date a law was passed supplementing the above by enacting that the estates of the above-named agents "and all others who are general proprietors of the Eastern Division of New Jersey 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." *

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

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

† C 2, Commissions, p. 331, &c., July 25th, 1768.

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 Russell, Judge of the Court of Vice Admiralty for the Province of Massachusetts; William Allen, Chief Justice of Pennsylvania; Samuel Holland and William De Brahm, 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 Berkeley 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 of 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 Mahackamack, 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

*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.

degrees twenty-one minutes and thirty-seven seconds to Hudson's River at the said Rock, in the Latitude of forty-one degrees as above described.

(Signed) "CHAS. 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.

"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 Parties, 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 Island.

"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 Mahackamack 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 Proprietors' 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 Rutherfurd 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 Rutherfurd 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 Rutherfurd 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 the 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, 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

* Book C 3, Commissions, p. 11.

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; * * *

[Here follows a list of said tracts of land.]

"'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; * * *

[Here follows a list of these tracts of land.]

"'And Whereas it is conceived 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 Rutherfurd, 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 Cæsarea 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 Rutherfurd, 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 Mahackamack 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 Rutherfurd 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 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*. 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.

"Sealed and signed in presence of
"ROBERT HALL,
"CHARLES WICKHAM CROOKE,
"JOHN STEVENS, Jr.,
"WM. S. LIVINGSTON.

(*Signed*) W. WICKHAM,
SAMUEL GALE,
JOHN STEVENS,
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 Machackamack 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 Thirty-eight Chains. In witness whereof we have hereunto set our hands and seals the twenty-sixth day of November, in the year of Our Lord one thousand seven hundred and seventy-four.

"JAMES CLINTON,
"ANTHONY DENNIS.

"Sealed and Delivered in the presence of
"BARENT MARTLINGS,
"JACOB GARRABRANTS."

"Be it remembered that on the nineteenth day of September, in the year of Our Lord One thousand seven hundred and eighty-five, appeared before me Azariah Dunham one of the Judges of the Court of Common Pleas in the County of Middlesex, John Stevens one of the subscribing witnesses to the within instrument who being sworn upon the Holy Evangelist saith he saw the within mentioned William Wickham, Samuel Gale, John Stevens and Walter Rutherfurd seal and deliver the within instrument as their voluntary act and deed for the uses therein mentioned.

"Taken and acknowledged before me AZARIAH DUNHAM. } JOHN STEVENS, JR.

"Examined and agrees with the original,
"JAMES PARKER."

The work of this commission has been given here in detail, because the results reached by it have been recently confirmed by a new commission, by the Legislatures of both States concerned and by the Congress of the United States. It had been found, however, during the progress of the Geological Survey, that the line, as run in 1774, was not a straight line, but an irregular curved line, and as several of the monuments had been destroyed or lost, the Board of Managers authorized the State Geologist to survey the line. This survey was made during 1874, by Prof. E. A. Bowser, and the report made on the work in that year embodies also the history of the disputes and work of the commissions on the line from the beginning.* This survey showed that the line at Greenwood lake was 2,415 feet south of a straight line, and that the former surveyors had followed a magnetic rhomb line as nearly as the large amounts of local attraction met with would allow them to run.

As a result of this examination, the following act was passed:

* Report on a Survey of the Boundary Line between New Jersey and New York, made in July and August, 1874. Geo. H. Cook, State Geologist.

"An Act appointing commissioners to locate the northern boundary line between the states of New York and New Jersey, and to replace or erect monuments therein.*

"Approved April 13, 1876.

"WHEREAS, The state of New York passed an act, May twenty-sixth, eighteen hundred and seventy-five, authorizing the regents of the university of the state of New York, in connection with the authorities of Pennsylvania and New Jersey, respectively, to replace any monuments which have become dilapidated or been removed on the boundary lines of those states, and it being suggested that there is uncertainty about the true location of the boundary line between the states of New York and New Jersey, as defined in the act entitled 'An act 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,' passed the twenty-sixth day of September, seventeen hundred and seventy-two, and confirmed by the king in council, the first day of September, seventeen hundred and seventy-three; now, therefore,

"SEC. 1. That the governor of this state be and he is hereby authorized to appoint three commissioners, with power on the part of this state to meet any authorities of the state of New York who may be duly authorized, and with them to negotiate and agree upon the true location of said boundary line between the states of New York and New Jersey as defined in said act of September twenty-sixth, seventeen hundred and seventy-two, and also to replace any monuments which may have become dilapidated or been removed on said boundary line, or to erect new ones; which agreement shall be in writing, and signed and sealed by the authorities of the state of New York and the commissioners of this state, but shall not take effect unless confirmed by the respective legislatures of the states of New York and New Jersey.

"SEC. 2. That the governor is hereby authorized to fill any vacancies in said commission occasioned by death, resignation or otherwise.

"SEC. 3. That the expenses of said commissioners shall be paid by the treasurer on the warrant of the comptroller, after being first approved by the governor."

"A Supplement to an act entitled 'An act appointing commissioners to locate the northern boundary line between the states of New York and New Jersey, and to replace or erect monuments therein,' approved April thirteenth, one thousand eight hundred and seventy-six.†

"Approved March 25, 1881.

"1. That the commissioners appointed under said act to which this is a supplement, shall, in addition to the authority conferred by said

* Revision of 1878, p. 1180.

† Supplement to Revision, 1877 to 1886, p. 1023.

act, have authority, in their discretion, to proceed to ascertain and agree upon the location of the northern boundary line between the states of New York and New Jersey, as originally established and marked with monuments; and in case any monuments are found dilapidated or removed from their original location, said commissioners are authorized to renew or replace them, in a durable manner, in their original positions, and to erect such additional monuments at such places on said line as they may deem necessary for the proper designation of the boundary line of said state.

"2. That any agreement made by the said commissioners shall be in writing, and signed and sealed by the authorities of the state of New York and the commissioners of this state, but shall not take effect unless confirmed by the respective legislatures of the states of New York and New Jersey."

Under this act, Abraham Browning, Thomas N. McCarter and George H. Cook were appointed by the Governor, Commissioners on the part of New Jersey.

The following extracts are from the Report of the New Jersey Commissioners concerning the northern boundary line between the States of New York and New Jersey, made to the Governor in 1883:

"The Joint Commission met at Piermont, on the 20th of July, 1881. At this meeting there were present, Abraham Browning, Thomas N. McCarter and Geo. H. Cook, Commissioners for the State of New Jersey, and Henry R. Pierson and Elias W. Leavenworth, Commissioners for the State of New York, together with David Murray, Secretary of the Board of the New York State University; Chauncey M. Depew, the third Commissioner from the State of New York was not present.

"The members organized as a Joint Commission, by the appointment of Abraham Browning, President, and David Murray, Secretary. After a review of the data in hand, to guide them in the discharge of their duties, it was concluded by all that the principles enunciated in the decisions of the United States Supreme Court, in cases like this, should guide here. And that the boundary line in question between the two States, though not perfectly straight, as ordered in the description made by the Commission of 1769, is the line which was run by the Commissioners and their surveyors in 1774, and most of the monuments set by them to mark it are still in their places; and that this line, so long established and recognized, must still be accepted as the true one. And in accordance with this conclusion the duties of the Commission are limited to the restoration of monuments lost, to a careful adjustment of all the monuments, to an accurate measurement of the line, and fuller description and references for all its permanent marks.

"It was also resolved that Edward A. Bowser, surveyor, who made a reconnoissance of the line in 1874, for the State Geologist of New Jersey, be in charge of said work, in concurrence with a surveyor to be appointed by the New York Commission; and that these surveyors should at once proceed to examine the line, and ascertain the number and character of the monuments required, and report the same, with such recommendations as they may deem proper, to the Joint Commission for further action. The meeting then adjourned.

"The New York Commission appointed H. W. Clarke as their surveyor. And Prof. Bowser and Major Clarke, according to their instructions, examined the line and reported their conclusions and recommendations to the Commissioners at their next meeting, which was held at the St. Nicholas Hotel, in New York City, November 30th, 1881.

"At this meeting were present Gen. Leavenworth, Mr. Depew and Prof. Murray, on the part of New York, and Mr. Browning, Mr. McCarter and Prof. Cook, on the part of New Jersey. The report of the surveyors was received and discussed, and instructions prepared for their guidance in surveying the line and setting its monuments."

They were instructed to determine as nearly as practicable the location of the old boundary monuments and reset them. Also to establish a new monument at the east side of, and contiguous to the old monument, and in line therewith. Where one or more of the old monuments could not be found, they were to run straight between the nearest adjacent mile points whose locations were known, and establish the new monuments on this straight line. The mile monuments were to be of granite, four feet long, the top dressed six inches square for a distance of six inches down, with the letters "N. Y." on one side and on the opposite side "N. J.;" upon a third side a number corresponding to the number of the original mile-stone. At the crossing of each highway and railroad were to be set granite monuments four and one-half feet in length, and six by twelve inches in cross-section. The mile monuments were to project six, the road monuments twelve inches above the surface when set. Special terminal monuments were to be established at or near the ends of the line.

"The survey of the line was begun on the 6th of April, 1882, and completed on the 14th of June following; and the resetting of the old monuments, and the setting of new and additional ones was begun on the 24th of June and completed on the 11th of August.

"The old mile-stones were made of the stone found in the country; they were about 4 feet long, from 15 to 18 inches wide, and from 5 to 7 inches thick; about 18 inches of their length was under the surface,

leaving them standing about 2½ feet high; and their breadth was in the direction of the line. The words 'New York' were cut on the north side of each stone, and 'New Jersey' on the south side; and the number of miles from the east end of the boundary was also cut on them.

"Of the 48 original mile-stones, all except 6 were found; these were the 26th, 31st, 34th, 36th, 41st and 47th. The 26th falls in Greenwood lake, and no attempt was made to set one there. The other missing stones were replaced according to the instructions, except the 36th, which was reset according to the very plainly marked property lines.

"In the rough country over which the line runs, the original measurements for the miles could not be very accurate. The following tabular statement gives the length in feet of the spaces between the old mile-stones:

MILE-STONES.

Mile-stone.	Distance west from preceding mile-stone, in feet.	Location. (The figures are for feet.)
I.	5,628.2	971′ east of Rockland road, on west slope of Palisade mountain.
II.	5,296.9	1,501′ east of Northern railroad, in Tappan timber swamp.
III.	5,304.6	584′ east of summit of Andre hill, Tappan.
IV.	5,241.1	On slight elevation, 2,419′ east of Neuvy and Orangeburg road.
V.	5,261.3	In woods, 50 paces west of clearing, 2,842′ west of above road.
VI.	5,225.2	On east slope of hill, 927′ west of road, and 2,800′ west of Hackensack R.
VII.	5,241 1	Just east of summit of ridge, 1,640′ east of New Jersey and New York railroad.
VIII.	5,251.1	250 paces west of Pascack creek, 120 paces east of road.
IX.	5,284.2	North of Upper Montvale church, 109′ west of road to Monsey.
X.	5,286.7	North of Chestnut Ridge church, 318′ west of road to Monsey.
XI.	5,267.6	About 100 yards west of Saddle river, 1,217′ west of Saddle River road.
XII.	5,269.8	At west foot of hill, 1,186′ west of road from Saddle River to Sufferns.
XIII.	5,298.	West slope of hill, 673′ east of road from Ramsey's to Tallman's.
XIV.	5,298.2	About 400 yards west of summit of high ridge, 1 mile east of Sufferns.
XV.	5,280.	441′ west of Erie railroad, and about 3,000′ southeast of Sufferns station.
XVI.	5,363.	200 yards due south of a rocky knob of Ramapo mountain, 1 mile northwest of Sufferns.
XVII.	5,141.6	Southeast edge of small clearing, about three-eighths mile southwest of Log chapel.
XVIII.	5,301.2	Half-way down west slope of Ramapo mountain, in open field.
XIX.	5,137.9	Near top of ridge and 60 paces east of road, between Negro and Sheppard ponds.

Mile-stone.	Distance west from preceding mile-stone, in feet.	Location. (The figures are for feet.)
XX.	5,227.4	In wet meadow, 2,000 *feet northwest of Sheppard's pond*, 80 paces west of woods.
XXI.	5,202.9	100 paces east of road from Ringwood to Snyder mine, west slope.
XXII.	5,258.5	About 300 yards southeast of *summit, on southeast slope of* Black Rock mountain.
XXIII.	4,585.9*	In swamp at east foot of Beech mountain, 1,000′ N. 20° E. from Morris' house.
XXIV.	5,197.3	West side of wood road, half-way down west slope of Beech mountain.
XXV.	5,247.4	About 100 yards west of wood road, in depression in ridge east of Greenwood lake.
XXVI.	5,282.2	On east edge of a point of land on west shore of Greenwood lake.
XXVII.	5,047.5	On Bearfort mountain, 300 yards west of highest ridge.
XXVIII.	5,161.1	On east slope of steep hill, 1,295′ east of a by-road to Warwick.
XXIX.	5,232.8	Half-way down west slope of hill, 1,813′ east of Warwick turnpike.
XXX.	5,325.7	On top of mountain, 1,020′ east of road from Green mine.
XXXI.	5,280.	On west slope of mountain, 1,000′ northerly from Layton mine.
XXXII.	5,317.	West of Vernon and N. Milford road, 75 paces northwest of Welling's main barn.
XXXIII.	5,356.	740′ west of road from Vernon to Edenville, property of A. Ely.
XXXIV.	5,280.	In swampy field, on land of Mr. Layton, east of Pochuck meadow.
XXXV.	5,351.	On Pochuck meadow, 700′ east of road from Glenwood to Pine island.
XXXVI.	5,280.	East slope of Pochuck mountain, 40 paces southwest of Daniel Bailey's house.
XXXVII.	5,147.6	In ravine, between two peaks of Pochuck, north edge of a swamp.
XXXVIII.	5,247.5	On Drowned Lands, 1,596′ west of Liberty Corner road.
XXXIX.	5,278.7	50 paces from the foot of the first ridge west of the Wallkill.
XL.	5,229.9	200 paces southeast of Kimber's mill, 500 paces east of New York, Susquehanna and Western railroad.
XLI.	5,280.	200 paces southwest of Aliakim Everitt's barn, Unionville.
XLII.	5,262.	1 yard west of a white oak between Benjamin and Goldsmith, Unionville.
XLIII.	5,270.	In Jos. L. Clark's line fence, 1,014′ east of road.
XLIV.	5,304.7	In swampy meadow, 1,619′ west of road running north from Mount Salem.
XLV.	5,301.7	Southwest corner of woods, 34 paces northeast of Widow Taylor's house.
XLVI.	5,233.4	200 paces west of east summit of Blue mountain.
XLVII.	5,280.	West edge of wood road, on west slope of Blue mountain.
XLVIII.	5,139.7	Top of "Hog Back," 300 paces east of road to Port Jervis.
Tri-States rock.	2,512.9	In fork of the Delaware and Navesink.

* This is evidently a mistake of ten chains in the original survey of 1774.

"The magnetic bearing of the line is about north 50° west; some of the miles, as the 1st, being north 49° 40′ west, and the 24th being north 54° west, which is the largest variation from the general course. By means of the drawings and descriptions given in the map and record books, the line may be easily found, and any of its parts resurveyed.

"The description of the old and the new terminal monuments is given in the following report to the Joint Commission:

"'The undersigned, a committee appointed by your Board to ascertain and mark, by substantial and permanent monuments, the terminal points of said boundary, have discharged the duties assigned them and herewith report somewhat in detail the work done.

"'The boundary line in question was settled by a Commission appointed by the king of Great Britain, and the final decision rendered in 1769 was "That the boundary or partition line between the said Colonies of New York and New Jersey, be a direct and straight line from the Delaware river at the fork at the mouth of the Mahackamack, in the latitude of 41° 21′ and 37″, to Hudson's river, at a rock (on the bank of said river) in the latitude of 41°, as above described."

"'The Mahackamack river is now known as the Neversink, and the fork at the mouth of it is the south point of Laurel Grove Cemetery. It is a bare lime-stone rock, with its upper surface near the high-water mark at the confluence of the two streams above mentioned. It was early marked by a crow-foot cut into the rock, on its upper face. The mile monuments on the boundary line, which were set by the Joint Commission of the two States in 1774, are in range with it, and the traditions of the country people have always recognized it as the western station point of the boundary. The mark was very plain in 1874, though its cut edges were somewhat smoothed by the exposure of an hundred years. In 1874 the U. S. Coast and Geodetic Survey, at the request of the Geological Survey of New Jersey, determined accurately the latitude and longitude of this point, and, at the close of the work, marked it by drilling a deep hole in the rock and fastening in it a copper tube filled with lead, and setting and describing proper witnesses of its location. The station point, according to this determination, is in latitude 41° 21′ 22.63″ north; longitude 74° 41′ 40.70″ west from Greenwich.

"'This point we have now marked by setting in the solid rock a large pillar or monument of granite. This pillar is in one piece, $11\frac{1}{2}$ feet long, and with a cross section of something over one foot by two feet; it weighs nearly three tons, and is set four feet down in an accurately cut hole in the rock, and fastened with cement mortar; and is further supported for a foot and a half more by building stone and hydraulic mortar around it; the remaining portion (six feet) is hammer-dressed, and marked on two of its sides. The words 'Boundary Monument,' and the date, '1882,' are cut on both sides.

"'The north side is further marked—

NEW YORK.

HENRY R. PIERSON,
CHAUNCEY M. DEPEW,
ELIAS W. LEAVENWORTH,
Commissioners.
H. W. CLARKE,
Surveyor.

"'The south side is further marked—

NEW JERSEY.

ABRAHAM BROWNING,
THOMAS N. MCCARTER,
GEORGE H. COOK,
Commissioners.
E. A. BOWSER,
Surveyor.

"'The location of the monument is particularly favorable for its protection from mutilation; and solid material and setting give promise of durability and permanency.*

"'The eastern end of the boundary, in the description given by the Commission of 1769, is said to fall "at a rock on the west side of Hudson's river, marked by said surveyors, being 79 chains and 27 links to the southward on a meridian from Sneyden's house, formerly Corbet's." It was described in the report of the Joint Boundary Commissioners of the two States in 1774, as "that the rock on the west side of Hudson's river marked by the surveyors (of the Royal Commission of 1769) in the latitude of 41°, we have marked with a straight line through its surface, passing through the place marked by said surveyors, and with the following words and figures, to wit: 'Latitude 41° north,' and on the south side thereof the words 'New Jersey,' and on the north side thereof the words 'New York.'"

"'The rock above described is still in place. It is about a mile below Sneden's landing, on the west bank of the Hudson, and about

*The top of this stone, containing the inscription, has since been broken off by an ice gorge in the Delaware. The base remains firmly imbedded in its place and has been dressed smooth. A witness monument has been set up farther back from the river, containing, besides the above inscription, on the north side the following: "The corner between New York and Pennsylvania is in the centre of the Delaware river 475 feet due west of the Tri-State Rock," and on the south side "South 64 degrees west, 72¼ feet from this is the Tri-State Rock, which is the N. W. end of the New York and New Jersey Boundary, and the north end of the New Jersey and Pennsylvania Boundary." On the east edge or side, cut in sunken letters upon a polished and margined tablet, are the words "Witness Monument."

six inches above high-water mark, and at the foot of the north end of the Palisades. It is a long four-sided block of trap-rock, lying upon one of its sides. It is seven feet six inches long, three feet two inches high, and four feet wide. The marks cut on it in 1774 are still plain and legible. The "straight line through its surface" is a vertical line two feet from its north end. It lies 313.21 feet S. 18° 44′ W., from the United States Coast Survey Station *Duer;* and from the determination of that survey it is in latitude 40° 59′ 48.17″ north; longitude 73° 54′ 11″ west from Greenwich.

"'By estimation, the rock weighs nearly eight tons, so that it is not likely to be moved by accident; and it has not suffered from the action of the elements during the 113 years since it was first marked; but it lies immediately under the Palisades, where it is liable to be buried under the debris which falls from the rocks above; and there is danger of its destruction or removal in the progress of projected changes and improvements on the bank of the river. To avoid any danger to arise from its loss, and also to mark more conspicuously the terminus of the line, a pillar or monument of granite, similar to the one on the Delaware, and marked in the same way, has been set up on the boundary line where it crosses the highest part of the Palisades; it is 488 feet from the marked rock on the bank of the river, and is 463 feet above tide level; it is of the same dimensions as that at the west end of the boundary, and it is set in the solid trap-rock of the mountain in the same way as that; it stands opposite a point on the Hudson River railroad midway between Dobbs' Ferry and Hastings, and the boundary line, if extended across the Hudson, would cross the railroad near the tall, old chimney south of Hastings. By clearing away bushes, the monument is in plain sight of the east bank of the Hudson from near Sing Sing almost to Yonkers; it is also in sight on the boulevard at the west foot of the mountain, and near where the boundary crosses it. The monument stands on the property of the Palisades Land Company.

"'These terminal monuments are of such durable material, and so firmly set, and are objects of such public attention and interest, that they seem little liable to destruction and loss.

* * * * * * *

"'Respectfully submitted,

"'GEO. H. COOK,
"'E. W. LEAVENWORTH,
"'*Committee.*'"

"'November 17th, 1882.

With their report this commission filed also the following documents in the archives of the State:

1. A report upon the terminal monuments of the northern boundary line of New Jersey, as made by a committee of the Joint Boundary Commission.

2. A copy of the instructions given to the surveyors, for their guidance in resurveying the boundary line, and setting the several monuments upon it. (Copied into Book 5.)

3. The surveyors' report of their work upon the line and its monuments.

4. The field notes of the survey of the New York and New Jersey boundary.

5. A description of the several monuments which were set upon the boundary line by the surveyors.

6. A topographical map of the country adjacent to the boundary line, with the line and its monuments correctly placed upon it.

7. An account of all the expenses incurred in the work, with vouchers for the same.

An agreement was executed and ratified by the following act, which closed the work of the commission:

"An Act* to ratify and confirm an agreement made between the commissioners appointed on the part of the state of New York, and the commissioners appointed on the part of the state of New Jersey, respecting the location of the northern boundary line between the states of New York and New Jersey, and the replacing and erecting of monuments thereon, bearing date the seventh day of June, in the year of our Lord one thousand eight hundred and eighty-three.

"Approved April 2, 1884.

"WHEREAS, Henry R. Pierson, Elias W. Leavenworth and Chauncey M. Depew, commissioners duly appointed on the part of the state of New York, and Abraham Browning, Thomas N. McCarter and George H. Cook, commissioners duly appointed on the part of the state of New Jersey, for the purpose of negotiating and agreeing upon the true location of the northern boundary line between the states of New York and New Jersey, and also of replacing any monuments that may have become dilapidated or been removed on said boundary line, and of erecting new ones, have executed a certain agreement in duplicate, which is contained in the words following:

* Supplement to Revision, 1877–1886, p. 1024.

["*An agreement, made the seventh day of June, in the year eighteen hundred and eighty-three, between Henry R. Pierson, Elias W. Leavenworth and Chauncey M. Depew, Commissioners on the part of the State of New York, and Abraham Browning, Thomas N. McCarter and George H. Cook, Commissioners on the part of the State of New Jersey.*

"WHEREAS, By the first Section of Chapter CCCXL. of the Laws of the state of New York, for the year one thousand eight hundred and eighty, it was recited, among other things, that whereas, by an act of the legislature, passed the twenty-sixth day of May, eighteen hundred and seventy-five, the Regents of the University of the State of New York were authorized and directed, in connection with the authorities of Pennsylvania and New Jersey, respectively, to replace any monuments which have become dilapidated or been removed on the boundary lines of those states, and it was thereby declared that the lines originally laid down and marked with monuments by the several joint commissioners duly appointed for that purpose, and which have since been acknowledged and legally recognized, by the several states interested, as the limits of their territory and jurisdiction, are the boundary lines of said states, irrespective of want of conformity to the verbal descriptions thereof; and, by the second section of the same chapter of the laws of the state of New York, the said regents were authorized and empowered to designate and appoint three of their number as commissioners to meet such commissioners as may have been or may be appointed on the part of the states of Pennsylvania and New Jersey, or either of them, and with such last-named commissioners, as soon as may be, to proceed to ascertain and agree upon the location of said lines as originally established and marked with monuments; and in case any monuments are found dilapidated or removed from their original location, said commissioners are authorized to replace them in a durable manner in their original positions, and to erect such additional monuments at such places on said lines as they may deem necessary for the proper designation of the boundary lines of said states;

"AND WHEREAS, ALSO, The above-named Henry R. Pierson, Elias W. Leavenworth and Chauncey M. Depew having been duly designated and appointed by the said the Regents of the University of the state of New York, commissioners on the part of said state for the purposes mentioned in the said act;

"AND WHEREAS, ALSO, By an act of the legislature of the state of New Jersey, entitled 'An act appointing commissioners to locate the northern boundary line between the states of New York and New Jersey, and to replace and erect monuments thereon,' approved April 13th, 1876, the governor of the state of New Jersey was authorized to appoint three commissioners, with power, on the part of said state of New Jersey, to meet any authorities on the part of the state of

New York who may be duly authorized, and with them to negotiate and agree upon the true location of the said boundary line between the states of New York and New Jersey, and also to replace any monuments which may have become dilapidated or been removed on said boundary lines, and to erect new ones, which agreement it was thereby enacted should be in writing, and signed and sealed by the authorities of the state of New York and the commissioners of the state of New Jersey;

"AND WHEREAS, The above-named Abraham Browning, Thomas N. McCarter and George H. Cook have been duly appointed commissioners on the part of the state of New Jersey under said act;

"AND WHEREAS, By a supplement to the last said act, approved on the 25th day of March, 1881, the commissioners under the last said act were, in addition to the authority conferred by the last said act, also authorized, in their discretion, to proceed to ascertain and agree upon the location of the northern boundary line between the states of New York and New Jersey, as originally established and marked with monuments; and in case any monuments are found dilapidated or removed from their original location, said commissioners were authorized to renew and replace them in a durable manner in their original positions, and to erect such additional monuments at such places on said line as they may deem necessary for the proper designation of the boundary line of said states;

"AND WHEREAS, The said commissioners, acting for and on behalf of their respective states, have entered upon the performance of the duties imposed upon them by the said acts, and have, in pursuance of the authority to them severally given as aforesaid, agreed, and hereby do agree, as follows:

"*First.* The line extending from the Hudson river on the east to the Delaware river on the west, as the same was laid down and marked with monuments in 1774 by William Wickham and Samuel Gale, commissioners on the part of the then colony of New York, duly appointed for that purpose in pursuance of an act of the assembly of the colony of New York, passed on the sixteenth day of February, 1771, 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 possession,' and John Stevens and Walter Rutherfurd, commissioners on the part of the then colony of New Jersey, duly appointed in pursuance of an act of the assembly of the colony of New Jersey, passed on the twenty-third day of September, 1772, 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 possession,' which said line has since been acknowledged and recognized by the two states as the limit of their respective territory and jurisdiction, shall, notwithstanding its want of conformity to the verbal description thereof, as recited by

said commissioners, continue to be the boundary or partition line between the said two states;

"*Provided*, that wherever upon said line the location of one or more of the monuments erected by said commissioners in 1774 has been lost, and cannot otherwise be definitely fixed and determined, then and in that case, and in every case where it is required to establish intervening points on said line, a straight line drawn between the nearest adjacent monuments, whose localities are ascertained, shall be understood to be, and shall be, the true boundary line.

"*Second*. The monumental marks by which said boundary line shall hereafter be known and recognized are hereby declared to be: *first*, the original monuments of stone erected in 1774, along said line by the commissioners aforesaid, as the same have been restored and re-established in their original positions by Edward A. Bowser, surveyor on the part of New Jersey, and Henry W. Clarke, surveyor on the part of New York, duly appointed by the parties hereto; *second*, the new monuments of granite erected by the aforesaid surveyors at intervals of one mile, more or less, along said line, and numbered consecutively, beginning from the Hudson river, and severally marked on the northerly side with the letters N. Y., and on the southerly side with the letters N. J.; and *third*, the monuments of granite erected by the aforesaid surveyors at intervening points on said line at its intersection with public roads, railroads and rivers, and severally marked by them on the northerly side with the letters N. Y., and on the southerly side with the letters N. J.; and *fourth*, the terminal monuments erected at the western terminus of said line at the confluence of the Delaware and Navesink rivers, and the terminal monument erected on the brow of the rock called the Palisades, near the eastern terminus, and the rock lying and being at the foot of the Palisades on the bank of the Hudson river, and marked as the original terminal monument of said line established in 1774, as the same are described in a joint report made to the parties hereto by Elias W. Leavenworth, commissioner on the part of New York, and George H. Cook, commissioner on the part of New Jersey.

"*Third*. The field-books of said surveyors, containing the descriptions of the locations of the several monuments erected by them, and of the witness marks thereto, the report of said surveyors containing the account of their work in ascertaining and marking said line, together with the topographical map of said line and the vicinity thereof, and the several documents and books of record containing the transactions of the parties aforesaid, having been duly authenticated and attested by the signatures of the said commissioners, and placed on file in the offices of the secretaries of state of the two states, shall constitute the permanent and authentic records of said boundary line, and are hereby adopted by the parties hereto, and made part of this agreement.

"*Fourth*. This agreement shall become binding on the two states

when confirmed by the legislatures thereof, respectively, and when confirmed by the congress of the United States.

"IN WITNESS WHEREOF, the said commissioners have hereto set their hands and seals, in duplicate, this seventh day of June, in the year of our Lord one thousand eight hundred and eighty-three.

"HENRY R. PIERSON, [L. S.]
"E. W. LEAVENWORTH, [L. S.]
"CHAUNCEY M. DEPEW, [L. S.]

"A. BROWNING, [L. S.]
"THOMAS N. McCARTER, [L. S.]
"GEO. H. COOK, [L. S.]

"Executed in the presence of—

"Witness as to H. R. Pierson,
"A. C. JUDSON, Albany.

"As to commissioners of New Jersey,
"B. WILLIAMSON.

"Witness to the signature of E. W. Leavenworth,
"A. F. LEWIS.

"As to Chauncey M. Depew,
"W. I. VANARSDALE."]

"Therefore,

"SEC. 1. That the aforesaid agreement, and every article, clause, matter, and thing therein contained, shall be and the same are hereby ratified and confirmed on the part of the state of New Jersey."

EASTERN BOUNDARY BETWEEN NEW JERSEY AND NEW YORK.

There were disputes as to this line through Hudson river, New York bay, and Arthur kill, which lasted until 1833. A commission was appointed in 1807 and another in 1827, but no result was reached. A history of these disputes and a statement of the causes which led the commission of 1833 to adopt the agreement below given, will be found in an opinion given by Judge Elmer, in 1862, in New Jersey Supreme Court case, State *v.* Babcock, 1 Vr. 29, from which the following is extracted: Up to the close of the Revolution "the charters of New York city, and the proceedings of its authorities, showed that it had always been claimed that the whole of Hudson river up to the low-water mark on the westerly shore, belonged to that State. But it was only after the Revolution, and when it appeared that, if this claim was acquiesced in, all the wharves and improvements on the

Jersey shore would be subject to the control of New York, that New Jersey claimed that, by conquest from the Crown, the right of New Jersey was extended to the middle of the river." When the commissioners met in 1833, it was found that those of New York "deemed it indispensable that their great commercial emporium should have exclusive control of the police on the surrounding waters, and full power to establish such quarantine regulations as should be found necessary. The commissioners of this State deemed it wise to secure exclusive property to the soil to the middle of the river, and exclusive jurisdiction over the wharves, docks and other improvements made or to be made on the Jersey shore, and of vessels fastened thereto, and the right to regulate the adjacent fisheries, leaving to New York, which was thought to be quite as much a burthen as a privilege, the exclusive jurisdiction over the offenses in or upon the waters or the land covered by the water outside of low-water mark. * * * Nothing has since occurred to make the propriety of this arrangement doubtful; on the contrary, there is every reason to believe that it has secured important rights to this State which otherwise might have been lost."

The history of the commission of 1833 is contained in the following acts:

"An Act for the settlement of the territorial limits and jurisdiction between the states of New Jersey and New York.*

"Passed February 6, 1833.

"WHEREAS, The legislature of the state of New York have recently passed a law authorizing the governor of that state to appoint commissioners, to meet commissioners on the part of this state, to negotiate and agree respecting the territorial limits and jurisdiction of the state of New Jersey and the state of New York; and whereas, it is expedient and desirable that the difference heretofore existing on this subject should be amicably and speedily adjusted; therefore,

"1. That the governor of this state, or the person administering the government of the same, be and he is hereby authorized to appoint three commissioners, with full power on the part of New Jersey to meet the commissioners appointed or to be appointed under or by virtue of a law of New York, passed January the eighteenth, eighteen hundred and thirty-three, and with them to negotiate and agree respecting the territorial limits and jurisdiction between the said states, as to them may seem just; and if, by death, resignation or otherwise, a vacancy do happen among those appointed by the state of

*Revision of 1877, p. 1177.

New Jersey, the governor, or person administering the government of this state, is hereby authorized to supply the same.

"2. That the said commissioners on the part of the state of New Jersey, or a major part of them, shall have full power and authority to agree upon, settle and determine the limits of territory and jurisdiction between the said states, as to them may seem just, and their agreement in the premises, in writing, signed and sealed by the said commissioners of both states, or a majority of them, respectively, if made on or before the first Tuesday of January next, shall become binding on this state, when confirmed by the respective legislatures of New Jersey and New York, and approved by congress."

[Sections 3 and 4 executed.]

"An Act to ratify and confirm an agreement made between the commissioners appointed by the governor of the state of New York, and the commissioners appointed by the governor of the state of New Jersey, respecting the territorial limits and jurisdiction between the said states.*

"Passed February 26, 1834.

"WHEREAS, Commissioners duly appointed on the part of the state of New York, and commissioners duly appointed on the part of New Jersey, for the purpose of agreeing upon and settling the jurisdiction and territorial limits of the two states, have executed certain articles, two copies for each state, which are contained in the following words:

"Agreement made and entered into, by and between Benjamin F. Butler, Peter Augustus Jay and Henry Seymour, commissioners duly appointed on the part and behalf of the state of New York, in pursuance of an act of the legislature of the said state, entitled 'An act concerning the territorial limits and jurisdiction of the state of New York and the state of New Jersey,' passed January eighteenth, eighteen hundred and thirty-three, of the one part, and Theodore Frelinghuysen, James Parker and Lucius Q. C. Elmer, commissioners duly appointed on the part and behalf of the state of New Jersey, in pursuance of an act of the legislature of the said state, entitled 'An act for the settlement of the territorial limits and jurisdiction between the states of New Jersey and New York,' passed February sixth, eighteen hundred and thirty-three, of the other part.

"ART. I. The boundary line between the two states of New York and New Jersey, from a point in the middle of Hudson river, opposite the point of the west shore thereof, in the forty-first degree of north latitude, as heretofore ascertained and marked, to the main sea, shall be the middle of the said river, of the bay of New York, of the water between Staten Island and New Jersey, and of Raritan bay, to the main sea, except as hereinafter otherwise particularly mentioned.

"ART. II. The state of New York shall retain its present jurisdic-

* Revision of 1877, p. 1178.

tion of and over Bedlow's and Ellis' islands, and shall also retain exclusive jurisdiction of and over the other islands lying in the waters above mentioned, and now under the jurisdiction of that state.

"ART. III. The state of New York shall have and enjoy exclusive jurisdiction of and over all the waters of the bay of New York, and of and over all the waters of Hudson river, lying west of Manhattan island and to the south of the mouth of Spuytenduyvel creek, and of and over the lands covered by said waters to the low-water mark on the westerly or New Jersey side thereof, subject to the following rights of property and jurisdiction of the State of New Jersey, that is to say:

"(1). The state of New Jersey shall have the exclusive right of property in and to the land under water, lying west of the middle of the bay of New York and west of the middle of that part of the Hudson river which lies between Manhattan island and New Jersey.

"(2). The state of New Jersey shall have the exclusive jurisdiction of and over the wharves, docks and improvements made and to be made on the shore of said state, and of and over all vessels aground on said shore, or fastened to any such wharf or dock, except that the said vessels shall be subject to the quarantine or health laws, and laws in relation to passengers of the state of New York, which now exist or which may hereafter be passed.

"(3). The state of New Jersey shall have the exclusive right of regulating the fisheries on the westerly side of the said waters; provided, that navigation be not obstructed or hindered.

"ART. IV. The state of New York shall have exclusive jurisdiction of and over the waters of the Kill von Kull, between Staten island and New Jersey, to the westernmost end of Shooter's island, in respect to such quarantine laws and laws relating to passengers as now exist, or may hereafter be passed under the authority of that state, and for executing the same; the said state shall also have exclusive jurisdiction for the like purposes of and over the waters of the sound from the westernmost end of Shooter's island to Woodbridge creek, as to all vessels bound to any port in the said state of New York.

"ART. V. The state of New Jersey shall have and enjoy exclusive jurisdiction of and over all the waters of the sound between Staten island and New Jersey, lying south of Woodbridge creek, and of and over all the waters of Raritan bay, lying westward of a line drawn from the light-house at Princes' bay to the mouth of Matavan creek, subject to the following rights of property and jurisdiction of the state of New York, that is to say:

"(1). The state of New York shall have the exclusive right of property in and to the land under water lying between the middle of the said waters and Staten Island.

"(2). The state of New York shall have the exclusive jurisdiction of and over the wharves, docks and improvements made and to be made on the shore of Staten Island, and of and over all vessels aground

on said shore, or fastened to any such wharf or dock, except that the said vessels shall be subject to the quarantine or health laws and laws in relation to passengers of the state of New Jersey, which now exist or which may hereafter be passed.

"(3). The state of New York shall have the exclusive right of regulating the fisheries between the shore of Staten Island and the middle of the said waters; provided, that the navigation of the said waters be not obstructed or hindered.

"ART. VI. Criminal process issued under the authority of the state of New Jersey against any person accused of an offense committed within that state, or on board any vessel being under the exclusive jurisdiction of that state, as aforesaid, or committed against the regulations made or to be made by that state, in relation to the fisheries mentioned in the third article; and also civil process issued under authority of the state of New Jersey against any person domiciled in that state, or against property taken out of that state to evade the laws thereof, may be served upon any of the said waters within the exclusive jurisdiction of the state of New York, unless such person or property be on board a vessel aground upon or fastened to the shore of the state of New York, or fastened to a wharf adjoining thereto; or unless such person shall be under arrest, or such property shall be under seizure by virtue of the process or authority of the state of New York.

"ART. VII. Criminal process issued under the authority of the state of New York against any person accused of any offense committed within that state, or committed on board of any vessel being under the exclusive jurisdiction of that state as aforesaid, or committed against the regulations made or to be made by that state in relation to the fisheries mentioned in the fifth article; and also civil process issued under the authority of the state of New York against any person domiciled in that state, or against property taken out of that state to evade the laws thereof, may be served upon any of the said waters within the exclusive jurisdiction of the state of New Jersey, unless such person or property be on board a vessel aground upon or fastened to the shore of the state of New Jersey, or fastened to a wharf adjoining thereto, or unless such person shall be under arrest, or such property shall be under seizure by virtue of the process or authority of the state of New Jersey.

"ART. VIII. This agreement shall become binding on the two states when confirmed by the legislatures thereof, respectively, and when approved by the congress of the United States.

"Done in four parts (two of which are retained by the commissioners of New York, to be delivered to the governor of that state, the other two of which are retained by the commissioners of New Jersey, to be delivered to the governor of that state), at the city of New York, this sixteenth day of September, in the year of our Lord

one thousand eight hundred and thirty-three, and of the independence of the United States the fifty-eighth.

"THEODORE FRELINGHUYSEN, B. F. BUTLER,
"JAMES PARKER, PETER AUGUSTUS JAY,
"LUCIUS Q. C. ELMER, HENRY SEYMOUR.

"Therefore—

"That the aforesaid agreement, and every article, clause, matter, and thing therein contained, shall be and the same is hereby fully and amply ratified and confirmed on the part of the state of New Jersey.

"Confirmed by New York, February 5th, 1834.

"Approved by the congress of the United States, June 28th, 1834."

It will be noticed that the above agreement does not describe the line with much definiteness. The middle of Hudson river, as it was in 1833, may be difficult to determine. The middle of New York bay and of Raritan bay is quite indefinite. It seems that this whole line needs to be submitted to a commission at once for accurate determination. The part through Raritan bay has just been accurately described and marked by a commission appointed by the Governor under the following:

"Joint Resolution authorizing the appointment of a commission to locate and mark out the boundary line between the state of New Jersey and the state of New York in Raritan bay.*

"Approved April 20, 1886.

"WHEREAS, Disputes are constantly arising between citizens of this state and citizens of the state of New York, engaged in the shell fisheries in Raritan bay, as to the boundary line between the two states in lands under water of said Raritan bay; *and whereas*, that by reason of the absence of any means to locate the boundary line there exists an uncertainty about the true location thereof between the state of New Jersey and the state of New York, as defined in the act entitled 'An act for the settlement of the territorial limits and jurisdiction between the states of New Jersey and New York,' passed the sixth day of February, one thousand eight hundred and thirty-three; now, therefore,

"SEC. 1. That the governor of this state be and he is hereby authorized to appoint three commissioners, with power, on the part of the state, to meet any authorities of the state of New York who may be duly authorized, and with them locate and mark out, by proper buoys, the boundary line between the two states in lands under water of Raritan bay; that the expenses of said commission shall be paid

*Supplement to Revision, 1877–1886, p. 1027.

by the treasurer, on the warrant of the comptroller, after being first approved by the governor."

Pursuant to the resolution above mentioned, Governor Green appointed Robert C. Bacot, A. B. Stoney and George H. Cook as the committee on the part of New Jersey.

The commissioners on the part of New York were appointed by Governor Hill, under an act passed in 1887, the text of which is as follows:

"An Act for the settlement of territorial disputes in regard to the lands under water in Raritan bay.

"Passed March 15th, 1887, three-fifths being present.

"THE PEOPLE OF THE STATE OF NEW YORK, *represented in Senate and Assembly, do enact as follows:*

"SEC. 1. The governor shall appoint three commissioners, who shall have full power, on the part of the state of New York, to meet the commissioners appointed or to be appointed by the state of New Jersey, and with them locate and mark out, by proper monuments and buoys, the true boundary line between the two states in lands under water in Raritan bay.

"SEC. 2. The said commissioners, within one year from the passage of this act, shall file with the secretary of the state of New York, a map showing such boundary line.

"SEC. 3. The expenses of the said commissioners, not exceeding one thousand dollars, shall be paid by the treasurer, upon the warrant of the comptroller, after being first approved by the governor."

After several meetings of the Joint Commission, and careful inquiry as to precedents, the following result was reached:

"An agreement, made the 12th day of October, in the year 1887, between Mayo W. Hazeltine, Robert Moore and Lieut. G. C. Hanus, U. S. N., commissioners on the part of the state of New York, and George H. Cook, Robert C. Bacot and A. B. Stoney, commissioners on the part of the state of New Jersey:

"WHEREAS, By chapter 69 of the laws of the state of New York for the year 1887, the governor was authorized to appoint three commissioners on the part of the state of New York, with full power to meet with the commissioners duly authorized on the part of the state of New Jersey, and with them to locate and mark out, by proper monuments and buoys, the true boundary line between the two states in lands under water in Raritan bay; and

"WHEREAS, The said Mayo W. Hazeltine, Robert Moore and

Lieut. G. C. Hanus, U. S. N., were duly appointed commissioners on the part of the state of New York, for the purposes mentioned in the said act; and

"WHEREAS, By an act of the legislature of the state of New Jersey, passed April 20th, 1886, entitled 'Joint resolution authorizing the appointment of a commission to locate and mark out the boundary line between the state of New Jersey and the state of New York in Raritan bay,' the governor of the state of New Jersey was authorized to appoint three commissioners, with power, on the part of the state, to meet any authorities duly authorized on the part of the state of New York, and with them to locate, by proper buoys, the boundary line between the two states of lands under water in Raritan bay; and

"WHEREAS, The said George H. Cook, Robert C. Bacot and A. B. Stoney were duly appointed commissioners for the purposes of said act; and

"WHEREAS, The said commissioners acting for and on behalf of their respective states, have entered upon the performance of the duties imposed upon them by said act, and have in pursuance of the authority to them severally given as aforesaid, agreed and hereby do agree upon a boundary line between the two states, in lands under water in Raritan bay, and locate the same as follows:

"*First.* From 'Great Beds light-house,' in Raritan bay, north, twenty degrees sixteen minutes west, true, to a point in the middle of the waters of Arthur Kill, or Staten Island sound, equidistant between the southwesterly corner of the dwelling-house of David C. Butler, at Ward's Point, on Staten Island, in the state of New York, at the southeasterly corner of the brick building on the lands of Cortlandt L. Parker, at the intersection of the westerly line of Water street with the northerly line of Lewis street, in Perth Amboy, in the state of New Jersey.

"*Second.* From 'Great Beds light-house' south, sixty-four degrees and twenty-one minutes east, true (S. 64° 21′ E.), in line with the center of Waackaack or Wilson's beacon, in Monmouth county, New Jersey, to a point at the intersection of said line with a line connecting 'Morgan No. 2' triangulation point, U. S. Coast and Geodetic Survey, in Middlesex county, New Jersey, with the 'Granite and Iron beacon,' marked on the accompanying maps as 'Romer stone beacon,' situated on the 'Dry Romer shoal;' and thence on a line bearing north, seventy-seven degrees and nine minutes east, true (N. 77° 9′ E.), connecting 'Morgan No. 2' triangulation point, U. S. Coast and Geodetic Survey, in Middlesex county, New Jersey, with said 'Romer stone beacon' (the line passing through said beacon and continuing in the same direction), to a point at its intersection with a line drawn between the 'Hook beacon,' on Sandy Hook, New Jersey, and the triangulation point of the U. S. Geodetic Survey, known as

the Oriental Hotel, on Coney Island, New York; then southeasterly, at right angles with the last-mentioned line, to the main sea.

"*Third.* The monumental marks by which said boundary line shall be hereafter known and recognized, are hereby declared to be as follows:

"1. The 'Great Beds light-house.'

"2. A permanent monument marked 'State Boundary Line New York and New Jersey,' and to be placed at the intersection of the line drawn from the 'Great Beds light-house' to 'Waackaack or Wilson's beacon,' Monmouth county, New Jersey, and the line drawn from 'Morgan No. 2' triangulation point, U. S. Coast and Geodetic Survey, in Middlesex county, New Jersey, to 'Romer stone beacon.'

"3. Eight buoys or spindles, to be marked like the permanent monument above mentioned, and placed at suitable intervening points along the line from the said permanent monument to the 'Romer stone beacon.'

"4. The 'Romer stone beacon.'

"*Fourth.* The maps accompanying and filed with this agreement, showing the location of the above-described boundary line between the state of New York and the state of New Jersey, in Raritan bay to the main sea, and of the monumental marks by which it is marked, and to be marked, duly authenticated and attested by the signatures of the said commissioners, and placed on file in the offices of the secretaries of state of the respective states, shall constitute the permanent and authentic records of said boundary line, and are hereby adopted by the parties hereto and made part of this agreement.

"In witness whereof, the said commissioners have hereto set their hands and seals in duplicate, this 12th day of October, in the year of our Lord 1887.

"M. W. HAZELTINE,	[L.S.]	GEO. H. COOK,	[L.S.]
"ROBERT MOORE,	[L.S.]	ROBERT C. BACOT,	[L.S.]
"G. C. HANUS, Lieut. U.S.N.,	[L.S.]	A. B. STONEY,	[L.S.]"*

THE BOUNDARY SEAWARD.

The question as to how far the jurisdiction of the State extends seaward is not well defined. The territorial limits may be regarded as extending three geographical miles from the coast line. †

BOUNDARY BETWEEN NEW JERSEY AND DELAWARE.

Uncertainty as to the limits of territory and jurisdiction of these two States has led to serious and sometimes violent disputes, chiefly as

* Report of the Proceedings of the New Jersey Boundary Commission, etc., 1887.

† Gould on Waters, sec. 4.

to the fisheries. A statute of Delaware defines its limits to be "low-water mark on the eastern side of the river Delaware within the twelve-mile circle from New Castle, and the middle of the bay below said circle." *

The following sets forth the claim of New Jersey, conflicting with the first clause of the above:

"Joint Resolution relative to the rights of the state of New Jersey in that part of the Delaware river which runs between the states of Delaware and New Jersey. †

"Approved March 30, 1876.

"WHEREAS, The state of Delaware now claims to own the bed and to have exclusive jurisdiction, from shore to shore, of a portion of the Delaware river, extending from the boundary line between the states of Pennsylvania and Delaware, for some distance below the town of New Castle; and has lately endeavored to exercise jurisdiction co-extensive with said claim; *and whereas,* this state always claimed and now doth claim to own the bed of said river to the middle thereof, so far as said river lies between this state and the state of Delaware, and to be entitled to exclusive jurisdiction (subject to the constitution of the United States and the acts of congress made in pursuance thereof) over its half of said river, and hath always heretofore exercised jurisdiction accordingly; *and whereas,* it is desirable and necessary that the rights of this state, as between it and the state of Delaware, in and to said river, shall be definitely, finally and conclusively settled; *and whereas,* the efforts heretofore made to settle said matters of difference by consultation and agreement between the said differing states, have proved ineffectual; therefore,

"SEC. 1. That the governor of this state be and is hereby authorized to cause to be instituted and prosecuted, in the supreme court of the United States, a suit in equity, or an action at law, by the state of New Jersey against the state of Delaware, to ascertain, determine and settle the true territorial boundary line between said states, and the extent of the jurisdiction of each of said states in and on said river, and for that purpose the governor shall have power to employ, on behalf of this state, counsel to assist the attorney-general in the commencement and prosecution of said suit, or action, and the expenses necessarily and reasonably attending the commencement and prosecution of said suit, or action, on bills certified by the governor, shall be paid out of any moneys in the treasury not otherwise appropriated."

Previous to this, however, in 1873, an act was passed authorizing the Governor to appoint three commissioners with full power and

* Revised Code of Delaware, 1874, chap. 1, sec. 2.

† Revision of 1877, p. 1185.

authority to agree upon, settle and determine the limits of territory and jurisdiction between the States; the Legislature of Delaware having passed a joint resolution authorizing the appointment of commissioners to meet with them, Delaware refused afterwards to submit the question as to the title claimed by that State to the bed of the Delaware river to the commission, and nothing was accomplished.

An injunction of the Supreme Court of the United States having been obtained, "commanding and enjoining the State of Delaware, its officers and agents, to desist and refrain from arresting, imprisoning, trying, fining or in any manner punishing or seizing, holding or selling any property of any citizen of New Jersey for fishing in the river Delaware, as they had heretofore been accustomed to do, until the said court should make other order to the contrary," the Attorneys-General of the two States agreed that for the purposes of this injunction the head of Delaware bay should be considered to be a line drawn from Cohansey light-house to Bombay Hook Point.

Although, as we have seen, the claims of the two States conflict as to limits in the Delaware river, from the Pennsylvania and Delaware line to the foot of Reedy island, there seems to be an agreement that below Reedy island the middle of the bay is the territorial line. The Attorney-General of New Jersey holds this to mean the middle line between low-water marks of the opposite shores. He states, however, in his report to the Governor for the year 1887, that his attention has been called to the continued effort on the part of Delaware to enforce the statutes of that State which prohibit the taking of running fish within its territorial limits, against the citizens of New Jersey, in Delaware bay.

In a report submitted to the Governor August 12th, 1885, on this dividing line, the Attorney-General states as follows:

"The authorities of Delaware, while claiming that the boundary of the State of Delaware was the middle of the channel, and that the operation of their laws was confined only by that limit, had agreed that no citizen of New Jersey should be molested for fishing in any part of the bay beyond the Delaware side of the channel."

The report then proceeded to state the exact point of difference between the States as follows:

"The statutes of Delaware prohibit the taking of running fish within these limits, although there should be no interference with the

soil. The statute law of New Jersey protects oyster beds within her territorial limits, because they are attached to the soil, of which she is the proprietor.

"It has been held that the statute of New Jersey prohibiting citizens of another State from coming upon the lands under water belonging to the State, and subverting the soil and interfering with the property there found, is not a violation of that clause of the Constitution of the United States which ordains that the citizens of each State shall be entitled to all the privileges and immunities of citizens in the several States.

"Whether any State has the right to claim the exclusive privilege of taking running fish in the great navigable rivers, bays and seas within the *fauces terræ*, is a question of great doubt and delicacy."

He closes the report submitted on this matter, for 1887, as follows:

"I have examined the decisions which have taken place since the above report was made, and I am still of the opinion that it is very unwise for either New Jersey or Delaware to attempt to prohibit the citizens of either State from taking running fish in any part of the bay. I have no doubt that it is the common interest of the fishermen of the two States to preserve the fishing in the waters which divide the States, for their mutual benefit.

"I recommend that a commission be appointed, with power to confer with a similar commission which may be appointed by the State of Delaware, in reference to this important subject."*

BOUNDARY BETWEEN NEW JERSEY AND PENNSYLVANIA.

In an opinion by Judge Elmer, of the New Jersey Supreme Court, it is stated that "the river Delaware was never within the jurisdiction either of this State or Pennsylvania until, by the Revolution, the rights of the Crown were extinguished, and each State then held to the middle. Under these circumstances, the agreement between the two States, adopted in 1783, provided that the two States should have concurrent jurisdiction in and upon the water of that river."†

The results of this commission of 1783 are given in the following act:

*Annual Report of the Attorney-General of the State of New Jersey, for the year 1887.

† State *v.* Babcock, 1 Vr. 29.

"An Act to ratify and confirm an agreement made between commissioners appointed by the legislature of the state of Pennsylvania, and commissioners appointed by the legislature of the state of New Jersey, for the purpose of settling the jurisdiction of the river Delaware, and islands within the same.*

"Passed May 27, 1783.

"WHEREAS, Commissioners, duly appointed on the part of the state of Pennsylvania, and commissioners, duly appointed on the part of the state of New Jersey, for the purpose of settling the jurisdiction of the river Delaware, and islands within the same, have executed two instruments of an agreement for the purpose aforesaid, one for each state, which agreement is contained in the following words:

"An agreement made and concluded between George Bryan, George Gray and William Bingham, commissioners appointed by the legislature of the state of Pennsylvania for settling the jurisdiction of the river Delaware, and islands within the same, and Abraham Clark, Joseph Cooper and Thomas Henderson, commissioners appointed by the legislature of the state of New Jersey for the like purpose.

"WHEREAS, Inconveniences and mischiefs have arisen, and may hereafter arise, from the uncertainty of jurisdiction within and on the river Delaware; therefore, to prevent the same, and in order that law and justice may hereafter in all cases be executed, and take effect within and upon the same river from shore to shore, in all parts and places thereof, where the same river is a boundary between the said states, the said commissioners do agree and establish, for and in behalf of their respective states, in the manner following, that is to say:

"*First.* It is declared, that the river Delaware, from the station point or northwestern corner of New Jersey, southerly, to the place upon the said river where the circular boundary of the state of Delaware toucheth upon the same, in the whole length and breadth thereof, is and shall continue to be and remain a common highway, equally free and open for the use and benefit, and advantage of the said contracting parties; *provided, nevertheless,* that each of the legislatures of the said states shall hold and exercise the right of regulating and guarding the fisheries on the said river Delaware annexed to their respective shores, in such manner that the said fisheries may not be unnecessarily interrupted, during the season for catching shad, by vessels riding at anchor on the fishing ground, or by persons fishing under claim of a common right on said river.

"*Secondly.* That each state shall enjoy and exercise a concurrent jurisdiction within and upon the water, and not upon the dry land between the shores of said river, but in such sort, nevertheless, that every ship and other vessel, while riding at anchor before any city or town in either state, where she hath last laded or unladed, or where it is intended she shall first thereafter either lade or unlade, shall be con-

* Revision of 1878, p. 1181.

sidered exclusively within the jurisdiction of such state; and every vessel fastened to or aground on the shore of either state, shall in like manner be considered exclusively within the jurisdiction of such state; but that all capital and other offences, trespasses, or damages committed on said river, the juridical investigation and determination thereof shall be exclusively vested in the state wherein the offender or person charged with such offence shall be first apprehended, arrested or prosecuted.

"*Thirdly.* That all islands, islets, and dry land within the bed and between the shores of said river, and between the said station point, northerly, and the falls of Trenton, southerly, shall, as to jurisdiction, be hereafter deemed and considered as parts and parcels of the state to which such insulated dry land doth lie nearest at the time of making and executing this agreement; and that from said falls of Trenton to the state of Delaware, southerly, Biles' island, near Trenton, Windmill island, opposite to Philadelphia, League island, Mud or Fort island, Hog island, and Little Tinnicum islands, shall be annexed to the state of Pennsylvania, and considered as parts and parcels thereof; and that Biddle's or Newbold's island, Burlington island, Petty's islands, Redbank island, Harmanus Helm's island, Chester island and Shiverse's island, shall be annexed to the state of New Jersey and considered as parts and parcels thereof; and that all other islands within said river, between the falls of Trenton and the state of Delaware, which are not hereinbefore particularly enumerated, shall be hereafter deemed and considered as parts and parcels of the state to which such island doth lie nearest, at the date hereof; and that all islands which may hereafter be formed within the said river shall be classed and annexed to the jurisdiction of either state, according to the same principle.

"*Fourthly.* That this present agreement, and every article and clause therein contained, shall be suspended and take no effect until each of the legislatures of the state of Pennsylvania and New Jersey, respectively, shall have passed laws approving of and ratifying the same; which being done, the said agreement shall then be considered as a joint compact between the said states, and the citizens thereof, respectively, and be forever thereafter irrevocable by either of the said contracting states, without the concurrence of the other. In witness whereof, we, commissioners of the aforesaid states, have set our hands and seals to two instruments of the agreement, one for each state, dated this twenty-sixth day of April, anno domini one thousand seven hundred and eighty-three.

"ABRAHAM CLARK,	[L. S.]	GEORGE BRYAN,	[L. S.]
"JOSEPH COOPER,	[L. S.]	GEORGE GRAY,	[L. S.]
"THOMAS HENDERSON,	[L. S.]	WILLIAM BINGHAM,	[L. S.]

"Therefore—

"That the aforesaid agreement, and every article, clause, matter and thing therein contained, shall be and the same is hereby fully

and amply ratified and confirmed, and shall be and ever hereafter remain in force, agreeably to the true tenor and extent thereof."

(Ratified by Pennsylvania, September 20th, 1783.)

The work of specifically naming which of the islands in the Delaware river, between the falls of Trenton and the northwest corner of New Jersey, should belong to each State, was given to another commission and an agreement made, and ratified by the following act:

"An Act to ratify and confirm an agreement made between the commissioners appointed by the legislature of the state of Pennsylvania, and the commissioners appointed by the legislature of the state of New Jersey, for the purpose of agreeing upon, and accurately describing which of the islands, islets and insulated dry land, mentioned in the agreement between the two states, bearing date on the twenty-sixth day of April, seventeen hundred and eighty-three, belong to each of the said states, according to the purport of that agreement.*

"Passed March 16, 1786.

"WHEREAS, Commissioners duly appointed on the part of the state of Pennsylvania, and a commissioner duly appointed on the part of the state of New Jersey, for the purpose of dividing the islands in the river Delaware, between the falls of Trenton and the station point, or northwest corner of the state of New Jersey, have executed two articles of agreement, one for each state, which is contained in the following words:

"An agreement made and concluded upon, between George Wall, John Okely and Jonas Hartzell, commissioners appointed by the supreme executive council of the state of Pennsylvania, for dividing the islands and insulated dry land in the river Delaware, with the state of New Jersey, from the falls of Trenton to the station point, or northwest corner of the said state, and Moore Furman, commissioner appointed by the said state of New Jersey, for the like purpose.

"*First.* The parties aforesaid, in pursuance of the authority to them severally given, and in behalf of the respective states aforesaid, do agree that from the said falls of Trenton, to the station point, or northwest corner of the state of New Jersey aforesaid, the following islands opposite to the county of Bucks, and the townships hereafter named, that is to say, opposite to the Falls township, Bird's island; opposite Lower Makefield township, Slack's three islands, Duer's island and Harvey's lower island; opposite to Upper Makefield township, Harvey's upper island and Lowne's island; opposite to Solebury township, Smith's island and bar, and Paxton's island and bar; opposite to Tinnicum township, Pratt's two islands, Wall's island, Resolu-

*Revision of 1878, p. 1182.

tion island, Marshall's island, Wall's two islands, Fishing island and Pennington's island; opposite to Nockamixon township, Loughley's island; and opposite the county of Northampton, and the townships hereafter named, that is to say, Williams township, Pohatcung island, Shoemaker's island and Loor's island; opposite to the Forks township, Easton island; opposite to Mount Bethel, Mason's island and bar, Mason's island, Foulrift island, McElhany's island and Attin's two islands; opposite to Lower Smithfield, Handy's island and bar, Goodwin's two islands, Shawanagh, or I. and B. Van Campen's island, H. Depew's island and two bars, Chambers' island and Van Oken's island; opposite to Delaware township, Swartswood's island and Isaac Van Campen's island; opposite Upper Smithfield township, Punkey's island and five bars, shall be annexed to the state of Pennsylvania, and considered as parts and parcels thereof.

"And that the following islands, opposite to the county of Hunterdon, in the state of New Jersey, and the townships hereafter named, that is to say, opposite to the township of Trenton, Yard's island, Mott's two islands and Gould's two islands; opposite to the township of Hopewell, Stout's island; opposite to the township of Amwell, Smith's Mill island, Coryell's island, Holcombe's two islands, Eagle island and Bull's island; opposite to the township of Kingwood, Rush island, Ridge's island, Shyhawk's three islands, Pinkerton's island and Man-of-war island; opposite to the township of Alexandria, Stull's island, Lowrey's island and Loughley's island and bar; and opposite to the county of Sussex, and the townships hereafter named, that is to say, opposite the township of Greenwich, Rope's island, Chapman's island, tout's island and bar and Bar island; opposite the township of Oxford, Capush island, Foulrift island and Mack's island; opposite the township of Knowlton, Mack's island and three bars, and Gap island; opposite the township of Wallpack, Hoop's two islands, Chambers' island, A. Van Campen's fishing island, Opaughanaugh island and Necesseas island; opposite to the township of Sandyston, Nominack island and Westfall's island; opposite to the township of Montague, Minisink island, Quick's two islands and bar, Shabbacung great island and bar, and Westfall's two islands, shall be annexed to the state of New Jersey, and hereafter be considered as parts and parcels thereof, agreeable to a map or chart of said river, and descriptive of the several islands and insulated dry land therein, made under our direction by Mr. Reading Howell, surveyor, and herewith exhibited to each state.

"*Secondly.* That all other islands which may hereafter be formed within said river, between the falls of Trenton and the station point, or northwest corner of the state of New Jersey aforesaid, shall hereafter be deemed and considered as parts and parcels of the state to which such islands may be nearest. In witness whereof, we, the commissioners of the states aforesaid, have set our hands and seals to the two instruments of writing, one for each state, dated this second

day of December, anno domini one thousand seven hundred and eighty-five.

"GEORGE WALL, [L. S.] JONAS HARTZELL, [L. S.]
"JOHN OKELY, [L. S.] MOORE FURMAN, [L. S.]

"Therefore—

"*That the aforesaid agreement*, and every article, clause, matter, and thing therein contained, shall be and the same is hereby fully and amply ratified and confirmed, and shall be and ever hereafter remain in force, agreeably to the true tenor and extent thereof." *

POLITICAL DIVISIONS AND AREAS.

EAST AND WEST NEW JERSEY.

The earliest division of New Jersey was into East and West Jersey. Charles II. granted New England and the country westward to the Delaware river to James, Duke of York, March 12th, 1663–64. The Duke of York transferred New Jersey to John, Lord Berkeley, and Sir George Carteret the following 24th day of June. They held and governed it until the 29th of July, 1674, when the Duke of York, in a second grant, deeded to Carteret all of the province north of a line drawn from "a certain creek called Barnegatt, being about the middle, between Sandy Point and Cape May, * * * to a certain creek in Delaware river, next adjoining to and below a certain creek in Delaware river called Renkokus Kill." † The division into East and West Jersey, however, was finally made by the Quintipartite Deed of July 1st, 1676, "between Sir George Carteret, of Saltreene, in the county of Devon, knight and baronet, and one of his Majesty's most honorable Privy Council, of the first part; William Penn, of Richman's worth, in the county of Hertford, Esq., of the second part; Gawn Lawry of London, merchant, of the third part; Nicholas Lucas of Hertford, in the county of Hertford, malster, of the fourth part; and Edward Billinge of Wistminster, in the county of Middlesex, gent., of the fifth part." ‡

The last four parties held the undivided moiety or half part which had been transferred by Lord Berkeley. No mention is here made of the second grant of the Duke of York to Carteret. This quintipartite deed gives to Carteret all east of a straight line to be drawn from the most northerly point of the Duke of York's grant, here

* See act of Pennsylvania, September 25th, 1786.

† Leaming & Spicer, p. 47.

‡ Id., p. 61.

agreed to be called the north partition point, "unto the most southwardly point of the east side of Little Egg Harbour," which was agreed to be called the south partition point. His part was to be known as East New Jersey and the part west of this line was deeded to the other four parties, and was to be known as West New Jersey. The uncertainty as to what point on the Delaware was intended by the Duke of York to be the northernmost point led, as has been explained, to disputes as to the north line of the province, which were finally settled by the commission of 1767 agreeing upon the forks of the Mahackamack or Navesink river as the point, so there were controversies as to this line, which were settled by the adoption of Lawrence's line, run in 1743, but in this case the northernmost point was taken to be at Cochecton, in latitude 41 deg. 40 min. A line had been run in 1687, by George Keith, however, which, although it was not accepted by the proprietors, was agreed on as the line by Governor Daniel Coxe, of West Jersey, and Governor Robert Barclay, of East Jersey, in 1688. While this agreement had no effect on the claims of the respective proprietors, it did give this line prominence as a political division, and it is to-day represented in the boundaries of ten counties. It ran from the north side of Little Egg Harbor inlet in a straight line to where the present line between Hunterdon and Somerset counties strikes the South Branch of the Raritan river, at Three Bridges; thence along the present line between said counties to Lamington river (this line then following the rear of the plantations along the Raritan); thence up said river to Allamatonk falls; thence straight to the nearest point of the Passaic river, as the line between Somerset and Morris counties now runs. From here it followed down the Passaic and up the Pequannock to latitude 41 degrees, thence due east to the partition point between New Jersey and New York, on Hudson river. The whole area of the State, excluding the waters of Raritan and Delaware bays, being 7,795 square miles, this division would have given East Jersey but 2,392 square miles and West Jersey 5,403 square miles. The line finally adopted was run by John Lawrence, in 1743, as nearly straight as the rough compass and chain survey of that time would admit of, from the north side of Little Egg Harbor inlet to Cochecton, crossing the Delaware river about one and one-half miles below Dingman's Ferry. This gave to East Jersey 3,073 square miles and to West Jersey 4,722 square miles. This line has only been preserved as a political division in the boundaries of six townships of Sussex county. The governments of East

and West Jersey having been surrendered in 1702, and the two divisions united under one government, this became merely a property line.

THE FORMATION OF COUNTIES.

Under the government of the proprietors of East Jersey a law was passed by the General Assembly in 1682, creating the four counties of Bergen, Essex, Middlesex and Monmouth.* In 1688 Somerset county was formed from a part of Middlesex.†

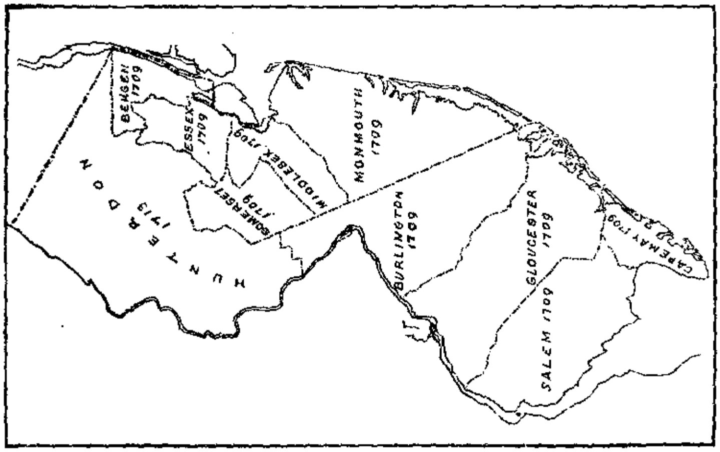
In West Jersey, Cape May county was erected in 1685.‡ This act states that the province had formerly been divided into three counties, but they could not have been very well defined. In 1692 the bounds between Burlington and Gloucester were defined,§ but this law was repealed the following year, and the boundary must have been left quite indefinite.

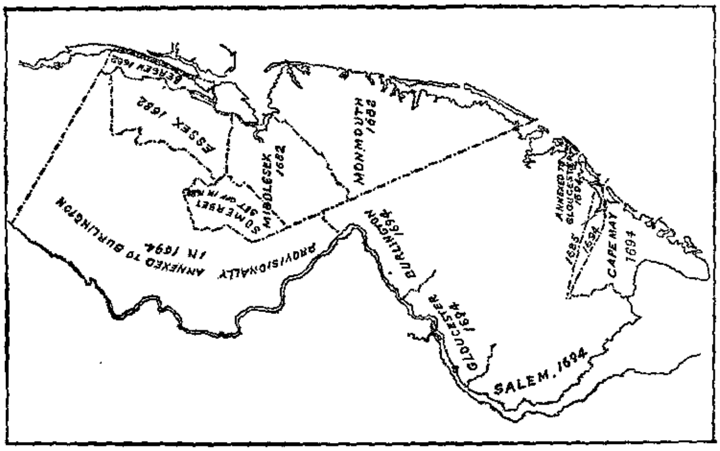
In 1694 laws were passed fixing the boundaries of Burlington, Gloucester and Salem counties a few miles back from Delaware river only, leaving everything indefinite in the interior. The sketch on following page shows the progress which had been made in the formation of counties up to this year, 1694.

In 1709 an act was passed defining the boundaries of all the counties in the province of New Jersey. The counties named in this act were Bergen, Essex, Somerset, Middlesex, Monmouth, Burlington, Gloucester, Salem and Cape May.

In 1713 all of the northern part of the province not contained in the above-mentioned counties was erected into the county of Hunterdon. It will be seen by reference to the accompanying sketch that most of the lines established in 1709 still remain as county lines. From this time the several counties began to assume their present shape. Hunterdon was reduced to its present form by the setting off of Morris county, in 1738–9. Somerset and Middlesex have been but little changed since 1713–14, and in the same year Monmouth was made to include what is now Monmouth and Ocean counties. Cumberland was set off from Salem in 1748, the latter county remaining otherwise as created in 1709. Sussex county was formed, containing what is now Sussex and Warren, in 1753. Warren was erected in 1824, Passaic and Atlantic in 1837, Mercer in 1838, Hudson in 1840,

* Learning & Spicer, p. 229.
† Id., p. 305. ‡ Id., p. 507. § Id., p. 513.


BERGEN 1709
ESSEX 1709
MIDDLESEX 1709
MONMOUTH 1709
SOMERSET 1709
HUNTERDON 1713
BURLINGTON 1709
GLOUCESTER 1709
SALEM 1709
CAPE MAY 1709


BERGEN 1682
ESSEX 1682
MIDDLESEX 1682
MONMOUTH 1682
SOMERSET
PROVISIONALLY ANNEXED TO BURLINGTON IN 1694
BURLINGTON 1694
GLOUCESTER 1694
SALEM, 1694
ANNEXED TO GLOUCESTER 1694
1685
1694
CAPE MAY 1694

Camden in 1844, from Gloucester; Ocean in 1850, from Monmouth; Union in 1857, from Essex. There are at present twenty-one counties.

The General Assembly of East Jersey, in 1693, passed a law dividing the several counties into townships, as follows:* Bergen into Hacksack and Bergen; Essex into Acquickanick and New Barbadoes, Newark and Elizabethtown; Middlesex into Woodbridge, Perth Amboy and Piscataway; Monmouth into Middletown, Shrewsbury and Freehold. Somerset was not subdivided. We have few records of the erection of townships in West Jersey, but an act of 1701† mentions in Burlington county, Hopewell, Maidenhead, Nottingham, Chesterfield, Mansfield, Springfield, Northampton, Burlington, Wellinborough, Chester, Eversham; in Gloucester county, Waterford, Newton, Gloucester, Deptford, Greenwich, Egg Harbour; in Salem county, the precincts of Salem, Elsinborough, Penn's Neck, Maneton (Mannington), Alloways Creek, "the upper side of Cohansey creek," and Fairfield. None are mentioned in Cape May county. From this beginning the number of townships has steadily increased, until now it has reached 241. These townships range in size from 136 square miles, the area of Galloway township, Atlantic county, to less than one square mile. There are also 40 cities, ranging in population from 153,513 to 567, and 35 boroughs and incorporated villages, with populations ranging from 8,542 to 169.

AREAS.

The following table of areas has been prepared from the maps of the recent Topographic Survey, as follows: The State was divided into sections, including 15 minutes of latitude by 15 minutes of longitude, or one-sixteenth of a square degree each. The areas of these sections were determined geodetically; all sections having the same latitudes being, of course, equal in area. Then to ascertain the area of the State, all of those sections lying partly within and partly without the State had these two parts carefully measured with an Amstler polar planimeter. The sum of these areas, or the whole area of the section as ascertained by planimetric measurement, was then compared with the geodetic area, and the small difference indicated was divided proportionally between the two parts. Then the sum of all the sections and part sections lying within the State boundaries, gave the true area of the State.

* Leaming & Spicer, p. 328.

† Leaming & Spicer, p. 581.

The boundaries followed in the measurement are shown on the map of New Jersey, on a scale of five miles to an inch, and are also given in the chapter on boundaries. Seaward they included all to a line drawn across from Oriental Hotel station, United States Coast and Geodetic Survey, on Coney Island, to Hook beacon on Sandy Hook; thence following low-water mark to Cape May, crossing the several inlets on a line with the beach fronts; thence straight across toward Cape Henlopen to the intersection of the Delaware and New Jersey line through the middle of the bay. The areas of the counties were then determined by measuring the part sections lying in the several counties, correcting these partial areas so that their sum in each section agreed with the true geodetic area of the section, and then adding together the areas belonging to each county. The townships were next measured, and the sum of the areas of those in a given county made to agree with the area of the county as already ascertained.

By this system of measurement it is believed that the list of areas here given is freed from all errors save those which come from uncertainty as to the exact location of boundary lines, arising from vagueness of description or imperfect marking.

SUMMARY OF AREAS.

	Square Miles.	Acres.
The State	8,224.44	5,263,641
Land surface	7,514.40	4,809,218
Water surface *	710.04	454,423
Upland †	7,022.76	4,494,567
Tide-marsh ‡	463.28	296,500
Beach	28.36	18,151
Forest §	3,234.09	2,069,819
Cleared upland	3,788.67	2,424,748
Improved land in farms, census of 1880 ‖	....	2,096,297

* Includes all streams and channels more than 100 yards in width, and all bodies of water approximating or exceeding 100 acres in extent.

† Upland as distinguished from tide-marsh, but really including all swamps and fresh meadow.

‡ 34,304 acres of this is embanked and more or less improved.

§ Includes all lots of ten acres and upward.

‖ A comparison of the areas by counties in the census with the areas below, will show, in most cases, a considerable excess of cleared upland over improved land in farms. Cape May and Cumberland counties are exceptions, but here and in Camden,

Areas by Counties.

COUNTIES.	Total.		Upland.	Tide Marsh.	Beach.	Total Land Surface.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Atlantic	613.49	392,633	307,409	53,325	3,415	364,149	28,484	35,771	271,638
Bergen	244.66	156,581	142,504	8,378	....	150,882	5,699	85,879	56,625
Burlington	898.79	575,223	532,929	22,374	989	556,292	18,931	211,232	321,697
Camden	225.96	144,613	139,101	2,964	....	142,065	2,548	72,518	66,588
Cape May	442.05	282,915	105,004	53,638	5,503	164,145	118,770	29,631	75,373
Cumberland	685.36	438,630	274,669	52,661	....	327,330	111,300	101,691	172,978
Essex	129.72	83,023	76,746	4,631	....	81,377	1,646	52,507	24,239
Gloucester	339.28	217,139	199,901	10,946	....	210,847	6,292	126,319	73,582
Hudson	60.48	38,709	15,786	11,468	....	27,254	11,455	15,073	713
Hunterdon	439.12	281,037	279,919	....	....	279,919	1,118	240,438	39,481
Mercer	227.90	145,858	144,229	376	....	144,605	1,253	128,400	15,829
Middlesex	324.44	207,639	191,440	8,199	....	199,639	8,000	131,276	60,164
Monmouth	537.94	344,280	300,999	3,378	1,901	306,278	38,002	211,288	89,711
Morris	480.19	307,318	303,910	....	....	303,910	3,408	163,809	140,101
Ocean	675.61	432,389	338,998	27,969	6,343	373,310	59,079	43,831	295,167
Passaic	200.16	128,100	126,454	....	....	126,454	1,646	50,284	76,170
Salem	389.37	249,198	188,138	31,780	....	219,918	29,280	138,081	50,057
Somerset	305.02	195,213	194,965	....	....	194,965	248	166,352	28,613
Sussex	535.31	342,603	338,393	....	....	338,393	4,210	201,855	136,538
Union	104.94	67,164	61,304	4,413	....	65,717	1,447	46,954	14,350
Warren	364.65	233,376	231,769	....	....	231,769	1,607	171,564	60,205
The State	8224.44	5,263,641	4,494,567	296,500	18,151	4,809,218	454,423	2,424,748	2,069,819

Gloucester and Salem counties, considerable areas of improved tide-marsh have been included in the improved land in farms. For the State the areas of cleared upland and improved tide-marsh aggregate 2,459,052 acres, exceeding the census figures for improved land in farms by 362,755 acres. This excess may be accounted for approximately as follows:

Cleared but unimproved land in farms	125,384	acres.
Highways	150,000	"
City and town sites	65,000	"
Railway lines	20,000	"

This is sufficiently close to establish the accuracy of the census figures. The agreement of the two sets of figures obtained by entirely independent and widely different methods, is in fact remarkable.

Atlantic County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Absecon	5.299	3,391	2,396	995			1,066	1,330
Atlantic City	2.620	1,677		720	166	791		
Buena Vista	57.974	37,103	37,103				4,940	32,163
Egg Harbor	111.678	71,474	43,300	18,387	8,703	1,084	9,266	34,034
Egg Harbor City	10.624	6,799	5,971	643	185		659	5,312
Galloway	135.949	87,008	44,074	23,660	17,734	1,540	6,873	37,201
Hamilton	113.857	72,869	72,690		179		1,197	71,493
Hammonton	45.008	28,805	28,805				7,142	21,663
Mullica	54.818	35,083	35,083				2,266	32,817
Weymouth	75.663	48,424	37,987	8,920	1,517		2,362	35,625
Totals	613.490	392,633	307,409	53,325	28,484	3,415	35,771	271,638

Bergen County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Englewood	11.319	7,244	6,547		697	4,196	2,351
Franklin	29.011	18,567	18,567			10,122	8,445
Harrington	26.764	17,129	15,537		1,592	6,995	8,542
Hohokus	30.274	19,376	19,376			8,718	10,658
Lodi	15.077	9,649	7,551	1,925	173	5,334	2,217
Midland	16.035	10,262	10,262			7,229	3,033
New Barbadoes	3.857	2,468	2,033	345	90	1,778	255
Orvil	17.260	11,046	11,046			7,265	3,781
Palisade	16.269	10,412	9,542		870	5,232	4,310
Ridgefield	18.595	11,901	8,006	2,085	1,810	5,571	2,435
Ridgewood	6.921	4,429	4,429			3,277	1,152
Saddle River	14.883	9,525	9,525			7,265	2,260
Union	13.995	8,957	4,467	4,023	467	3,332	1,135
Washington	24.398	15,616	15,616			9,565	6,051
Totals	244.658	156,581	142,504	*8,378	5,699	85,879	56,625

*80 acres of this is improved.

Burlington County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Bass River	79.625	50,959	44,834	5,166	959	....	1,573	43,261
Beverly City	0.544	348	348	....	....	....	348	....
Beverly Township	6.250	4,000	3,182	109	709	....	2,971	211
Bordentown	9.140	5,850	5,536	83	231	....	5,130	406
Burlington	18.830	12,051	10,862	397	792	....	9,923	939
Chester	18.904	12,099	11,977	122	....	....	11,059	918
Chesterfield	22.123	14,159	14,159	....	....	....	13,827	332
Cinnaminson	11.610	7,430	5,681	721	1,028	....	5,355	326
Delran	9.050	5,792	5,299	71	422	....	4,281	1,018
Easthampton	5.766	3,690	3,690	....	....	....	3,600	90
Evesham	29.604	18,947	18,947	....	....	....	10,012	8,935
Florence	10.153	6,498	6,076	45	377	....	5,776	300
Little Egg Harbor	75.305	48,195	21,173	12,431	13,602	989	3,253	17,920
Lumberton	20.820	13,325	13,325	....	....	....	11,612	1,713
Mansfield	23.204	14,851	14,518	96	237	....	13,635	883
Medford	42.001	26,880	26,880	....	....	....	9,622	17,258
Mount Laurel	22.128	14,162	14,162	....	....	....	12,996	1,166
New Hanover	40.913	26,184	26,184	....	....	....	18,912	7,272
Northampton	2.356	1,508	1,508	....	....	....	1,462	46
Pemberton	64.899	41,535	41,535	....	....	....	12,913	28,622
Randolph	61.685	39,478	35,860	3,044	574	....	1,150	34,710
Shamong	70.321	45,005	45,005	....	....	....	7,852	37,153
Southampton	47.194	30,204	30,204	....	....	....	14,581	15,623
Springfield	29.576	18,929	18,929	....	....	....	18,372	557
Washington	41.515	26,570	26,570	....	....	....	627	25,943
Westhampton	11.242	7,195	7,195	....	....	....	6,287	908
Willingboro	7.238	4,632	4,543	89	....	....	3,700	843
Woodland	116.792	74,747	74,747	....	....	....	403	74,344
Totals	898.786	575,223	532,929	*22,374	18,931	989	211,232	321,697

*299 acres of this is embanked and improved.

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Camden County.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Camden City	5.241	3,354	1,971	561	822	1,971	....
Centre	12.995	8,317	7,845	472	....	6,883	962
Delaware	24.395	15,613	15,613	....	....	13,734	1,879
Gloucester	36.667	23,467	23,467	....	....	15,215	8,252
Gloucester City	1.732	1,108	535	223	350	535	....
Haddon	12.344	7,900	7,314	586	....	7,186	128
Merchantville	0.632	404	404	....	....	369	35
Stockton	15.394	9,852	7,354	1,122	1,376	7,073	281
Waterford	57.325	36,688	36,688	....	....	10,023	26,665
Winslow	59.233	37,910	37,910	....	....	9,524	28,386
Totals	225.958	144,613	139,101	2,964	2,548	72,513	66,588

Cape May County.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Cape May City	2.056	1,316	177	920	58	161	177	....
Dennis	68.044	43,548	31,855	9,991	1,113	586	6,178	25,677
Lower	35.641	22,810	13,634	7,233	1,210	733	6,924	6,710
Middle	93.057	59,556	29,619	21,321	6,184	2,432	10,515	19,104
Upper	79.316	50,763	29,719	14,170	5,283	1,591	5,837	23,882
* Water	163.937	104,922	....	....	104,922	....	....	....
Totals	442.051	282,915	105,004	†53,638	118,770	5,503	29,631	75,373

* Part of Delaware bay included in Cape May county, but not belonging to any township.
† 1,402 acres of this is embanked and more or less improved.

Cumberland County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Bridgeton	12.870	8,237	8,167	....	70	5,041	3,126
Commercial	35.096	22,461	13,954	7,765	742	4,907	9,047
Deerfield	41.416	26,506	26,506	....	....	14,899	11,607
Downe	57.023	36,495	20,374	15,666	455	4,228	16,146
Fairfield	42.065	26,922	17,486	8,764	672	7,767	9,719
Greenwich	19.361	12,391	8,015	4,139	237	6,313	1,702
Hopewell	33.926	21,713	19,832	1,516	365	17,439	2,393
Landis	69.946	44,765	44,765	....	....	16,134	28,631
Lawrence	36.093	23,100	17,374	5,585	141	6,284	11,090
Maurice River	104.837	67,096	58,574	7,818	704	5,514	53,060
Millville	45.529	29,138	28,217	563	358	3,876	24,341
Stow Creek	19.271	12,333	11,405	845	83	9,289	2,116
*Water	167.927	107,473	....	....	107,473	....	....
Totals	685.360	438,630	274,669	†52,661	111,300	101,691	172,978

*Part of Delaware bay included in Cumberland county, but not belonging to any township.
†7,142 acres of this is embanked and improved.

Essex County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Belleville	2.926	1,873	1,822	....	51	1,428	394
Bloomfield	6.732	4,308	4,308	....	....	3,574	734
Caldwell	28.428	18,194	18,194	....	....	10,581	7,613
Clinton	6.870	4,397	3,769	628	....	3,663	106
East Orange	3.903	2,498	2,498	....	....	2,338	160
Franklin	3.492	2,235	2,197	....	38	1,838	359
Livingston	17.419	11,148	11,148	....	....	6,123	5,025
Millburn	10.194	6,524	6,524	....	....	3,619	2,905
Montclair	6.180	3,955	3,955	....	....	3,081	874

Essex County—Continued.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Newark	20.997	13,438	7,878	4,003	1,557	7,455	423
Orange	2.144	1,372	1,372	....	....	1,332	40
South Orange	8.364	5,353	5,353	....	....	3,901	1,452
West Orange	12.075	7,728	7,728	....	....	3,574	4,154
Totals	129.724	83,023	76,746	4,631	1,646	52,507	24,239

Gloucester County.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Clayton	21.645	13,853	13,853	....	....	7,416	6,437
Deptford	20.362	13,032	12,623	409	....	9,631	2,992
East Greenwich	14.190	9,082	9,024	58	....	7,715	1,309
Franklin	57.875	37,040	37,040	....	....	11,509	25,531
Glassboro	11.366	7,274	7,274	....	....	4,669	2,605
Greenwich	14.959	9,574	4,318	3,378	1,878	4,177	141
Harrison	19.405	12,419	12,208	211	....	11,184	1,024
Logan	28.101	17,984	10,863	4,502	2,619	8,801	2,062
Mantua	18.869	12,076	12,076	....	....	10,091	1,985
Monroe	45.837	29,335	29,335	....	....	7,824	21,511
South Harrison	20.292	12,987	12,987	....	....	10,040	2,947
Washington	22.575	14,448	14,448	....	....	10,584	3,864
West Deptford	20.172	12,910	9,167	1,948	1,795	8,344	823
Woodbury	1.687	1,080	1,029	51	....	1,023	6
Woolwich	21.945	14,045	13,656	389	....	13,311	345
Totals	339.280	217,139	199,901	*10,946	6,292	126,319	73,582

*3,558 acres of this is embanked and improved.

Hudson County.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Bayonne	11.533	7,381	2,279	404	4,698	2,279	....
Guttenberg	0.208	133	133	....	....	133	....
Harrison	1.309	838	534	246	58	534	....
Hoboken	1.907	1,220	518	209	493	518	....
Jersey City	19.199	12,288	5,859	2,086	4,343	5,836	23
Kearney	10.283	6,581	1,448	4,520	613	1,208	240
North Bergen	11.949	7,647	3,152	3,990	505	2,788	364
Union (Town of)	0.425	272	272	....	....	272	....
Union Township	1.329	851	592	....	259	582	10
Weehawken	1.472	942	443	13	486	367	76
West Hoboken	0.869	556	556	....	....	556	....
Totals	60.483	38,709	15,786	*11,468	11,455	15,073	713

* 4,045 acres of this is embanked, and 1,550 acres improved.

Hunterdon County.

Townships.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Alexandria	27.381	17,524	17,454	70	15,097	2,357
Bethlehem	23.645	15,133	15,133	....	9,789	5,344
Clinton (Town of)	1.128	722	722	....	722	....
Clinton Township	28.010	17,926	17,926	....	16,023	1,903
Delaware	43.107	27,589	27,353	236	25,028	2,325
East Amwell	24.577	15,729	15,729	....	12,313	3,416
Franklin	22.861	14,631	14,631	....	13,334	1,297
Frenchtown	0.439	281	236	45	236	....
High Bridge	17.731	11,348	11,348	....	8,481	2,867
Holland	24.886	15,927	15,665	262	12,594	3,071
Kingwood	36.940	23,642	23,271	371	20,698	2,573

Hunterdon County—Continued.

Townships.	Total. Sq. M.	Total. Acres.	Land. Acres.	Water. Acres.	Cleared Land. Acres.	Forest. Acres.
Lambertville	1.178	754	671	83	671	....
Lebanon	26.396	16,893	16,893	....	12,313	4,580
Raritan	39.663	25,384	25,384	....	24,050	1,334
Readington	48.734	31,190	31,190	....	29,818	1,372
Tewksbury	32.281	20,660	20,660	....	16,792	3,868
Union	19.897	12,734	12,734	....	11,910	824
West Amwell	20.266	12,970	12,919	51	10,569	2,350
Totals	439.120	281,037	279,919	1,118	240,438	39,481

Mercer County.

Townships.	Total. Sq. M.	Total. Acres.	Upland. Acres.	Tide Marsh. Acres.	Water. Acres.	Cleared Upland. Acres.	Forest. Acres.
Chambersburg	1.225	784	784	....	....	784	....
East Windsor	16.956	10,852	10,852	....	....	9,104	1,748
Ewing	17.748	11,359	11,103	....	256	10,512	591
Hamilton	41.075	26,288	25,388	376	524	23,432	1,956
Hopewell	60.242	38,555	38,312	....	243	34,893	3,419
Lawrence	21.660	13,862	13,862	....	....	12,902	960
Millham	0.628	402	402	....	....	402	....
Princeton	18.331	11,732	11,732	....	....	9,951	1,781
Trenton	2.908	1,861	1,631	....	230	1,631	....
Washington	20.796	13,309	13,309	....	....	10,982	2,327
West Windsor	26.334	16,854	16,854	....	....	13,807	3,047
Totals	227.903	145,858	144,229	376	1,253	128,400	15,829

Middlesex County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Cranbury	17.713	11,336	11,336	....	....	9,886	1,450
East Brunswick	29.162	18,664	17,971	622	71	9,745	8,226
Madison	37.496	23,998	22,766	1,232	....	9,136	13,630
Monroe	44.159	28,262	28,262	....	....	21,025	7,237
New Brunswick	4.351	2,785	2,586	51	148	2,528	58
North Brunswick	14.024	8,975	8,975	....	....	7,076	1,899
Perth Amboy	6.245	3,997	2,624	334	1,039	1,880	744
Piscataway	32.212	20,616	20,462	....	154	19,107	1,355
Raritan	35.688	22,840	20,370	1,950	520	15,038	5,332
Sayreville	17.161	10,983	8,366	1,745	872	1,790	6,576
South Amboy	1.122	718	705	13	....	615	90
South Brunswick	48.971	31,341	31,341	....	....	21,640	9,701
Woodbridge	29.536	18,903	15,676	2,252	975	11,810	3,866
* Water	6.596	4,221	....	....	4,221	....	....
Totals	324.436	207,639	191,440	8,199	8,000	131,276	60,164

* Part of Raritan bay included in Middlesex county, but not belonging to any township.

Monmouth County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Atlantic	31.662	20,264	20,264	....	....	....	14,088	6,176
Eatontown	12.000	7,680	7,199	77	404	....	5,358	1,841
Freehold	40.577	25,969	25,969	....	....	....	16,941	9,028
Holmdel	17.968	11,500	11,500	....	....	....	10,203	1,297
Howell	65.951	42,209	42,209	....	....	....	16,345	25,864
Manalapan	31.276	20,017	20,017	....	....	....	16,755	3,262
Marlboro	30.575	19,568	19,568	....	....	....	14,860	4,708
Matawan	8.455	5,411	4,891	520	....	....	4,304	587
Middletown	43.132	27,604	25,326	1,008	1,270	....	20,353	4,973
Millstone	39.616	25,354	25,354	....	....	....	19,300	6,054

Monmouth County—Continued.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Neptune	12.756	8,164	7,445	39	680	....	3,553	3,892
Ocean	25.237	16,152	12,355	206	1,690	1,901	9,450	2,905
Raritan	9.410	6,022	5,200	822	....	....	4,169	1,031
Shrewsbury	32.882	21,044	18,308	526	2,210	....	13,055	5,253
Upper Freehold	47.997	30,718	30,718	....	....	....	29,550	1,168
Wall	40.994	26,236	24,676	180	1,380	....	13,004	11,672
*Water	47.450	30,368	....	....	30,368	....	....	....
Totals	537.938	344,280	300,999	3,378	38,002	1,901	211,288	89,711

* Part of Raritan bay included in Monmouth county, but not belonging to any township.

Morris County.

Townships.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Boonton	6.875	4,400	4,400	....	1,990	2,410
Chatham	22.913	14,664	14,664	....	10,611	4,053
Chester	30.200	19,328	19,328	....	13,089	6,239
Hanover	51.587	33,016	33,016	....	21,728	11,288
Jefferson	44.258	28,325	27,315	1,010	7,369	19,946
Mendham	24.355	15,587	15,587	....	10,969	4,618
Montville	18.850	12,064	12,064	....	6,490	5,574
Morris	18.870	12,077	12,077	....	8,269	3,808
Mount Olive	32.066	20,522	20,036	486	11,282	8,754
Passaic	33.315	21,322	21,322	....	16,160	5,162
Pequannock	36.777	23,537	23,430	107	9,370	14,060
Randolph	27.854	17,827	17,827	....	9,607	8,220
Rockaway	63.339	40,537	39,420	1,117	10,606	28,814
Roxbury	24.244	15,516	14,828	688	7,012	7,816
Washington	44.682	28,596	28,596	....	19,257	9,339
Totals	480.185	307,318	303,910	3,408	163,809	140,101

Ocean County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Beach.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Berkeley	58.563	37,480	26,826	2,036	7,615	1,003	2,091	24,735
Brick	62.127	39,761	32,888	2,739	3,787	347	6,456	26,432
Dover	55.732	35,669	24,534	2,458	7,785	892	6,494	18,040
Eagleswood	35.308	22,597	6,251	5,566	9,607	1,173	1,036	5,215
Jackson	98.431	62,996	62,996	....	....	....	9,873	53,123
Lacey	107.511	68,807	56,369	2,800	8,792	846	2,621	53,748
Manchester	83 239	53,273	53,273	....	....	....	1,857	51,416
Ocean	33.936	21,719	10,182	1,368	9,569	600	972	9,210
Plumstead	40.191	25,722	25,722	....	....	....	8,245	17,477
Stafford	55.749	35,679	22,803	6,246	5,756	874	2,800	20,003
Union	44.821	28,686	17,154	4,756	6,168	608	1,386	15,768
Totals	675.608	432,389	338,998	27,969	59,079	6,343	43,831	295,167

Passaic County.

TOWNSHIPS.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Acquackanonck	11.338	7,256	7,256	....	6,395	861
Little Falls	5.804	3,715	3,715	....	2,509	1,206
Manchester	10.934	6,998	6,998	....	4,556	2,442
Passaic	3.241	2,074	2,074	....	2,023	51
Paterson	8.472	5,422	5,422	....	5,131	291
Pompton	53.394	34,172	33,968	204	7,535	26,433
Wayne	26.729	17,107	17,011	96	9,488	7,523
West Milford	80.244	51,356	50,010	1,346	12,647	37,363
Totals	200.156	128,100	126,454	1,646	50,284	76,170

Salem County.

TOWNSHIPS.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Alloway	34.046	21,789	21,789	....	....	14,032	7,757
Elsinboro	13.242	8,475	4,261	4,163	51	4,188	73
Lower Alloways Creek	45.787	29,304	13,462	15,759	83	10,731	2,731
Lower Penns Neck	24.075	15,408	10,787	4,218	403	10,187	600
Mannington	38.321	24,526	20,204	4,047	275	18,551	1,653
Oldmans	21.266	13,610	11,216	1,710	684	8,414	2,802
Pilesgrove	37.044	23,708	23,708	....	....	22,414	1,294
Pittsgrove	49.874	31,919	31,919	....	....	11,088	20,831
Quinton	24.798	15,871	15,373	498	....	8,101	7,272
Salem	2.863	1,832	1,258	523	51	1,258	....
Upper Penns Neck	18.707	11,973	11,111	862	....	8,663	2,448
Upper Pittsgrove	36.016	23,050	23,050	....	....	20,454	2,596
*Water	43.333	27,733	....	....	27,733	....	....
Totals	389.372	249,198	188,138	†31,780	29,280	138,081	50,057

*Part of Delaware river included in Salem county, but not belonging to any township.
†15,225 acres of this is embanked and improved.

Somerset County.

TOWNSHIPS.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Bedminster	27.018	17,292	17,292	....	16,882	410
Bernards	41.402	26,497	26,497	....	20,435	6,062
Branchburg	20.362	13,032	13,032	....	12,867	165
Bridgewater	44.395	28,413	28,343	70	23,729	4,614
Franklin	47.107	30,148	29,970	178	27,477	2,493
Hillsboro	58.232	37,268	37,268	....	33,226	4,042
Montgomery	33.075	21,168	21,168	....	20,074	1,094
North Plainfield	14.051	8,993	8,993	....	4,598	4,395
Warren	19.378	12,402	12,402	....	7,064	5,338
Totals	305.020	195,213	194,965	248	166,352	28.613

Sussex County.

Townships.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Andover	24.599	15,743	15,626	117	10,903	4,723
Byram	36.249	23,199	21,912	1,287	4,948	16,964
Frankford	36.509	23,366	22,581	785	16,617	5,964
Green	20.969	13,420	13,420	....	10,609	2,811
Hampton	29.765	19,050	18,950	100	14,254	4,696
Hardiston	38.741	24,794	24,794	....	13,438	11,356
Lafayette	18.245	11,677	11,677	....	10,346	1,331
Montague	44.565	28,522	28,166	356	9,319	18,847
Newton	2.750	1,760	1,760	....	1,587	173
Sandyston	42.527	27,217	27,002	215	12,821	14,181
Sparta	42.233	27,029	26,893	136	14,293	12,600
Stillwater	37.614	24,073	23,473	600	17,223	6,250
Vernon	69.045	44,189	43,949	240	20,292	23,657
Wallpack	23.337	14,936	14,562	374	7,122	7,440
Wantage	68.169	43,628	43,628	....	38,083	5,545
Totals	535.317	342,603	338,393	4,210	201,855	136,538

Union County.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Clark	4.743	3,036	3,036	....	....	2,806	230
Cranford	5.838	3,736	3,736	....	....	2,727	1,009
Elizabeth	12.961	8,295	4,388	2,658	1,249	3,989	399
Fanwood	10.451	6,689	6,689	....	....	4,668	2,021
Linden	14.008	8,965	7,057	1,710	198	5,822	1,235
New Providence	9.919	6,348	6,348	....	....	3,703	2,645
Plainfield	5.923	3,791	3,791	....	....	3,433	358
Rahway	4.035	2,582	2,537	45	....	2,484	53
Springfield	4.958	3,173	3,173	....	....	1,966	1,207

Union County—Continued.

Townships.	Total.		Upland.	Tide Marsh.	Water.	Cleared Upland.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.	Acres.
Summit	6.012	3,848	3,848	....	....	2,222	1,626
Union	15.274	9,775	9,775	....	....	8,312	1,463
Westfield	10.822	6,926	6,926	....	....	4,822	2,104
Totals	104.944	67,164	61,304	4,413	1,447	46,954	14,350

Warren County.

Townships.	Total.		Land.	Water.	Cleared Land.	Forest.
	Sq. M.	Acres.	Acres.	Acres.	Acres.	Acres.
Allamuchy	20.572	13,166	13,166	....	8,699	4,467
Belvidere	1.349	863	832	31	819	13
Blairstown	31.817	20,363	20,363	....	14,688	5,675
Franklin	23.927	15,313	15,313	....	12,441	2,872
Frelinghuysen	23.759	15,206	15,206	....	12,003	3,203
Greenwich	11.067	7,083	7,083	....	6,463	620
Hackettstown	2.964	1,897	1,897	....	1,851	46
Hardwick	17.662	11,304	11,304	....	7,298	4,006
Harmony	24.323	15,567	15,345	222	11,751	3,594
Hope	30.850	19,744	19,627	117	14,896	4,731
Independence	20.164	12,905	12,905	....	9,150	3,755
Knowlton	25.651	16,417	16,171	246	13,087	3,084
Lopatcong	9.387	6,008	5,925	83	5,554	371
Mansfield	30.335	19,414	19,414	....	13,600	5,814
Oxford	34.057	21,796	21,556	240	16,526	5,030
Pahaquarry	21.155	13,539	13,118	421	3,197	9,921
Phillipsburg	1.186	759	689	70	689	....
Pohatcong	14.807	9,476	9,299	177	8,150	1,149
Washington (Borough)	1.823	1,167	1,167	....	1,141	26
Washington Township	17.796	11,389	11,389	....	9,561	1,828
Totals	364.651	233,376	231,769	1,607	171,564	60,205

AREAS OF LAKES AND PONDS.

	Acres.
ATLANTIC COUNTY.	
Bargaintown, lower pond	73
Bargaintown, upper pond	57
Gloucester lake	85
May's Landing mill-pond	333
Pleasant Mills, south pond	51
Weymouth mill-pond	205
BERGEN COUNTY.	
Franklin lake	89
Rotten pond	25
BURLINGTON COUNTY.	
Atsion mill-pond	77
Batsto, east pond	89
Brown's Mills pond	45
Hanover Furnace pond	103
Harrisville mill-pond	101
CUMBERLAND COUNTY.	
Bridgeton mill-pond	85
Millville mill-pond	926
Willow Grove mill-pond	118
ESSEX COUNTY.	
Orange reservoir	64
GLOUCESTER COUNTY.	
Clayton mill-pond	69
Malaga Furnace pond	92
MIDDLESEX COUNTY.	
Weston's Mills pond	64
MONMOUTH COUNTY.	
Como lake	50
Deal lake	144
Silver lake	14
Spring lake	18
Sunset lake	18
Takanassee lake	29
Wesley lake	18
MORRIS COUNTY.	
Budd's lake	475
Denmark pond	172
Dixon's pond	35
Durham pond	47
Green pond	460

	Acres.
Hopatcong lake	2,443
Middle Forge pond	96
Mooseback pond	21
Petersburg mill-pond	53
Shongum pond	70
Splitrock pond	315
Stickle pond	110

OCEAN COUNTY.

Carasaljo lake (Lakewood)	97
Cook's pond	22
Little Silver lake	16
Manahawken mill-pond	98
Old Sam's pond	28
Twilight lake	21

PASSAIC COUNTY.

Buckabear pond	59
Cedar pond	69
Charlottesburgh mill-pond	42
Dunker pond	17
Greenwood lake (total area)	1,920
Hank's pond	75
Macopin lake	299
Mud pond	28
Negro pond	69
Pompton lake	196
Sheppard's pond	97
Tice's pond	20

SALEM COUNTY.

Alloway mill-pond	122

SUSSEX COUNTY.

Bear ponds	38
Buckmire pond	10
Catfish pond (near Stillwater)	14
Cranberry reservoir	154
Culver's pond	486
Davis pond	14
Decker pond (Pochuck mountain)	76
Franklin Furnace pond	55
Hewitt's pond	35
Hopewell Furnace pond	24
Howell's pond	26
Hunt's pond	37
Iliff's pond	36
Lane's pond, or Grinnell lake	67
Little pond (Swartswood)	100

	Acres.
Long pond (near Culver's Gap)	299
Long pond (near Andover)	117
Long pond (Kittatinny mountain)	13
Losee pond	137
Marcia lake	23
Mashipacong pond	46
Morris pond	136
Mud pond (Hamburg mountain)	28
Panther pond	41
Quick pond	43
Roe pond	23
Round pond (Kittatinny mountain)	33
Sand pond (near Coleville)	65
Sand pond (Hamburg mountain)	32
Stag pond	23
Stanhope reservoir	339
Stickle pond	35
Sucker pond	95
Swartswood lake	505
Turtle pond	13
Waterloo pond	68
Wawayanda lake	240
White lake	17
White's pond	11
Wright's pond	31

WARREN COUNTY.

Allamuchy pond	56
Catfish pond	31
Cedar lake (near Blairstown)	27
Glover's pond	13
Green's pond	117
Sand pond	14
Shuster pond	14
Silver lake	35
Sunfish pond	41
White pond	67

AREAS OF TIDAL WATERS.

Hudson river and New York bay, in New Jersey	12,048
Newark bay	5,126
Raritan bay, in New Jersey	35,274
Navesink river, Highlands to Seabright and Red Bank	2,502
Shrewsbury river above Seabright bridge	2,202
Shark river bay	1,018
Manasquan river	1,216

	Acres.
Barnegat bay, Bay Head to Cedar Bonnets	46,289
Little Egg Harbor bay, Cedar Bonnets to Little Egg Harbor light	20,103
Great bay	11,347
Little and Grassy bays	2,969
Reed's bay	2,502
Absecon bay	1,440
Lake's bay	1,792
Scull's bay	627
Great Egg Harbor bay, not including Peck's bay	4,832
Ludlam's bay	960
Great sound	1,542
Jenkins' sound and Genesis bay	730
Delaware bay in New Jersey, below Cohansey light	207,448

TOPOGRAPHICAL DESCRIPTION.

New Jersey lies on the eastern slope of the Appalachian region. This region may be defined as being bounded on the east by the Atlantic, on the south by the Gulf of Mexico, on the west by the Mississippi and Ohio rivers, and on the north by the river St. Lawrence. The elevation of Lake Erie is 565 feet above the sea, and the Ohio river at Pittsburgh is 700 feet. The highest part of the boundary of the region lies between these two points, and does not exceed 1,000 feet. The mountains which give character to the whole Appalachian region, rise at the promontory of Gaspé, on the Gulf of St. Lawrence, and extend southwest to Northern Alabama, where they sink below the plain.

The remarkably deep valley of the Hudson and Lake Champlain cuts off the New England portion from the rest of the region. So deep is this valley that a rise of about 150 feet in the sea level would cut off New England from the rest of the continent, forming a great island. The New England section consists of twin mountain masses divided by the valley of the Connecticut. The eastern mass, beginning at Gaspé, reaches an elevation of 5,385 feet in Mt. Katahdin, 225 miles southwest, and its culminating point is Mt. Washington, at an elevation of 6,288 feet, 375 miles from Gaspé. Thence it descends irregularly southward into Massachusetts. Westward the other mass, that of the Green mountains, rises near Quebec, and crossing into New Hampshire and Vermont as a double ridge, attains a height of 4,450 feet in Mt. Mansfield, in Northern New Hampshire. Killington peak is 4,221 feet high. Thence the Taghkanic and Hoosic

mountains extend southward between the valleys of the Hudson and Connecticut, reaching the Highlands of the Hudson with an elevation of about 1,600 feet. Here the range is cut through to its base, but continues onward southwest, essentially as one range, into New Jersey, becoming our Highland region.

From the heart of the Appalachian region, at Albany, New York, the Mohawk valley runs due west to the northwest border of the system. North of this valley and west of the Hudson-Champlain valley lies the triangular mountain mass known as the Adirondacks, detached from the northwest side of the Appalachians. Its maximum elevation is Mt. Marcy, 5,379 feet above the sea, and within 20 miles of Lake Champlain.

Southwest of the Hudson and Mohawk valleys lies the division of the Appalachians which crosses New Jersey and Pennsylvania. It is distinguished by having on its eastern side a series of parallel and remarkably-continuous ridges, and for its western half, broad plateaus, which range from 2,000 feet to 2,600 or 2,700 feet in elevation, and descend gradually northwest toward Lakes Erie and Ontario, and the western base of the system. First on the east come the Highlands, which we have already followed across the Hudson. They come into New Jersey with an elevation of from 1,400 to 1,500 feet, and continue southwest, gradually descending to about 700 feet as they reach the Delaware, but recovering a height of more than 1,000 feet again in Pennsylvania before they finally disappear at Reading. For sixty miles southwest the range is lost sight of, but re-appears beyond the Susquehanna, as South mountain. Swerving more to the southward and crossing the Potomac near Harper's Ferry, we reach an elevation of 3,993 feet in the Peaks of Otter, west of Lynchburg, Virginia. Thence into North Carolina these mountains continue as two ranges, the eastern of which retains the name Blue Ridge, which is applied to the range in Virginia, while the western is known as the Unaka or Smoky mountains. Here and there the two ranges are connected by transverse ridges, forming great mountain masses, which range above 4,000 feet elevation, and reach a maximum of 6,707 feet in Black Dome, North Carolina.

Northwest of this rather irregular range lies one of the most continuous and remarkable features of the Appalachian region. It is the Great Appalachian valley, which runs through from the St. Lawrence by Lake Champlain and the Hudson river, which stream, as we have

already seen, leaves it at Newburg and proceeds southward by a deep clove* through the Highlands to the sea.

Thence the Great valley runs southwest across Ulster and Orange counties, New York, and across Sussex and Warren counties, New Jersey, via Bethlehem, Pennsylvania, to Harrisburg and onward, becoming, finally, the valley of the East Tennessee river. It is known as Kittatinny valley in New Jersey and Eastern Pennsylvania, and as Cumberland valley in Southern Pennsylvania.

Northwest of this valley is a remarkably-continuous level-crested ridge, which is known as the Shawangunk mountain, in New York, and as the Kittatinny mountain, in New Jersey and Pennsylvania. It runs along the northwest border of New Jersey from the New York line to the Delaware Water Gap, which is cut through it. Thence it continues across Pennsylvania west of Harrisburg, following the Great Valley, as already described. It rarely exceeds 2,000 feet in elevation, the highest point in New Jersey being 1,801 feet. A feature of this range is the remarkable series of picturesque gaps through it, which give passage to the drainage of the country west. Among these may be mentioned the Delaware, Lehigh, Schuylkill, Swatara, and Susquehanna Gaps, ranging at distances of from 22 to 28 miles apart.

This ridge and the valley west of it, running through from Kingston, New York, to Port Jervis, thence as the Delaware river flows, to the Water Gap and on southwest, crossing Pennsylvania southeast of Mauch Chunk and Pottsville, are the last members of the Appalachian mountain region which are represented in New Jersey. Northwest of these lies a region having for its northwest border the steep face of the Allegheny mountain, and generally about 50 miles in width. Beginning at the Hudson, we have the Catskills, rising above 4,000 feet. This plateau region extends into Pennsylvania, where it is known as the Pocono mountain, and ranges a little above 2,000

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*This term is here and subsequently used to denote a narrow, deep valley running across the mountain ranges and not conforming to the general geological and topographical structure of the country, while the term valley is confined to valleys which do thus conform to the structure. The terms Hudson valley, Delaware valley, Susquehanna valley, etc., are misleading, as none of these streams has one valley throughout. All enter and flow in the Great Appalachian valley, for instance, for a short distance, then leave it through narrow cloves, cutting the intervening ridges through to their bases. Ravine is here confined to a hollow, which is very shallow high up at the head of the stream, and becomes deeper below. A "clove," on the contrary, is of about the same depth throughout. A cañon is a clove with vertical sides and a flat bottom.

feet in elevation. Next, southwest, this region becomes a labyrinth of mountains, with a few small plateaus, but mainly composed of narrow, steep-sided ridges, rising from 800 to 1,000 feet above the valleys. About the Susquehanna the country becomes more open, with low, rolling slate hills and limestone valleys, the whole being under cultivation. Still further southwest we have a series of parallel ridges rising from 800 to 1,200 feet above the valleys, and sometimes reaching 1,500 feet. The valleys range from 500 to 1,000 feet.

Back of this region of mountain ridges and small plateaus rises the Allegheny mountain, presenting on the southeast a nearly continuous wall of rock 2,000 feet high. Northwest from its crest the country generally descends slightly, but maintains the character of a great plateau.

The eastern base of the Appalachian system is a plain gently sloping toward the Atlantic, having a width of about 50 miles in New England, but being decreased by the great bight of the ocean sweeping inward between Capes Cod and Hatteras to but a few miles near New York, thence increasing rapidly in width southward, it reaches 200 miles at Cape Hatteras. Its elevation along the base of the mountains in New England is from 300 to 500 feet; in New Jersey from 200 to 600 feet, and southward it rises above 1,000 feet. The western base on the plains about the Ohio river is about 1,000 feet above tide, and about Buffalo, Rochester and Syracuse from 500 to 600 feet.*

TOPOGRAPHY OF NEW JERSEY.

The topography of the State is readily classed in belts which correspond closely with the outcrops of the various geological formations. Beginning at the northwest we have the Kittatinny mountain and valley, occupying the western half of Sussex and Warren counties, and corresponding to the Paleozoic formation, next the Archæan Highlands, then the rolling Triassic or red sandstone plain, then the furrowed and irregularly-hilly Cretaceous plain, and lastly the triangular, extremely-level, sandy and pine-clad plain of the Tertiary formation, fringed seaward by a belt of tide-marsh enclosed from the sea by sand beaches. These features are common to the Atlantic slope southwest.

* The Appalachian Mountain System, by Prof. Arnold Guyot, in Silliman's Journal, Vol. 31, Second Series, p. 157; and Prof. J. P. Lesley's Topography of Pennsylvania, have been freely drawn upon for the above.

EFFECT OF GLACIAL ACTION ON THE TOPOGRAPHY.

Before proceeding with a detailed description of these belts it will be well to explain the cause of the great contrast presented by the northeastern and southwestern portions of each. The most cursory glance at the topographic sheets will reveal a marked difference in the two portions. To the northeast there is evidence of great erosion, the ridges are more cut up by transverse depressions, the valleys are less smooth, and everywhere we find lakes and ponds, marshes and sink-holes. This is to be attributed to a cause the discussion of which belongs more properly to the geologist than to the topographer, yet the effects are so striking to the observer that it is necessary to briefly call attention to it here.

In 1877 and 1878 the annual reports of the State Geologist set forth the evidence of the existence at some time of a great ice sheet covering New Jersey, in common with the rest of our continent, down to latitude 40° 30′. Its southern limit was traced carefully across the state. This limit is clearly marked by a line of extremely irregular, fantastically-arranged hills of gravel and boulders, formed of the material eroded by the glacier from the hills to the north and deposited here where the ice melted. This moraine begins at Perth Amboy and runs thence through Metuchen, east of Plainfield, where the Netherwood hotel is built upon it, to the base of the First mountain north of Scotch Plains. Thence the mantle of gravel is wrapped about the slope and over the north end of Springfield or Roll's hill and filling completely the valley west, crosses Second mountain and lies up against the north end of Long hill, at Chatham. From here to Morristown it fills the valley of the Passaic with a broad ridge of gravel, thence it skirts around the base of the Highlands and up through the valley of the Rockaway to Dover. From here the line is quite direct by Budd's lake, Hackettstown and Townsbury, to Belvidere.

To the north of this the ice sheet was thick enough to overtop all of the mountains of northern New Jersey and most of those of New York. Its movement was generally toward the south, and when we recall that a thickness of 2,000 feet would mean a pressure at the base of sixty tons per square foot, and that often boulders were imbedded in the base of the ice and moved forward with irresistible force, it may bring some conception of the enormous eroding action

of the glacier. It denuded the ridges of all disintegrated rocks, scooping out transverse depressions where the rock was soft, and leaving often hard, bare summits and irregular, jagged ridge lines in place of the well-soiled, gracefully-undulating ridges to the south of the moraine. It deposited in the valleys great masses of gravel and mud, which have been in some cases assorted and worked down into level terraces by water, but again left in all the fantastic disorder of their original deposition, in crooked ridges enclosing bowl-like depressions with no outlets, or hills carrying similar depressions in their very tops, like small volcanoes with their craters, and in every conceivable topographically-monstrous arrangement. Often these deposits have closed the outlet of a valley, holding back the water in beautiful lakes and ponds, the water having been forced back over the original divide of the valley into another drainage system. When the drift dam has not been high enough for this, it has been cut away again by the water overtopping it. Remains of such dams may be found, with gravel terraces on the slopes of the valley above to mark the shores of the ancient lakes. The above accounts for the existence of most of the beautiful lakes of the northern counties, and also for the swamps and sink-holes which are merely shallow lake basins which have become filled with mud or vegetable matter. The drift dam which has formed Budd's lake is very evident, as is the one at Green's pond. The slopes of the hills of this region have usually been left covered with boulders, the finer material having been carried down into the valleys by water. The whole aspect of the country has been changed. Much of the soil having been rendered unfit for cultivation, a large percentage of the area is left in forest.

MINISINK VALLEY.

The Delaware river, from Port Jervis to the Water Gap, lies in the valley which runs through from just west of Kingston, New York, by Ellenville to Port Jervis, thence to Stroudsburgh and southwest, crossing the Lehigh river between Mauch Chunk and the Lehigh Gap. This quiet and beautiful Minisink valley, with its wealth of romantic aboriginal traditions and associations and its tragic colonial history, has long enjoyed a well-merited reputation as a charming, restful summer retreat for those who admire simple nature, and as a paradise for the sportsman and angler. On the southeast rise the

long, forested slopes of Kittatinny mountain, with its continuous level crest, and bold front raised as a final bulwark against the busy, bustling world beyond, and giving to the valley its air of remoteness and seclusion. To the northwest rises first, near the river, a line of steep wooded hills four or five hundred feet high, and back from their crests the undulating slope of the Catskill plateau still ascends for ten miles from the Delaware, attaining an elevation of 1,500 or 1,600 feet in Pike county and over 2,000 feet in Monroe county. From crest to crest of the mountains, therefore, this valley is more than fifteen miles wide and about 1,200 feet deep. From Port Jervis to Walpack bend the Delaware flows through a flat-bottomed, U-shaped sub-valley, at the bottom of the great valley, having steeper slopes and a mean width of two miles with a depth of 400 to 500 feet. This is really a trough in the rock with its bottom filled to a depth of more than 100 feet with gravel and drift. It is a buried valley. A well at Port Jervis was bored to a depth of 113 feet, or 63 feet below the river, without striking bed-rock.* The surface of this gravel has been formed into a series of level terraces; the lowest, rising abruptly from the river as a gravel bluff from 20 to 30 feet high, is well shown at Mashipacong island, Milford, Dingman's, Shapnack island and above Poxono island. There is another terrace at about 50 feet, another at 120 feet and a fourth at 150 feet above the river. These are so well marked as to become prominent topographical features of the valley, and may be traced on the contour maps on the New Jersey side. Their further discussion must be left to the geologist. On these terraces, and particularly on the lowest, which is composed of finer material than the others, were the level and easily-cultivated Indian plantations and later the farms of the pioneers, which gave, early in the eighteenth century, a wide reputation for fertility to the Minisink country.

From Deposit, the Delaware river comes rushing down through a narrow clove in the Catskill plateau, with a fall of six and one-half feet per mile for 90 miles, and enters our valley at Port Jervis. Here it turns a sharp right angle to the right and then meanders southwesterly through the valley, now gliding gently through long, deep pools and now leaping down short rapids, over rough boulder reefs. The total fall from Port Jervis, where its elevation is 411 feet, to the

*Second Geological Survey of Pennsylvania. The Geology of Pike and Monroe counties, p. 52.

Water Gap, is 124 feet, or just three feet to the mile for the 41 miles. Often the stream divides into two or more channels enclosing some large islands. At Mashipacong island the width from outside to outside of the extreme channels is three-quarters of a mile. From the river just above Milford one can look to the eastward up an apparently unbroken forest slope for six miles, to High Point, 1,400 feet above the river. At Wallpack bend, 25 miles down the valley from Port Jervis, the stream completely reverses its course twice within one and one-half miles, passing southeast through Wallpack ridge into another parallel sub-valley, partially separated from the first by the ridge. This valley first makes its appearance as a shelf on the mountain slope two miles southeast from and 380 feet above the river at Montague bridge; thence it gradually deepens southwesterly into the valley of Flat brook, and so rapidly steepens the west slope of Kittatinny mountain to a gradient of 1,000 feet per mile, cutting off Wallpack ridge to the west with a general elevation of about 700 to 900 feet, or from 300 to 500 feet above Flat brook. In this valley lie the villages of Hainesville, Layton, Peter's Valley, Wallpack Centre and Flatbrookville. The small valley of Millbrook, heading at the same point near Montague and coming out at Carpenter's Point, cutting off Hog-back ridge from the Kittatinny slope, might be considered a continuation to the northeast of this same sub-valley. It contains the most fertile land between the crest of the Kittatinny mountain and the Delaware; in fact, together with Wallpack ridge, it contains practically all the cleared land of this region. At Wallpack bend, where the Delaware cuts through it, Wallpack ridge becomes for a few miles a series of knobs merely, but rises again further on, separating the two sub-valleys. This ridge is formed of the hard, resisting Candagalli grit, the valley northwest being eroded in the Marcellus shale, and that southeast in the Clinton red-shale. Nowhere is the dependence of topographical features on geological conditions more clearly shown than in this Minisink valley.

As the river proceeds below Wallpack bend it nestles up close against the western foot of Kittatinny mountain, which here rises in an unbroken slope, 1,000 to 1,300 feet, in a distance of three-quarters of a mile, giving this part of the valley a wilder, more forbidding aspect than that above. Even here, however, we find quite broad cultivated gravel terraces on the Pennsylvania side, from which the river has separated the large Shawnee and Depue islands.

KITTATINNY MOUNTAIN.

Although, as we have seen, Wallpack and Hog-back ridges are cut off partially by the sub-valley, broadly we may consider the Kittatinny mountain region to embrace all between the Delaware river, the New York line, and the eastern foot of the steep mountain face which is so marked a feature of the landscape of Sussex and Warren counties. This embraces the townships of Montague, Sandyston and Wallpack, in Sussex county, and Pahaquarry, in Warren county, an area of about 140 square miles. Its width at the New York line is three miles. The spreading out of both sides brings the greatest width, which is opposite Montague, up to eight miles; thence it narrows down to two miles at the Water Gap. Its western foot is the Delaware, at an elevation of 411 feet, at Port Jervis, and 287 feet at the Water Gap. The foot of its steep eastern face rests on the high slate hills of the west side of Kittatinny valley, and has throughout a remarkably uniform elevation, ranging between 900 and 1,000 feet. The crest of the mountain is generally only from 200 to 400 yards west of this foot, and is from 450 to 650 feet above. The crest is often double, but excepting the first four miles from the New York line, the higher one is immediately at the top of the escarpment. From the depression at Otisville, New York, 10 miles northerly from the State line, where the mountain is crossed by the New York, Lake Erie and Western railroad, it rises gradually, reaching an elevation of 1,539 feet, where it enters New Jersey, and its culminating point at High Point, one and one-quarter miles southwest, with an elevation of 1,803 feet, is the highest land in New Jersey. Thence it descends irregularly to Sand pond, near Coleville. This portion of the crest is more irregular than any other part within the State. The eastern slope is less steep and rises in two terraces, the lower reaching a general elevation of 1,400 feet, and holding the beautiful Sand pond at an elevation of 1,302 feet. Just southwest of High Point, in the depression in the mountain crest, lies Lake Marcia, at an elevation of 1,570 feet—the highest body of water in New Jersey. At High Point the mountain is a simple ridge, with a short eastern and a long western slope. Five miles southwest, at Mashipacong pond, it has become a plateau four miles wide, with its eastern edge at an elevation of from 1,400 to 1,650 feet, and its western at about 1,200 feet; its western slope falling 800 feet in three miles, and its eastern slope being the char-

acteristic eastern escarpment of the mountain. The main eastern crest reaches a second culmination west of Beemerville, where it has an elevation of 1,650 feet. Thence it continues southwest, gradually descending to 1,340 feet, where it is cut through by Culver's gap, the bottom of which is at an elevation of 915 feet, being the lowest point of the crest between Otisville, New York, and the Delaware Water Gap. From the State line to this point the eastern escarpment is convex, beginning with a direction of south 15° west, and gradually curving round to south 50° west. Southward from this it is concave to the Warren county line. Opposite Culver's gap, on the northwest, Flatbrook valley begins to assume character and to steepen the western slope and narrow the mountain to a ridge; although the plateau, reduced to a width of less than two miles, continues to near the line between Sandyston and Wallpack townships. Here the mountain is suddenly narrowed to a single ridge, with a base width of less than one and one-half miles. It continues southwest to the Water Gap, with sometimes a single and sometimes a double crest, and with a base width of from one and one-quarter to two miles. The main crest is almost everywhere immediately at the top of the escarpment, and the highest point between Culver's gap and the Water Gap is just northeast of Round pond, reaching 1,614 feet. Through from Culver's gap to the Sandyston and Wallpack line it ranges from 1,300 to 1,400 feet, through Wallpack township from 1,300 to 1,600 feet, and through Warren county from 1,300 to 1,625 feet, excepting at Catfish Pond gap, the lowest point of the 23 miles between Culver's gap and the Water Gap, where it is 1,205 feet. There are long stretches of remarkably level crest; sometimes the elevation does not vary fifty feet for a distance of two or three miles.

This part of the mountain in Warren county is characterized by marked offsets in the eastern escarpment, the mountain suddenly advancing eastward as we proceed southwest. These offsets are three in number. The first, at the road crossing from Millbrook to Blairstown, amounts to about 700 yards; the next, five and one-half miles southwest, amounts to nearly a mile; and one at the Water Gap itself, to some 240 yards. At the famous Delaware Water Gap the Kittatinny mountain is cut completely across to its base. Coming down along the western foot of the mountain with a general course south 61° west, the river turns suddenly to a direction about south 27° east, and proceeds on this course directly through Kittatinny mountain and

ten miles onward across the valley almost to its eastern side. The elevation at the extreme end of the ridge on the New Jersey side of the gap is 1,486 feet, and one mile back the crest rises to 1,635 feet. The brow on the Pennsylvania side is 1,400 feet, and the top of the crest just southwest, 1,495 feet. The elevation of the river below is 283 feet. The width of the gap at the top is 1,500 yards, and at the bottom about 300 yards. The base of the mountain proper is a trifle over two miles, but the gap continues through the foot-hills east, having still a depth of 300 feet, one and a half miles from the foot of the Kittatinny escarpment. If we suppose the gorge to have been formed entirely by erosion, the mass of material removed in the four miles below the west foot of the mountain must have been 1,260 million cubic yards, or equal to a mass with a base of one square mile, and a height of over 1,200 feet. There is no doubt, however, that a fault exists here, and it is reasonable to suppose that there was a fissure of some width, which has been widened and deepened by erosion.

This clean cut through the remarkably-uniform, level-crested Kittatinny mountain, with its edges rising sheer 1,200 feet, in slopes averaging 45 degrees, and in part nearly vertical, is a most impressive and majestic feature of the landscape of Sussex and Warren counties. Visible from every hilltop open to the northwest or west, it rises against the horizon an awe-inspiring monument of the irresistible character of nature's forces and of the comparative insignificance of man and his works.

The Kittatinny mountain region is generally not well fitted for cultivation. The mountain crest is formed of the flinty Oneida conglomerate, but thinly soiled; and the western slope and rolling plateau are covered with loose rock, gravel and boulders, and have been but little cleared and improved. Nearly all of the fertile land is in the valleys of the Delaware and Flatbrook, and on the intervening Pompey or Wallpack ridge. Of the whole region, but 40 per cent. is cleared and cultivated. There is still a considerable amount of heavy timber standing, principally hard wood, with some pine and hemlock. The general aspect of the region is wild and forbidding.

KITTATINNY VALLEY.

New Jersey contains 40 miles of the length of the great Appalachian valley. Its width varies from 10 to 13 miles. Its general

direction is south 50° west. On the northwest it is bounded and overlooked by the almost unbroken Kittatinny escarpment, and on the east by the irregular edges of the Highland plateaus. Two well-defined drainage axes or sub-valleys traverse it longitudinally. The principal one lies from two and one-half to five miles from the northwestern side of the valley, gradually approaching the Kittatinny mountain as we proceed southwest. The general direction of this sub-valley is quite straight, and its highest point is just east of Augusta cross-roads, 501 feet above tide. Should the sea rise this amount, it would surround and make an island of the Highlands from the Hudson to the Delaware. Northeast from this divide the valley is drained by the Papakating creek and the Wallkill, reaching the State line with an elevation of 403 feet, and to the southwest by the Paulinskill, which enters the Delaware at an elevation of 270 feet; excepting the part occupied by Papakating creek, which is on the slate, the bottom is everywhere on the limestone, and is fertile. The higher parts of Kittatinny valley are slate, and the sub-valleys are generally on the Magnesian limestone. To the northwest of this drainage-axis the slate hills rise rather abruptly to elevations ranging from 700 to 900 feet, and then there is a general, although not always marked ascent toward the mountain, the foot of the escarpment of which ranges from 900 to 1,000 feet in elevation. There is a marked tendency to a ridge structure in this region of foot-hills, the axes of the ridges being parallel with the trend of the mountain above, and changing as it curves. The continuity of the ridges is broken by transverse ravines, the general direction of the drainage being southeast. One of the best known of these deep ravines is "the Clove," between Deckertown and Coleville. The ridges are not marked, however, and often the general appearance of the topography is that of a confused, irregular mass of hills and knobs, separated by very uneven and crooked ravines. At Mt. Salem and at Coleville, in Wantage township, these hills reach 1,030 feet in elevation. Between Branchville and Swartswood they assume the character of a plateau coming out quite level for three and one-half miles from the foot of Kittatinny mountain directly to the border of the sub-valley at Myrtle Grove with an elevation of 1,000 feet or more. Culver's pond, with an elevation of 849 feet, and Long pond, 865 feet, are clear and beautiful lakes on this plateau, directly at the foot of the Kittatinny escarpment. Their high elevation and the proximity of Culver's

gap and the mountain, from the crest of which may be had most charming views of the wild, romantic mountain scenery of the Kittatinny region itself, of the Catskill plateau in New York and Pennsylvania, beyond the Minisink valley, as well as of the calm and peaceful Kittatinny valley, with the graceful profiles of the Highlands beyond, to the southeast, should give these lakes and the surrounding country popularity as a summer resort. Northeast of Culver's pond there is a marked absence of ponds in the Kittatinny valley; but from this and White lake, almost exactly opposite on the east side of the valley, southwest to the terminal moraine, they are very numerous. One of the most attractive of these is Swartswood lake lying at the west side of the Paulinskill valley which is here about two miles wide and somewhat broken by limestone knobs. This lake is 482 feet above sea level, and is exceedingly picturesque and beautiful, having bold, irregular shore-lines, and clear, limpid waters. It has begun to attract pleasure-seekers in considerable numbers. A mile southwest of the Sussex and Warren line, just west of Newbaker's Corner, is the highest land in the foot-hill region. It is 1,105 feet above tide. A few miles below this the Paulinskill sweeps in toward the mountain, and the foot-hills are reduced to almost a continuous slope from the foot of the escarpment to the sub-valley 750 feet below.

The northeastern part of this foot-hill region is generally well cultivated and productive. Wantage township lies almost entirely on it, and has but 13 per cent. of its area in timber. Frankford township has 27 per cent., and Hardwick township 36 per cent. of uncleared land, showing the increase of waste land as we proceed southwest. This is largely due to glacial debris, as is also the greater prevalence of lakes and ponds in this direction. But even in the more cultivated parts of the Kittatinny valley the timber is so disposed over the tops and slopes of the hills as to give the impression of a country but little cleared and improved in any general view, particularly looking east, as there is rather more timber on the western than on the eastern slopes.

On the east side of the great valley, close to the foot of the Highland plateaus, lies the second drainage axis, or sub-valley. The Lehigh and Hudson River railroad, from the New York line to Belvidere, lies in it throughout. It cuts off from the Highlands the gneissic masses of Pochuck mountain, at the New York line, and Jenny Jump

mountain, near Belvidere, leaving them standing out like islands of Archæan rock in the edge of the limestone valley. If we take into account the geological structure and subordinate the topographical appearances, we may regard Pochuck mountain as a continuation of Pimple Hill ridge southwest, said ridge having been depressed below the valley bottom at Hamburg. Likewise Jenny Jump mountain may be regarded as a northeast continuation of Scott's mountain; but as much of the drainage of the Kittatinny valley passes around to the southeast and south of this mass through the valley of the Pequest, which has much in common with the main valley, and Pochuck mountain is so completely isolated, we prefer to regard Jenny Jump and Pochuck mountains as detached masses standing out in the great valley.

Five miles northeast of the New York line, in Orange county, Kittatinny valley has reached a width of 20 miles; for at the State line the Highlands fall back suddenly to the southeast and Kittatinny mountain not only becomes gradually depressed, but also keeps up the general retreat to the northwest, which it begins at Beemerville, in Sussex county. The bottom of the valley is here very level for a width of nine miles, with no marked sub-valleys, but going farther northeast the ridges of slate again rise and the sub-valleys are marked. Starting from the forks of the Wallkill and Pochuck creek, at the southern edge of this broad valley expanse, and passing up the Pochuck southward, we cross the New Jersey and New York line at an elevation of 392 feet on the Pochuck meadows, and find ourselves cut off from the great valley on the west by Pochuck mountain, which began to rise from the valley one and one-half miles back and has already reached an elevation of 1,167 feet, or 775 feet above the valley, and reaches its summit elevation four miles southwest, at the head of Decker pond, where it is 1,224 feet above the sea. From north to east, however, all is open to the main valley, for Vernon valley, as this part of the sub-valley is called, is funnel-shaped and is here still six miles wide. It is a pleasant and fertile limestone valley, with extensive meadows bordering its streams, and furnishing much good grazing, although they are rather too wet for the good of the district. On the southeast side—for we are gradually turning to the southwest as we proceed up the creek—rise the steep slopes of the Wawayanda and Hamburg mountains. In reality, this is only the edge of a broad Highland plateau. It rises sheer 1,000 feet above the valley. On its foot-hills, 100 feet above the meadows, stands the

village of Vernon. Five miles from the State line the valley has narrowed to a mile in width, but just beyond, at McAfee, it begins to spread again, opening out once more to the main valley as Pochuck mountain rapidly subsides below the bottom of the valley. One mile from Hamburg we pass over the dividing rim between the Pochuck and Wallkill drainage basins, at an elevation of 493 feet, and reach the Wallkill at Hamburg, with an elevation of 405 feet. This stream comes out in the Kittatinny valley, at Franklin Furnace, from a small valley in the Highlands, which might, as we have observed, be considered the head of Vernon valley. Thence to Hamburg the Wallkill falls 128 feet as it crosses our sub-valley diagonally, and then flows straight across into the northwestern sub-valley, with scarcely enough fall for ready flow, cutting the intervening ridge completely through.

At Hamburg begins a mass of drift, in hills and terraces, which almost destroys the continuity of the sub-valley line. The first eight miles of the valley, from the State line, was drained by the Pochuck. The Wallkill water-shed takes in seven and one-half miles, to just south of White lake, where we cross the rim of the Paulinskill basin, at an elevation of 620 feet. We are now on the Germany Flats, a district of broad gravel terraces, with a very decided slope toward the southwest. It is evident to the observer that there are great masses of gravel through from here to Andover, and the line of deep ponds and sink-holes, almost continuous, furnishes evidence of a buried valley. For four miles from White lake this sub-valley is drained by the east branch of the Paulinskill, which flows straight across the Kittatinny valley to the northwest sub-valley, through a remarkable cross valley or clove, which may well challenge the attention of the geologist. Starting from the valley of Flatbrook, near Layton, a marked depression may be followed across Kittatinny mountain, through Culver's gap to Branchville, where it is full 300 feet deep. From here it crosses by Lafayette to the southeastern sub-valley, at Sparta Junction, almost level, cutting through the intervening ridges with an average depth of about 100 feet, and proceeds across Pimple Hill ridge, with a depth of 400 feet, cutting it down to near the level of the valley at Sparta, whence it can be traced on completely across the Sparta plateau to Milton, Morris county, running thus 20 miles at right angles to the direction of the ridges and the strike of the rock.

At Mulford Station we pass over into the Pequest drainage basin at an elevation of 600 feet, and from here this stream follows the

sub-valley to its junction with the Delaware, at Belvidere, at an elevation of 229 feet. Through Germany Flats the sub-valley is something over a mile in width. The slopes of the Highlands on the southeast are gentler and more irregular than elsewhere, rising only from 200 to 400 feet. The limestone knobs and slate ridges northwest do not average more than 150 feet above the flats. At Long pond, near Andover, the valley is contracted to one-quarter of a mile, being almost filled by the pond; but from here it widens rapidly, the limestone hills northwest gradually falling off to the general level of the valley, so that between Johnsonburg and Allamuchy we have a flat two and one-half miles wide, with some scattering knolls 40 to 80 feet high. Here is the beginning of the Pequest meadows, and, just as we reach them, Jenny Jump mountain springs from the plain on the northwest, reaching at once an elevation of 1,141 feet and narrowing our valley to an average width of two miles. For four miles our sub-valley is now occupied by a dead level of peaty bog or heavily-timbered swamp, probably the remains of a shallow lake held back by a dam of drift at its lower end. The improvement of the outlet, a few years since, has so far relieved this tract from overflow as to render its cultivation very profitable, and a few years more will no doubt see this great waste converted into smiling fields and meadows.

To the southwest end of these meadows the direction of the sub-valley has been uniformly south 40° west, but here the way is completely blocked in this direction by Mt. Mohepinoke, which rises to an elevation of 1,140 feet. The valley, therefore, offsets its whole width to the southeast at Danville, and then continues in the same direction as before for five miles, when it turns due west around the south ends of Mohepinoke and Jenny Jump mountains to Belvidere.

It will be seen that this last sub-valley is less continuous than the one occupied by the Paulinskill, Papakating and Wallkill, and its drainage often passes across into that line of lowest levels of the valley; so we may regard the northwestern as the main axis of the great valley. Nevertheless, when we consider the higher levels only, the tops of the ridges and knolls, we find that the general elevation of the eastern side of Kittatinny valley is lower than the western. In fact, we can trace another quite distinct longitudinal line of low levels nearly midway between these two sub-valleys, well separated from the northwestern one by continuous slate ridges, but often so

imperfectly distinguished from the southeastern sub-valley as to sometimes make it seem almost truer to regard them as parts of one valley or level plain diversified by a confused jumble of shapeless limestone knobs. The two principal sub-valleys are from four to five miles apart across Sussex county and into Warren to where Jenny Jump mountain rises abruptly from the valley, but diverge from there, reaching a distance of ten miles apart, before the Pequest valley turns westward to the Delaware.

This third line of depression begins with the valley of Beaver run, a tributary of the Wallkill, west of Hamburg, and for some distance is less than two miles from the southeastern sub-valley. Beaver run valley is narrow, but as we reach the rim of the Paulinskill watershed, a mile southwest of Harmony Vale school-house, it spreads into a broad, flat valley, 564 feet above sea level, diversified by low knolls and ridges from 75 to 100 feet above its general level. On the southeast is a narrow, continuous slate ridge rising from 700 feet elevation opposite Hamburg to 800 feet southeast of Lafayette. On the northwest we are separated from the Papakating valley, which lies 150 feet lower, by a slate ridge more than a mile across, having many summits, irregularly disposed, and rising from 700 to 900 feet above tide. This ridge is cut down to the level of our valley of Beaver run by two gaps, the one near the road from Monroe Corners to Papakating valley, and the other between the two roads leading from Beaver run into the same valley.

Proceeding southwest to Lafayette, we cross the great cross clove, already mentioned, at an elevation of 550 feet, and proceeding, find our valley filled with the bog and brushy swamp known as the Paulinskill meadows, reaching from Branchville Junction to Newton, three miles, with an average width of three-quarters of a mile. It is noticeable that swamps occupy more than half the length of this line of low levels which we are following across Sussex county. These and the masses of gravel left by the glacier have robbed Sussex of much of what should be her most fertile land, the limestone bottoms of this and the valley east.

Where Newton lies up against its northwestern slope our valley begins to widen. After crossing the cross clove, through which the east branch of the Paulinskill pours the waters of Germany Flats, at Branchville Junction, the slate ridge southeast rose again, and opposite here it has an elevation of over 800 feet on some of the highest

knobs, but as we pass on from the Paulinskill to the Pequest drainage basin, with a maximum elevation of 592 feet, and reach Springdale, the Pequest breaks across the ridge due south to the valley beyond, and the two valleys become practically one from here to the northeast end of Jenny Jump mountain. This area from the crossing of the Paulinskill southwest to Jenny Jump mountain, about four miles wide and fifteen miles long, including the middle and southeastern sub-valleys, is best treated of as a whole. It is almost entirely on the limestone, and, while it has many very fertile farms scattered in among the craggy limestone knobs in the hollows, it embraces much waste land in its swamps and on its bare ledges of rock. At the northeast it has 30 per cent. of its area in forest and the southwest portion has 20 per cent., but the timber is so disposed over the hills as to appear to cover more than this.

Just northwest of Springdale, at the west side of this valley, lie the famous Muckshaw and the cavern known as the Devil's hole, of revolutionary fame. Southwest of Springdale we can still readily follow the line of low levels, nowhere rising above 600 feet, passing just east of the village of Johnsonburg, which nestles in a depression in the side of the slate ridge northwest, and just beyond striking Glover's pond, the source of the eastern branch of Beaver brook. We now pass into a well-defined valley to the west of Jenny Jump mountain, which for nine miles onward rears its steep slopes from 600 to 700 feet above forming a marked feature of the landscape of this region. Reaching the quaint and attractive village of Hope, with its Moravian traditions and peaceful, rural aspect, we are met by Beaver brook which issues here from a small side valley which it has worked out for itself in the slate hills northwest. The valley bottom is here 400 feet above tide, and the hills on its northwest side range from 550 to 650 feet. It possesses the same general character to where the Pequest comes in from the east, two miles northeast of Belvidere, where a much larger valley opens out and continues southwest to Allentown, Pennsylvania.

Between this line of low levels last traced and the Paulinskill, there lies a very rolling slate plateau with some tendency to a ridge structure. Back of Newton, and also back of Johnsonburg, it is but two miles wide, expanding to three miles between these points. Southwest, near the Delaware, it is five miles in width. Northeast of Johnsonburg, where it is depressed to 700 feet, its summits rise from 850

to 950 feet above tide, and there is a remarkable uniformity in the elevation of its passes, several of which are 760 feet. Southwest, from Johnsonburg to the Delaware, its higher elevations range from 700 to 800 feet. This is as fully improved as any part of the Kittatinny valley, only from 10 to 20 per cent. of the area being uncultivated.

The Delaware comes through the Water Gap with an elevation of 280 feet, and passes straight across Kittatinny valley with an average fall of $4\frac{1}{3}$ feet per mile through a clove or cañon from three to four hundred feet deep, and with a bottom width of about one-third of a mile. At Manunka Chunk it turns abruptly, and follows the trend of the valley southwest toward Easton. At this crossing of the Delaware there is a marked change in the topography of Kittatinny valley. From here to the Hudson the main drainage is in the direction of the valley, and there are two or more sub-valleys, as described, but to the southwest we have but a single drainage axis. From the junction of the valleys of Beaver brook and the Pequest, at Belvidere, a broad limestone valley, about three miles wide, opens out and broadens as we proceed southwest. Easton, Bethlehem and Allentown, in Pennsylvania, are at its southeastern side and Nazareth at its northwestern, its width here being seven miles. Continuing its general course south 60° west, but narrowing somewhat, it strikes the Schuylkill river about six miles north of Reading. It will be recollected that at Belvidere we pass the southern limit of the great ice sheet, hence this valley has escaped its eroding action, and in place of the rough rock ledges, gravel and swamps of the more northern limestone, we have here gently sloping, well-soiled knolls and clean, fertile hollows. The general elevation ranges from 400 to 500 feet. The East Pennsylvania railroad passes over from the Lehigh river to the Schuylkill with a maximum elevation of less than 500 feet. This broad limestone valley lies at the extreme southeast side of the Kittatinny valley at the foot of the Highlands. At Belvidere, Scott's mountain rises 900 feet above on the southeast, but rapidly falls off and disappears below the valley at Easton. The continuation of the Highlands, from the Delaware to Reading, Pennsylvania, nowhere rises more than 700 feet above the valley level, and usually not more than 500 feet. On the northwest, slate hills ascend back to the foot of the Kittatinny escarpment in an almost continuous slope, rising to the same general elevation as the foot-hills in New Jersey. Their drainage is all southeast, directly toward the single line of low level.

The Delaware follows the middle of the limestone valley from Belvidere to two miles below Martin's Creek, then turns southward, reaching the southeastern side at Easton, where it is joined by the Lehigh. The elevation of the river being 229 feet at Belvidere and 156 feet at Easton, it will be seen that it lies from two to three hundred feet below the general level of the valley. In the 18½ miles from Manunka Chunk to Easton it falls 93 feet, 12 of which is at Foul rift, where for half a mile the river plunges down over a limestone reef. The remaining fall is uniformly distributed, averaging 4½ feet per mile. The Lehigh comes through Kittatinny mountain at Lehigh gap, with an elevation of 390 feet, and runs southeast 16 miles across the Kittatinny valley to Allentown, where its elevation is 250 feet. Here it turns northeast and follows the eastern side of the sub-valley to Easton, 14 miles. Nearly 30 miles of the main axis of Kittatinny valley, from Belvidere to Allentown, is thus occupied by these two streams, which are forced to follow its trend until the depression of the Highlands southeast allows their waters to break through and proceed seaward. The drainage of 70 miles of this valley finds its outlet at Easton. At this point, Scott's mountain having fallen off about four miles northeast, a broad expanse of rolling plain, at the same general elevation as the bottom of the great valley, extends eastward, connecting that valley and the fertile Pohatcong valley, lying to the southeast and extending northeasterly 18 miles up into the Highlands of Warren county. This valley is opposite here but imperfectly separated from the larger parallel valley of the Musconetcong, lying three miles southeast and reaching northeast 35 miles into the very heart of the Highland region. These two beautiful and fertile valleys are physically similar to the Kittatinny valley.

The Kittatinny valley region crosses Sussex county a little northwest of its middle line, occupying all of the townships of Wantage, Frankford, Lafayette, Hampton, Newton and Stillwater; all of Green excepting a narrow strip on the southeast; the northwestern halves of Vernon, Hardiston and Andover and a little of the northwestern portion of Sparta. In Warren county Hardwick, Frelinghuysen, Blairstown and Knowlton lie entirely in the valley, and Allamuchy, Independence, Hope, Oxford and Harmony partially; while Lopatcong, Greenwich and Pohatcong are almost entirely on the plain which puts into the Highlands east of Phillipsburg and Easton. The lower levels of the valley are mainly on the limestone. The por-

tion of this included in the last four townships above named, having escaped the ice field, presents a smooth, well-soiled surface, well adapted to the raising of grain. It is almost destitute of timber. Its fertility is attested by the substantial character of its buildings and other improvements. Northeast of Belvidere the limestone is much eroded and the harder portions stand up in craggy ledges, between which is often lodged gravel and other debris. Nevertheless, nestling in among these hills are many excellent farms, and to compensate for the untillable portions we have those beautiful limestone bottoms with their permanent meadows of rich, sweet grasses, which have given the Kittatinny valley in Warren and Sussex counties, and in Orange and Ulster counties, New York, a national reputation for the quantity and excellence of its dairy products. It is these which enable Sussex to produce more than one-quarter of the total milk yield of the State, and to make on her farms within two per cent. of as much butter as Orange county herself.*

The higher slate lands are devoted to ordinary farming. Indian corn, oats, rye and buckwheat are the staple crops, but little wheat being grown. When in bloom in the late summer the white buckwheat fields scattered over the hills are a prominent feature of the landscape. The forests cover from 10 to 13 per cent. of Wantage, Lafayette and Newton townships; from 20 to 25 per cent. of Frankford, Hampton, Stillwater, Green, Frelinghuysen, Knowlton and Hope, and from 28 to 35 per cent. of Blairstown and Hardwick. For the whole valley the average is 22 per cent.

THE HIGHLANDS.

This region lies to the southeast of Kittatinny valley, and occupies an area of over 800 square miles. Excluding the isolated masses of Jenny Jump and Pochuck mountains, which are, however, essentially a part of the Highlands, these mountains enter the State from New York with a width of eighteen miles, which is maintained for thirty-six miles southwesterly, the general trend being south 40° west. At this distance Mine mountain falls off to the plain at Peapack, and the eastern face of the Highlands retreats abruptly, the total width being reduced to thirteen miles. At the line of the Central Railroad of

* This refers to butter made on farms and not in large creameries. See Census of 1880, Statistics of Agriculture.

New Jersey there is another abrupt retreat of the eastern face, and from this point southwest the region is much depressed.

Next to the Kittatinny valley the Highlands rise to from 1,400 to nearly 1,500 feet, near Vernon, and from 1,000 to 1,200 feet southwest, rising generally from 600 to 1,000 feet above the valley. At their southeastern edge the elevations near the New York line rise to nearly 1,200 feet, but decrease southwest to less than 1,000 feet. This edge is, in places, depressed to the level of the plain southeast, but generally it rises from 500 to 600 feet above. Before being cut through by the Delaware at the southwest, the whole region has become depressed below 600 feet. Broadly, therefore, the culminating point of the region in New Jersey is the great plateau in Vernon township, Sussex county, and West Milford township, Passaic county, the summit of which is 1,496 feet above the sea. Thence the region descends southeasterly and southwesterly. This plateau is as elevated as any of the Highlands west of the Hudson river. Between the Hudson and the New York line the elevations range about the same as in New Jersey, northeast of Dover. Where the Hudson cuts through to their base, the Highlands do not exceed 11 miles in width. In Pennsylvania an irregular line of hills continues southwest over 40 miles to near Reading, where it finally disappears beneath the plain, leaving the Kittatinny valley for some distance open to seaward. These hills rise gradually from the Delaware, finally reaching above 1,200 feet in Berks county.

The foot of the southeastern slope of the Highlands may be outlined here. This slope is prominent throughout, usually rising rather abruptly from the plain. Beginning at Tompkins' cove, on the Hudson, it crosses Rockland county southwest to Suffern, where it enters New Jersey and proceeds in a direct line west of Pompton by Boonton, which lies upon the slope, to Morristown and on beyond Bernardsville to the north branch of the Raritan. Here it suddenly falls back northwest five miles, then proceeds southwest to Lebanon. Here is another sudden retreat of five miles, and then we proceed on a course a little more westerly than before, to the Delaware. The Highland district includes a strip six or seven miles wide at the southeastern side of Sussex and Warren counties, West Milford and Pompton townships, Passaic county, all of Morris county excepting the Passaic valley southeast of Boonton and Morristown, and the northern part of Hunterdon county.

The terminal moraine follows closely a line drawn across the district diagonally from Boonton to Belvidere. North of this the country is mostly a wilderness. The cleared land is almost all confined to the valleys, and fully 90 per cent. of the higher portions is in forest, the average for the whole area being about 75 per cent. The hills have many bare ledges of rock, and are thinly soiled, their slopes being strewn with boulders. The valleys are often covered with drift gravel. Many beautiful lakes and ponds are found, of which the largest is Lake Hopatcong, about six and one-half miles in length, and having extremely irregular and picturesque shore lines. Its surface is 926 feet above tide, and it covers an area of 2,443 acres. It is accessible by railroad, and is becoming popular as a place of summer residence. The next in size is Greenwood lake, lying partly in New York. It is six miles long by over half a mile broad, being of uniform width throughout. Its area is 1,920 acres, and its surface is 621 feet above the sea. Lying in a deep, narrow valley, with mountains rising sheer 700 feet above it on either side, and being reflected in its clear waters, this lake has attractions for numbers who yearly frequent it. Budd's lake, Green pond, Macopin lake and Wawayanda lake are all more or less known as summer resorts, but data as to these will be given elsewhere. It is needless to enumerate more of them or to point out their attractions, for a Highland lake implies a charming landscape.

The same cause which produced these beautiful lakes has scattered over hill and dale in this region numberless swamps, large and small. Those toward the north are distinguished by a growth of rhododendron, and are dark and almost impenetrable. The whole aspect of this part of the Highlands is dark and wild, excepting where here and there a cultivated valley introduces an element of quieter beauty, or a mountain lake sends from its mirror-like expanse a brightening gleam.

Southwest of the moraine line, where the country has escaped the denuding ice sheet, the appearance is different. Not a single natural lake occurs, nor even a swamp, excepting in the immediate vicinity of the moraine, where it has choked up valleys and forced the drainage back southward. Bare rock ledges are extremely scarce, the hills being well soiled and cultivated right across their summits. Timber covers but a little over 30 per cent. of the area, excepting in Randolph township, Morris county, where it rises to 43 per cent. It is

largely on slopes which are too steep for cultivation. The valleys here are fertile, and, for quiet, tranquil beauty, cannot be surpassed.

Taking up the structure of this Highland region more in detail, we find that it may be readily separated into four more or less distinct ranges. These are parallel, but not co-extensive. The trend of the Highlands, from the Hudson to the Delaware, is south 52° west, while these separate ridges trend south 40° west. Hence they stand *en echelon*, rising successively from Kittatinny valley, and running diagonally through to the southeast face of the Highlands, where they fall beneath the plain. By following any of the intervening valleys, we may pass through from Kittatinny valley to the plain southeast.

HUDSON RANGE.

The first of these ridges rising beyond the Hudson is cut completely across to its base by that stream between Cornwall and Peekskill, and forms the famous Highlands of the Hudson. Thence it runs southwest as a broad and rolling plateau, reaching an elevation of 1,490 feet just east of Turner's, on the Erie railroad, where it has a width of six miles. Continuing southwest, it maintains an elevation of over 1,000 feet to where it is again cut completely through from north to south by the deep clove of the Ramapo river. This stream enters from the valley west with an elevation of 450 feet, and issues from the east face of the range, at Suffern, with an elevation of 270 feet above tide. Taking advantage of this clove, the New York, Lake Erie and Western railroad finds its way through the Highlands and into Kittatinny valley, without rising above 608 feet in elevation.

Southwest of the Ramapo the eastern edge of the range immediately rises to 1,171 feet just south of the New Jersey and New York line. This end of the range is known as Ramapo mountain. Crossing the State line as a ridge four or five miles broad, it rapidly narrows and gradually descends, falling off near Pompton, ten miles southwest. It is a wilderness, too rocky and steep for cultivation.

WANAQUE VALLEY.

The valley west of this range enters from Kittatinny valley at Turner's, and is occupied by the Ramapo river for six miles southwest to the head of the clove below Southfield; thence we follow up

southwest to Tuxedo lake, a picturesque sheet of water which here fills the valley for nearly two miles. Just beyond the head of this lake, we reach the headwaters of Ringwood creek, at an elevation of 560 feet. This stream flows down southwest, through this narrow valley, into New Jersey to Ringwood, where the valley widens, and is but 360 feet above tide. At Boardville, just below, the Wanaque river enters from the northwest, and flows southerly through a portion of our valley, issuing from the southeastern face of the Highlands at Pompton, at an elevation of but 200 feet. The attractive scenery of the Wanaque valley is well known to patrons of the New York and Greenwood Lake railroad; its general course is south 9° west, but the remainder of the valley, from Turner's through to Boardville, is remarkably straight, and has a course south 29° west.

PASSAIC RANGE.

The next range rises southwest of Monroe and Turner's, New York, from the Kittatinny valley, which has here an elevation of from 600 to 700 feet. It soon reaches its maximum elevation, at a point one and one-half miles southwest of Mt. Bashan lake, where it is 1,333 feet above the sea. It continues southwest across the State line, keeping above 1,200 feet, Beech mountain, two miles southeast of Greenwood lake, and on the State line, being 1,227 feet. This part of the range is four miles wide. At its west side is a high, continuous ridge, with the elevations above noted. Its middle part is depressed to from 750 to 900 feet, and in this depression lie Sterling and Mt. Bashan lakes. At the east side of the range is a line of hills rising from 1,000 to 1,263 feet, but as the whole drainage from the high ridge west passes straight across southeast, through deep ravines, to the valley, these hills are not continuous. The Sterling iron mines lie in the central depression, two to three miles northeast of the State line, while the famous Ringwood mines lie in its southeast edge in New Jersey.

Greenwood lake lies in the valley at the northwest of this range at an elevation of 621 feet and pours its waters through a deep clove straight across to the Wanaque valley, at Boardville. At Hewitt, right in the heart of the range, the river is only 400 feet above tide.

As we pass onward southwest over the portion of the Passaic range lying in West Milford and Pompton townships, Passaic county, we

find that it widens and is seven miles across at the Pequannock river. The highest point of this section of the range is three-quarters of a mile north of where the road from Bloomingdale to West Milford crosses Post's brook. It is 1,242 feet above the sea. On the extreme northwest the narrow, continuous ridge of Kanouse mountain rises above the valley. Beginning at West Milford, with an elevation of about 800 feet, it runs southwest, then bends around to due south, and reaches an elevation of 1,195 feet near the Pequannock. At its eastern side lies Macopin* lake, at an elevation of 893 feet.

Here about Macopin the country is rolling and nearly half cleared. It lies at an elevation of from 1,000 to 1,150 feet. As we proceed eastward, however, the ravines deepen, while the general mass retains its elevation and becomes separated into steep, rocky knobs, with little regularity of arrangement, although there is some tendency to a ridge structure, the ridges having a north and south course instead of the usual northeast and southwest trend. It is particularly noticeable that the water-courses of this region all run north and south or east and west. Not more than 20 per cent. of this area is cleared, the remainder being covered with a close growth of chestnut timber. The slopes are steep, and covered with loose rocks. Winbeam mountain is a marked feature of the landscape of Wanaque valley and Pompton plains. It stands well out from the eastern edge of this Passaic range, and rises in a long, steep, wooded slope 800 feet above the valley. While it appears high, its elevation is but 1,026 feet, while two or three miles southwest the mountains rise to 1,218 feet.

The Pequannock river leaves the valley at Newfoundland with an elevation of 750 feet, and passing through Kanouse mountain, in a narrow gap 400 feet deep, makes a detour a mile south of its general course, to Charlottesburg, in the small valley beyond. Then it proceeds in a narrow, winding clove south 70° east, through the mountains to Pompton. This notable clove is from 400 to 500 feet deep, and seven miles long. It cuts this Passaic range completely across, and marks a decided change in structure. Southwest from here to the Rockaway, 12 miles distant, there is a more developed ridge structure than elsewhere in the Highland region. First, on the northwest are the long, level-crested ridges of Green pond and Cop-

*It is to be hoped that this lake, which is beginning to attract well-deserved attention, may be allowed to retain its ancient characteristic name and not lose its individuality under the later name now in use.

peras mountains, rising 600 feet above the valleys, parallel, with their crests from half to three-quarters of a mile apart, and from 1,200 to 1,300 feet above the sea. In the small valley between them lies Green pond, a clear and beautiful sheet of water two and one-half miles long and three-eighths of a mile wide. A mass of gravel has filled this valley at the northeast end of the pond, and the water, which formerly found its outlet in this direction, has been held back and forced over the rock-divide into the basin of the Rockaway. This is the way in which this beautiful lake has been made. The surface is 1,048 feet above the sea. These ridges are completely separated from the main range to the southeast by a broad valley running from the Pequannock river, at Charlottesburg, through to and beyond the Rockaway, opening out into the broad Succasunna plains. This valley has been recently occupied by the Morris County railroad. The highest point of its drainage axis, on the rim of the Pequannock and Rockaway water-sheds, at Green Pond mines, is 910 feet in elevation. Denmark and Middle Forge ponds, which lie in it, are artificial ponds originally used in operating forges. This valley is but little cultivated, being largely filled with glacial debris and swamps. The ridges northwest are wholly uncultivated, being steep and rocky. The valley trends south 50° west, the ridges rather nearer the meridian.

Next southeast is a belt from two to three miles wide, of irregular hills, barren, rocky and wooded, with valleys 700 or 800 feet and the hills from 1,050 to 1,150 feet above the sea. In this region are the famous Mt. Hope and Hibernia iron mines. Proceeding southeast, we have, east of Splitrock pond, a series of parallel ridges, with a height of from 200 to 300 feet above the narrow intervening valleys, and a base breadth usually not exceeding half a mile. There is a general decrease of elevation in this direction, and the edge of the Highlands immediately overlooking the valley at Pompton and Boonton, ranges from 850 to 950 feet in elevation. This portion of the Passaic range lying between the Pequannock and Rockaway rivers, in the townships of Pequannock, Montville, Boonton and Rockaway, Morris county, is generally uncultivated, the hills being thinly soiled and the valleys narrow, rough and drift-strewn. More than 70 per cent. of its area remains in timber.

Between Rockaway and Boonton, we have three well-developed valleys traversing the range longitudinally from northeast to south-

west. First, the valley of Beaver brook heads abruptly at Meriden, and runs thence southwest by Rockaway to Millbrook, about eight miles distant, where it ends abruptly again in the hills. It has a very level bottom at an elevation of about 540 feet, and the hills rise from 300 to 500 feet above it. A little over a mile southeast, the valley of Denbrook, heading southwest at Mt. Freedom, has an elevation of 720 feet one mile northeast, and falls to 520 feet at Cranberry pond, seven miles further on. Here it loses its valley character, but a line of depression may be followed northeast in the same direction to Buck mountain, four miles farther. About a mile southeast a third parallel valley runs from Denville northeast to the site of the old Decker forge, seven miles, with an elevation of 500 feet; and thence two lines of depression, one to the northwest and the other to the southeast of Rock Pear and Kakeout mountains, may be followed through to the Pequannock without rising much above 700 feet elevation. The southwest part of this valley, known as Rockaway valley, has a width of about half a mile. The Rockaway river entering from the northwest, west of Port Oram, with an elevation of 680 feet, cuts across the northwestern half of the Passaic range five miles, to the valley of Beaver brook, which it enters two miles east of Dover and follows two miles northeast to Rockaway. Here it passes east through broad depressions in the ridges intervening between this valley and Rockaway valley, entering the latter at Denville and following it northeast three miles to Powerville, where it turns again southeast, having still an elevation of nearly 500 feet, and passes out of the Highlands to the plain below, falling 250 feet in one and one-half miles at Boonton. The general course of the Rockaway in crossing the Passaic range is eastward. It does not cross through a continuous clove, as did the Pequannock, but follows the minor valleys until a depression occurs in the ridge southeast, then passes through to another valley. The depression by which it crosses is made use of by the Morris canal, the Delaware, Lackawanna and Western railroad and the High Bridge branch of the Central Railroad of New Jersey in crossing the Highlands. It is thus one of the main highways of travel of Northern New Jersey.

Southwest, the hills speedily regain their elevation, reaching a maximum of 1,122 feet one mile north of Mt. Freedom, with a width of about seven miles. The range narrows rapidly to three miles between Mendham and Ironia, and this width is carried through

to the end of the Passaic range at High Bridge, the elevations ranging from 800 to 1,000 feet. This region is a hilly plateau, with about 40 per cent. of its area uncultivated. Running through from Ironia southwest to Califon, the narrow valley occupied by Black river and Tanner's brook, having a maximum elevation of 840 feet three miles from its southwest end, cuts a narrow ridge off the border of the range next to German valley. Black river enters this sub-valley from Succasunna plains at Ironia, with an elevation of 700 feet, and follows it six miles southwest, through a swamp which occupies the whole valley, to Chester Furnace. Here it enters another of those remarkable north and south cloves peculiar to the southeastern half of the Highland region, and passes through the range to the plain at Pottersville, falling 90 feet to the mile.

Passing westward into the Highland region from Morristown by the valley of the Whippany, we follow along the base of the hills above described, crossing from the Whippany to the Raritan watershed near Mendham, at an elevation of 560 feet, and then descend to the plain again at Peapack. This valley cuts off a triangular mass of hills, having its vertex at Morristown, reaching a width of four miles and a maximum elevation of 857 feet between Mendham and Bernardsville, and dropping off suddenly to the plain at Peapack. This is known as Mine mountain. It is similar physically to the range northwest. The north branch of the Raritan flows from north to south through a clove 400 feet deep across its west corner. Mendham village is beautifully situated in the valley north, and is known as a healthful and quiet retreat to a limited number of patrons.

THE GERMAN-LONGWOOD VALLEY.

The most important valley of the Highlands is to the northwest of the range of hills just described. It is not only remarkable for its continuity, but also for dividing the Highlands into two parts, differing noticeably in structure. Leaving Kittatinny valley from the southeastern corner of Chester township, Orange county, New York, we ascend first the valley of Trout run three miles, when we pass over into the Greenwood lake water-shed, at an elevation of 780 feet. Thirteen miles of the valley is drained into Greenwood lake, the lake itself filling the valley for six miles, three miles in New York and three in New Jersey, with a surface elevation of 621 feet.

This portion of the valley trends south 35° west. It has the rocky face of Bearfort mountain rising 700 feet above it on the northwest. On the southeast the hills vary in height from 700 feet at the head of Greenwood lake to about 200 feet beyond its foot. The bottom of the valley is under cultivation, and this, with the hills immediately at the southeast about Macopin, contains most of the productive land of West Milford township. Slate rock underlies the valley but is frequently covered by sandy or gravelly drift soils.

Three miles southwest of the hamlet of West Milford we pass the rim of the Pequannock water-shed at an elevation of 837 feet. Kanouse mountain now begins to retreat to the eastward, while Bearfort mountain falls off and the western side of the valley retreats nearly two miles. Just across the Pequannock river, Green Pond mountain rises suddenly from the valley, so we bend a little west to avoid this and enter a broad slate valley having a width of over two miles which it preserves for over four miles to Milton. As its outlets are narrow and well concealed this sudden enlargement of the valley seems like a great basin enclosed completely by the green slopes of the hills which rise on every hand from 400 to 600 feet. Coming down from the plateau the Pequannock enters this valley at its northernmost corner with an elevation of 820 feet, and, making a loop two miles southwest, returns again, flowing round the northeast end of Green Pond mountain by the village of Newfoundland, and leaving the valley with an elevation of 750 feet at the gap through Kanouse mountain. It is a curious fact that at the point in the valley south of Oak Ridge, where the river turns again northeast, a dam 25 feet high would serve to send its waters down the valley 10 miles to the southwest, by the channel of the Rockaway, yet it turns away from this apparently easy outlet to make its way out right across the broad range of hills eastward through a clove four or five hundred feet deep. In fact it is seemingly anomalous that while this whole valley is so uniform in elevation and offers such free passage to the streams northeast and southwest its drainage should, nevertheless, pass eastward across the broad range of granite hills in four places: by the Wanaque, Pequannock, Rockaway and Black rivers.

At the point above mentioned the divide between the Pequannock and Rockaway water-sheds is but half a mile from the bed of the former, and the lowest elevation of the rim of the basin, in the valley, is 814 feet. Thence we descend easily southwest. At Milton

Bowling Green mountain puts out boldly from the plateau northwest and contracts the valley to a width of less than half a mile. This portion is known as Longwood valley. The wooded slopes rise steep and rocky 500 feet above it on either side. The bottom is cleared but is very rough, filled with glacial debris. Along the Rockaway are several old forge ponds which add to the romantic interest of the valley. Once its dark slopes echoed back to each other the clink, clink of the forge hammer, and through its forest vistas came the uncanny wheeze of the bellows and groan and splash of the laboring water-wheel. Forges were very numerous in this vicinity. Lower Longwood, Upper Longwood, Woodstock, Petersburg, Milton, Russia, with Hopewell just above in the mountains, Wallace's Corner and Clinton, in this valley, were all centers of development of a life which disappeared with the introduction of the blast furnace and modern methods of iron manufacture.

Before continuing through the valley we may pause a moment to notice the wealth of attractions which this portion holds out to summer sojourners. Newfoundland is already favorably known. Within a radius of five miles of that village are eleven attractive Highland lakes. To the northward Hank's, Buckabear and Cedar ponds lie in a trackless wilderness, and the hardiest mountain climber will find severe enough labor if he attempts to penetrate still further into the fastnesses of Bearfort mountain. Green and Macopin lakes are considerable bodies of water within easy walking distance by good roads. Pleasant drives are innumerable. Splitrock pond, Lake Hopatcong, Greenwood lake or the vantage points of Wawayanda mountain, overlooking beautiful Kittatinny valley, Shawangunk mountain and the Catskills beyond, may be made objective points for delightful day journeys. The quiet, pastoral scenes of the valley may be more to the liking of others, and here about Oak Ridge and Milton may be found healthful and pleasant sites for summer hostelries, at elevations of from 900 to 1,300 feet. Pure, sweet water abounds everywhere. The distance from New York is from 45 to 50 miles.

One and one-half miles southwest of the village of Berkshire Valley Longwood valley comes to an end by the falling off of Green Pond mountain, and the Rockaway river starts on its eastward course with an elevation of 680 feet. Just beyond this point the valley is filled for two miles with an enormous mass of gravel, the moraine of

the glacier. On the southeast a line of low hills shows here and there marking the continuation of the conglomerate of Green Pond mountain but hardly separating this valley from the broad Succasunna plains and the continuation of the valley of Green Pond brook to the southeast. Ignoring these hills we have here an extremely level, sandy plain two miles wide and three miles long, sloping only ten feet to the mile to the southwest, and about twice as much transversely. All of the drainage of this plain goes to the Raritan river, the divide between the Raritan and the Rockaway being within a mile of the latter stream where it leaves this valley. This divide is 730 feet above tide, Succasunna plains being about 720. The headwaters of the south branch of the Raritan and of Black river, a tributary of the north branch of the same stream, cross this plain within a mile of each other. Black river, as already noted, leaves the plain, penetrating the Highland range to the southeast at Ironia. The south branch follows the valley southwest, and keeping about 10 miles west and south of the first stream, finally rejoins it 40 miles below, near the village of Raritan.

Below Succasunna plains our valley is known as German valley. At Greenwood lake we noted that the trend of the valley was south 35° west. Longwood valley runs south 40° west, and German valley south 49° west. The last is a beautiful and fertile limestone valley about one and one-half miles in width to Califon, but here it contracts to become a mere ravine 500 feet deep, with the sides sloping directly to the stream bed. At High Bridge this ravine opens out to the plain, the ridge southeast dropping off gradually to the level of the country eastward. At Califon the stream is 470 feet above tide, and at High Bridge 230 feet. On the northwest of German valley, Schooley's mountain rises abruptly four to six hundred feet above. On the southeast the slope is gentler, and three to four hundred feet high.

CENTRAL HIGHLAND PLATEAU.

To the northwest of the valley first described lies the most important mountain range of the State. It is not so high by 300 feet as is Kittatinny mountain, but it is more massive, and the portion within the State is longer. It is a plateau with a width of from five to seven miles from the New York line to Lake Hopatcong and Budd's lake, but tapering down irregularly to a ridge two miles wide near the Del-

aware. At the northeast it rises to near 1,500 feet above the sea, while southwest it falls below 800 feet. Unlike the eastern ranges of the Highlands, it is not cut across by a single stream in the 70 miles from its northern end to the Delaware.

Rising in the southern corner of Chester township, Orange county, New York, as a single ridge, here known as Belleville mountain, it broadens rapidly after we pass the Warwick turnpike and at the State line is five miles wide, which is increased to seven miles before we reach the first pass at Stockholm, 11 miles further on. This pass is the lowest in the 32 miles from the beginning of the range to Lake Hopatcong. The New York, Susquehanna and Western railroad, having passed the Passaic range by the Pequannock clove, and surmounted this plateau by the aid of a ravine occupied by the same stream, crosses by this pass with a maximum elevation of 1,030 feet, thence winding its way down the western slope of the plateau to the Kittatinny valley.

From the State line to this point the low levels of the plateau are generally above 1,100 feet, and the summits rise from 1,200 to 1,496 feet. The bold western escarpment rising above Vernon valley is known as Wawayanda mountain above Vernon, and Hamburg mountain east of Hamburg. Bearfort mountain forms the southeast face. The latter is the most rugged, inaccessible mountain in the State. The rock is a hard conglomerate which rises in smooth ledges at the foot of which are often great piles of broken rock. Between the ledges are narrow and almost impassable jungles. Add to this a growth of stiff scrub-oak and it may be understood how it often became difficult for the surveying party to cover a mile an hour on their way to and from their work. The summit of this mountain is 1,490 feet above tide.

West of this ridge the valley occupied by Longhouse and Mossman's brooks apparently separates it from the plateau west, but as this valley is generally above 1,100 feet it is evident that there is no real separation.

The lower portions of this plateau are usually occupied by thick swamps; there is little fertile soil, and the cleared land does not exceed 20 per cent. of the whole. Wawayanda lake is the largest body of water in the region; its elevation is 1,152 feet above tide. There are ten smaller ponds.

Southwest of the Stockholm pass, the plateau soon regains an ele-

vation of 1,300 feet, but is contracted to a width of four miles by the widening of the valley at Oak Ridge. The width does not exceed five miles anywhere beyond Stockholm; the plateau is more rolling here than it was beyond the pass; elevations range from 1,200 feet upward, a maximum of 1,396 feet being reached just north of the Ford and Schofield mines, six miles southwest of Stockholm. One mile from the western edge of the range, the Ogden mines are at an elevation of 1,240 feet; this is the highest elevation reached by a railroad in the State. As we proceed the mountain falls off. Lake Hopatcong lies right in the middle of the plateau, is six and one-half miles long, and has a surface elevation of 926 feet. While here and there peaks rise nearly to, or sometimes above 1,200 feet more than half the area of the plateau from the head of Lake Hopatcong to Budd's lake, a distance of 12 miles, is depressed below 1,000 feet.

At the south end of Lake Hopatcong is an important pass at the same elevation with the surface of the lake, and it is worthy of note that while the natural outlet of the lake was westward, the dam erected by the Morris Canal Company across this outlet would have sent its waters coursing eastward into the Raritan water-shed, had not a small side dam been raised at the extreme south end of the lake. This pass is occupied by the Delaware, Lackawanna and Western railroad and the Morris canal. The Musconetcong river, the outlet of Lake Hopatcong, flows directly west from this pass to the Musconetcong valley, falling 270 feet in five miles. The whole mountain, up to above 1,200 feet, in this vicinity, is covered by glacial debris in contorted, fantastically-shaped knolls, ridges and hollows, the more elevated parts remaining in all the irregularity of the original deposition. This deposit lies in a belt about two miles wide running east and west across the range and lying mostly south of the pass. Down to the southern edge of this moraine the amount of cleared land does not exceed 20 per cent. of the area of the plateau. There are often several square miles of unbroken forest.

Lake Hopatcong is the largest body of fresh water in the State. Its area is 2,443 acres. It has an extremely intricate shore line. Byram cove extends back one and one-half miles from the main body of water. The shores are steep and rocky, rising in graceful slopes from one hundred and fifty to three hundred feet above the water. Its picturesque beauty, high elevation, and proximity to the metrop-

olis combine to give it a rapidly-increasing popularity as a retreat during the heated term, when life in the cities becomes unendurable.

Southwest of the pass the plateau bears the name of Schooley's mountain. Starting with a width of five miles, it narrows down to half this at Schooley's Mountain Springs. In the heart of the broad portion, just at the south edge of the moraine belt, lies Budd's lake, one and one-quarter miles in length by three-quarters of a mile wide. Its attractions have long been appreciated. It has a surface elevation of 933 feet above the sea, and by coming up from Stanhope and following down the outlet of the lake to the German valley it is possible to cross Schooley's mountain at an elevation not exceeding 945 feet. The highest point of Schooley's mountain is less than a mile west of this lake, and is 1,227 feet above tide. Down to the hotels at Schooley's Mountain Springs the elevations range from 1,100 to 1,200 feet, the hotels are 1,020 feet, and southwest the plateau hardly rises above 1,100 feet, and gently descends to 950 feet and less near the pass occupied by the Central Railroad of New Jersey. More than 60 per cent. of this plateau is cleared. Its surface is undulating and well soiled. It has long enjoyed a well-merited reputation for healthfulness. From its vantage points the charming Musconetcong and German valleys, with their well-tilled farms and neat villages, may be overlooked for miles, and rising above them are the green slopes and peculiarly graceful, undulating profiles of the bordering Highland ranges. These valleys lie from 500 to 700 feet lower than the surface of the plateau.

Three miles southwest of Schooley's Mountain village Spruce run begins to form for itself a longitudinal valley in the center of the plateau, trending a little more westerly than the range. This valley is from one hundred and fifty to over two hundred feet deep. Seven miles below its head it has approached to within half a mile of the western edge of the mountain, but here, at Junction village, it turns abruptly to the southeast, and passes out by a clove five or six hundred feet deep and three miles long, to the southeast face of the plateau. At the head of this clove the ridge just northwest, separating the valley of Spruce run from the Musconetcong valley northwest, is depressed to an elevation of 550 feet, or 100 feet above the valley of Spruce run. Coming up the clove, the Central Railroad of New Jersey crosses by this low pass to the Musconetcong valley. Just

northeast the top of the plateau is four miles wide, but southwest it is immediately reduced to two and one-half miles, and decreases in width still farther southwest toward the Delaware. Six miles southwest of Spruce run pass, the Lehigh Valley railroad, by taking advantage of a deep indentation in its northwest side, passes through this ridge, here known as Musconetcong mountain, by a tunnel but one mile in length, at an elevation of about 500 feet above tide, and over 400 feet below the crest of the ridge. Musconetcong mountain does not differ materially in character from Schooley's mountain. The Delaware cuts through it at an elevation of 125 feet, and, without rising again above 600 feet, it finally drops off to the plain five miles southwest, near Springtown, Bucks county, Pennsylvania.

SPARTA AND MUSCONETCONG VALLEYS.

There are no more continuous valleys to the westward passing entirely through the Highlands, but the Sparta and Musconetcong valleys, lying at the northwest base of the Central Highland plateau, are nearly so. The first heads near Stag pond, in the extreme north corner of Byram township, Sussex county, and runs northeast, coming out into the Kittatinny valley near Franklin Furnace. The Musconetcong valley heads in Sparta mountain, three miles east-northeast of the former, and runs southwest, but, separating the two valleys, is a rough ridge of gneiss rock, which puts off from the central plateau between Sparta and Woodport villages, and, running west-southwest with an elevation of about 1,100 feet, forms the sole connection between this plateau and the Alamuche-Pohatcong range northwest.

Sparta valley heads at an elevation of 740 feet, thence descends very gently three miles, its bottom being filled with swamp and meadow. At Sparta it falls 80 feet in a mile, the stream being 700 feet above tide above the upper bridge, then descends gently five miles to Franklin Furnace, where the pond is 533 feet above the sea. This is a limestone valley, and the Wallkill, below Sparta, meanders through beautiful grassy meadows. At Ogdensburg is a remarkable ridge of gravel putting out squarely across the valley from the southeast side and almost closing it, as it probably has done at some time. It is 100 feet above the valley bottom, and is utilized by the New York,

Susquehanna and Western railroad, which climbs down from the plateau and crosses the valley on this gravel bank. The famous Sterling Hill zinc mines are just opposite this ridge, and below are the great Franklin Furnace mines. Sparta village is pleasantly located and favorably known as a quiet, healthful summer retreat. Morris pond lies on the edge of the plateau, just above, at an elevation of 932 feet.

Musconetcong valley falls from 1,100 feet to 840 feet in the first one and one-half miles, thence descends gently southwest, being drained by Lubber's run for nearly nine miles, to the site of Old Andover furnace, where its elevation is 660 feet above tide. Here the Musconetcong river comes in from the east, carrying the drainage of 35 square miles of the plateau. With this exception, nearly all of the plateau drains eastward, and the change to the westward here may probably be traced to the disturbing effects of glacial erosion. This portion of the valley and onward from Old Andover to Saxton Falls, beyond Waterloo, is of variable width, but not much exceeding a mile anywhere. Its depth increases southwest from 200 feet to over 500 feet. It is only partially cultivated, being drift-strewn or rocky. At Saxton Falls the width is but half a mile. Just beyond it increases rapidly, reaching two miles at Hackettstown, but contracts again to one mile at Port Murray, then widens to two miles at Asbury. Contracting southwest from the latter village, it becomes but little more than a ravine beyond Bloomsbury. Five miles beyond the Delaware, at Springtown, Pennsylvania, it opens out to the plain southeast of the Highlands. At Hackettstown the valley is free of drift, and from here southwest it is under a high state of cultivation. Its soil is limestone and slate. Its surface is rolling. At Hackettstown the Musconetcong river has an elevation of 520 feet. The general surface of the valley is from 600 to 700 feet. Both valley and stream fall quite uniformly southwest. At Bloomsbury, 20 miles southwest, the stream is 260, and the valley does not rise above 400 feet. At the junction of the Musconetcong with the Delaware the elevation of the streams is 129 feet. To this point the valley is 42 miles long. The wooded slopes of the bordering mountains rise sheer from 400 to 600 feet. At Washington and again at Bloomsbury the western rim of the valley is depressed to the general level of the valley itself, connecting it with Pohatcong valley beyond.

ALAMUCHE-POHATCONG RANGE.

This range rises from Kittatinny valley at Franklin Furnace, and reaches an elevation of 1,124 feet in the Pimple hills north of Sparta. Just southwest it is cut through by the gap through which the Water Gap extension of the New York, Susquehanna and Western railroad finds its way to Kittatinny valley. It rises beyond the gap above 1,000 feet, and reaches 1,127 feet between Andover and Stag pond, where it makes a junction with the ridge putting off from the Central Highland plateau. Its width is now increased to three miles, and its surface is very hilly, its lower levels rising but little above the neighboring valleys, while its hill tops average 1,100 feet in elevation, reaching a maximum of 1,222 feet just east of Wright's pond and the Roseville mine, on the extreme southeast edge of the range. The surface hereabout is very rough and rocky, the rock standing up in high, bare ledges, with more or less gravel and boulders in the hollows between. The slopes are steep and irregular. About 25 per cent. of the area is cultivated.

The Sussex railroad crosses the range from Waterloo, in the Musconetcong valley, north to Andover, in the Kittatinny valley, with a summit elevation of 800 feet. This pass runs northeast of Panther hill. Just southwest of this hill is another pass of about the same elevation. In fact, throughout Byram township, the lower levels of the plateau range from 750 to 800 feet. Passing southwest, Alamuche mountain rises to 1,248 feet just east of Alamuche village. Lying up in this mountain, a mile north of Waterloo village, is one of the few tamarack swamps of the State. The width of the range here does not exceed two miles.

Just southwest of Alamuche the ridge throws off two curious spurs in a direction about west-southwest into Kittatinny valley. The first is about three miles, and the second, sometimes known as Cat Swamp mountain, about four miles in length. Between Hackettstown and Vienna the ridge is depressed, generally, below 1,000 feet, and is crossed by the moraine, which has left immense deposits of drift all across the top. Almost exactly midway between these two places, at an elevation of 989 feet, lies the little glacial pond or bog from which were taken six mastodon skeletons.

Just south of the moraine the mountain rises again to 1,230 feet; thence gradually descends to the southwest. Here, also, the range

forks, the Pohatcong mountain runs south 45° west, but a spur is thrown off in a direction south 52° west, and continued as a steep, narrow ridge connecting this range with the plateau of Scott's mountain. In the forks of the two ridges heads the Pohatcong valley. Pohatcong mountain, being now clear of the limits of the devastating effects of the ice sheet, partakes of the general character of Schooley's mountain, excepting that being narrower and the slopes steeper, rather less of its area is cultivated. At Washington it falls off to 500 feet elevation, the general level of the adjacent valleys. The town lies in this depression, and through it pass the Morris and Essex division and the main line of the Delaware, Lackawanna and Western railroad, and the Morris canal.

Again rising as a narrow ridge a mile in width, Pohatcong mountain reaches an elevation of 898 feet, five miles beyond, to fall off again to the level of the valley four miles further on. This gap near Bloomsbury is two miles wide, and gives passage to the Lehigh Valley and Central railroads, at an elevation of 350 feet. Musconetcong river and Pohatcong creek, on opposite sides of the ridge, have here approached to one and one-half miles, and onward to the Delaware the range has degenerated to a mere line of low hills rarely exceeding 700 feet in elevation. After being cut through by the Delaware, this ridge rises again in Pennsylvania, extending toward Hellertown and reaching above 1,000 feet.

POHATCONG VALLEY.

We have already noticed the heading of this valley west of Hackettstown; thence to Washington it descends and widens gradually. At this place the creek is at an elevation of 400 feet, and the valley has a width of one and one-half miles, which it preserves to Stewartsville, most of its surface lying below 400 feet and sloping gently. It is a highly-cultivated limestone valley, fertile and attractive. Scott's mountain raises its steep green slopes from six to seven hundred feet above on the northwest, and along its foot winds the Morris canal. On the southeast rises Pohatcong mountain, in gentler slopes, from four to five hundred feet. At Stewartsville the valley opens out at the eastern angle of a triangular plain, with a rolling limestone surface, at a general elevation of 400 feet, occupying nearly all of Lopatcong, Greenwich and Pohatcong townships. Scott's and Marble

mountain, falling off, form the north side of the triangle; Pohatcong mountain, with Pohatcong creek skirting along its foot, the southeast side, and the Delaware river, with the gneiss hills beyond in Pennsylvania, the western side. At Phillipsburg, in the northwestern angle, the plain is open to Kittatinny valley for two miles. This plain partakes of the general character of Kittatinny valley, and was spoken of in the description of that valley.

SCOTT'S MOUNTAIN.

The ridge which puts off from the Alamuche-Pohatcong range near Vienna, connecting Scott's mountain with that range, continues as a steep and rocky wooded ridge, eight miles, to Oxford Furnace, where the plateau begins. In a distance of three miles, between Karrville and Oxford Furnace, this ridge is cut by three gaps. The general elevation of the ridge is above 1,000 feet, reaching 1,145 feet between Stewart's and Sikes' gaps; Stewart's gap, back of Karrville, is 744 feet; Sikes' gap runs north and south, and is narrow and deep. Its elevation is 699 feet. Van Nest's gap is 637 feet. Here the Delaware, Lackawanna and Western railroad finds its way through from the Pohatcong to the Kittatinny valley by a tunnel half a mile long. Just west of this tunnel is Oxford Furnace with its famous mines, where a blast furnace was erected in 1742.

Here the plateau of Scott's mountain rises with a breadth of nearly four miles, and continues about ten miles southwest. Its maximum elevation is 1,277 feet just north of Montana church, and its surface averages about 1,100 feet. Just west of this point Harker's hollow heads and runs out southwest with a depth of 300 to 400 feet. The portion of the plateau which it cuts off to the northwest is known as Ragged ridge. This is continued beyond the rest of the plateau to the southwest of Harmony as Marble mountain, a very narrow ridge, with an elevation of 770 feet. It is cut through by the Delaware, then continues out into Kittatinny valley north of Easton, with an elevation of less than 700 feet, sinking finally to the valley two miles beyond.

About 50 per cent. of the area of this plateau is cultivated. Its general surface is about 800 feet above the surrounding valleys. Some of its slopes are long and steep. Their relative position and trend suggest that this plateau and the mass of Mt. Mohepinoke and

Jenny Jump mountain should be regarded as parts of the same range, with a broad gap at Butzville, by which the Pequest finds its outlet to the Delaware. The great width and low elevation of this gap, and its physical resemblance to the general surface of Kittatinny valley, make it appear better to consider them as distinct masses.

THE RED SANDSTONE PLAIN.

Next southeast of the Highlands comes a belt of country distinguished from that region in a marked way, not only by its topographical structure but also by the peculiar red color of its soil. It is the most densely populated and highly cultivated portion of New Jersey. Southwest of the south branch of the Raritan, in Hunterdon county, and in Mercer county not more than 10 per cent. of the area remains in forest. For the whole of Somerset county the wooded area equals 14 per cent., but if we exclude the trap ridges, it is less than 10 per cent. The effect of glacial action on this area of soft rock is shown by the fact that from less than 8 per cent. in Franklin and Piscataway townships, southwest of the moraine, the wooded area increases at once to 30 per cent. in Fanwood, Westfield, Cranford and Springfield townships, Union county. In the northern part of Bergen county the forests cover fully 50 per cent. of the surface. For the whole area northeast of the moraine the average is above 30 per cent., while southwest it does not exceed 12 per cent.

The northwest border of this plain follows the base of the Highlands and ranges from 300 to 400 feet in elevation, although at the openings of the Highland valleys it sinks to 200 feet. The southeast border follows the Hudson and Arthur Kill about to Star landing, in Woodbridge township. From here southwest, the distinction between this and the Cretaceous belt southeast, is rather geologic than topographic. The limit runs via Woodbridge village to the Raritan, at the mouth of Lawrence's brook, thence up this brook to Monmouth Junction and onward straight to Trenton. Much of this boundary is at tide-water, and it nowhere exceeds 100 feet elevation except at the moraine hills southwest of Woodbridge. From a width of 16 miles at the New York line, the plain broadens to over thirty miles at the Delaware. Its length is 67 miles, and its area 1,600 square miles. Excluding the high land near the Delaware and the trap ridges which stud the plain, it generally falls below 200 feet within

five miles of the Highlands, and the southeastern half has nearly all of its area below 100 feet, considerable areas being at high-water level only.

WATCHUNG MOUNTAINS AND THE PASSAIC VALLEY.

A feature of this plain worthy of notice is the Passaic valley and its encircling ridges of trap rock. The most easterly of these ridges rises near the little village of Darlington, and is separated from the Highlands only by the narrow valley of the Ramapo. Three miles northeast, near Suffern, this stream enters the State from New York, with an elevation of 270 feet, and runs down along the base of Ramapo mountain, through this narrow valley, past the ends of the trap ridges and into the basin which they enclose. The second trap ridge rises between Oakland and Pompton, at the east side of Pompton lake, near the base of the Highlands, and runs southeast five miles to High mountain, its highest point, 879 feet above the sea. Here the eastern ridge, coming down from the north with elevations ranging from 373 to 752 feet, approaches within one and one-half miles of this. From here these two ridges turn southwest and continue for 40 miles exactly parallel, with their crests one and one-half miles apart. Each has a steep eastern slope and a long, gentle western one, with remarkably level crests. The name First mountain is usually applied to the eastern one, and Second mountain to the western. They also have various local names. Their remarkable continuity and steep eastern faces make them noticeable features of the landscape of the plain. Their soil being thin and poor, they are mostly covered with timber.

From High mountain the western ridge continues south two miles, then southwest three miles, as a rough, jagged ridge, known as Preakness mountain, gradually descending to 400 feet elevation. At Little Falls is a gap two miles wide, through which the Passaic river comes from the west, and, crossing the barrier of trap rock at an elevation of 158 feet, drops by a cascade and rapids 40 feet in a mile of picturesque gorge, and then proceeds northeast three miles, to Paterson, where the eastern ridge has also a gap of two miles. Coming to this barrier with an elevation of 110 feet, the river drops in a sheer fall of 70 feet at a deep crevasse in the trap rock, forming the famous Passaic falls. This leap is now only occasionally made, however, for usually the stream is led away into the race of the Society for the Encouragement of Useful Manufactures, and harnessed to the wheels

which have done so much to raise Paterson to the front rank of manufacturing cities.

North of this gap, in which the city of Paterson lies, the eastern ridge is known as the Goffle. South, it rises abruptly above 500 feet, and proceeds fourteen miles in the direction south 28° west. Two and one-half miles on is the only gap for this distance, which falls below 500 feet. This is Great Notch, 303 feet, by which the New York and Greenwood Lake railroad crosses. The highest point of the ridge is just north of Montclair, 665 feet. The eastern slope, and to some extent the crest of this ridge, is rapidly becoming popular for sites for suburban residences. It is known as Orange mountain. From Eagle rock and other vantage points charming views are to be had of the cities of the plain below; and beyond New York bay, the Narrows, Sandy Hook and the Navesink Highlands, Long Island sound, the hills of Staten and Long Islands and Connecticut, form a pleasing and varied landscape. At Millburn the ridge drops off suddenly in another gap about two miles broad and the great masses of moraine debris obliterate the valley between and make almost a continuous slope from the crest of Second mountain out in the gap to the face of the First mountain, where, at Springfield, the plain east is below 100 feet elevation. The highest part of the narrow valley, between this and Second mountain, is at Pleasantdale, 392 feet, and from here, northeast, the valley is drained by Peckman's brook. Southwest, to the gap at Millburn, Rahway river receives the drainage. This little valley is from two to three hundred feet deep.

Second mountain rises abruptly from the gap at Little Falls to an elevation of 600 feet, reaching a maximum of 691 feet east of the village of Caldwell. The road from Montclair to Caldwell passes through a gap at an elevation of 474 feet. South of this the ridge rises immediately to 640 feet, then descends gradually to its greatest depression at Summit, 390 feet above the sea. The western slope is generally convex, the ridge being rather flat-topped, and very rolling. At Caldwell there are large bodies of drift-gravel in the form of terraces, at an elevation of about 400 feet. Generally, the slope is drift-strewn, and the whole ridge near Summit, where the moraine crosses, is buried under this debris, here piled in bewildering confusion. The two ridges and included valley cover a strip of country about four miles wide, and of this area not over 30 per cent. is cleared. Along the steep eastern faces of these ridges the trap-rock is easily quarried,

west toward the Highlands, but six miles beyond. First mountain falls off at Pluckamin. Second mountain continues north from this point almost to the Highlands, then curves back northeast. Just at this point is the only pass in this ridge excepting the outlet of the valley, at Paterson, which is lower than the pass at Summit. This pass is known as Moggy hollow, and is 331 feet above tide. It is merely a narrow gorge cut through a bed of gravel, of which the surface is about 380 feet above the sea. Running northeast four miles, to Bernardsville, the ridge finally comes to the foot of the Highlands again at an elevation of 430 feet. From Summit onward, about 50 per cent. of the area of these ridges and the included valley is cultivated.

We have thus enclosed between these ridges and the face of the Highlands a portion of the red sandstone plain forty-one miles long and varying from seven miles wide at the ends to twelve miles at the middle. Wanaque valley, extending north, and Ramapo valley northeast from the northeast end of this basin continue the low levels, below 300 feet elevation, for ten miles further. The bottom of this basin consists of a series of level plains and marshes lying between 160 feet and 240 feet elevation. Most of the area of the basin lies below 300 feet, but portions near the base of the Highlands southwest from Boonton rise occasionally to 400 feet.

So completely is this basin enclosed that the closing of the little gorge at Moggy hollow and raising of a dam one and one-half miles long across the outlet at Totowa, near Paterson, would flow an area of nearly 300 square miles to a depth of 200 feet in the deeper parts; the surface elevation of the lake being 385 feet above the sea. A series of distinct gravel terraces within this area, with elevations close to 400 feet, shows that at some time in the glacial epoch such a lake actually existed. Among these terraces may be noted especially those lying against the face of the Highlands for a distance of seven miles northeast from Boonton, some of which are three-quarters of a mile in width; those at Preakness church also very extensive; at Caldwell, on the west slope of Second mountain; Morris Plains; the flat ridge extending from Morristown to Chatham, and those at Moggy hollow, west of Liberty Corners. All of these are so large as to be features of the topography of the valley, and they appear to be masses of drift from 150 to 200 feet in depth, at least.

This enclosed basin is subdivided by other ridges of trap and drift

and large use is found for it for crushing to make road metal for macadamizing, for which purpose it is most admirably adapted.

Southwest from Summit the two ridges again continue side by side. First mountain, here sometimes called Springfield mountain, rises from the gap at Millburn to a height of 546 feet, two miles southwest. Southwest of this its crest keeps a little below 500 feet, generally. Just back of Washington rock, near Plainfield, it rises to 539 feet. The crest-line is very level. The moraine covers the end near Millburn gap, and is piled up in great masses of gravel and boulders against the southeast face of the ridge down to within a mile of Scotch Plains, otherwise the slopes of both ridges are remarkably smooth and clean southwest of Summit. The general course of the ridges from Summit 15 miles southwest, to Bound Brook, is south 52° west, and First mountain is from nine to ten miles from the face of the Highlands back of Morristown and Bernardsville. The valley between the ridges pours its drainage through three narrow gaps in First mountain. The first gives passage to Green brook, at Scotch Plains; the second to Stony brook, at Plainfield; the third to Middle brook, at Bound Brook. The higher parts of the valley are at an elevation of 300 feet, and the parts at the outlets back of the gaps about 200 feet. This valley is called Washington valley. It is narrow near Summit, but widens back of Bound Brook, at Martinsville, and has quite an area of farming land. The base breadth of First mountain is about one mile. It rises here about 400 feet above the plain.

From Summit to Mt. Horeb Second mountain is double-crested, and although the eastern crest is the higher nearly all of the drainage of the little hollow between the crests passes through it by a series of five gaps of which the deepest is Dock-watch hollow, over 300 feet below the crest. The distance between the two crests varies from half a mile near Summit to over a mile at Mt. Horeb. At the former point the elevation of the eastern or main crest is 547 feet, the same as First mountain, but while that ridge falls slowly southwest, this rises and reaches its maximum of 653 feet three miles northwest of Mt. Horeb, 18 miles from Summit. The western crest varies from 450 to 535 feet in elevation. The higher parts of the included hollow are nearly level with this crest, the lower parts sometimes reaching 100 feet below.

At Martinsville both ridges turn a right angle and run back north-

into four distinct parts. A ridge of trap rises just southwest or inside of the north end of Second mountain, at Pompton, and runs about south 10° east, for five miles, leaving on its east side, between itself and Preakness mountain, the little Preakness valley about two miles wide and opening out southward into the Central Passaic valley; then the ridge sweeps round in a circular curve to Mountain View where a gap gives passage to Pompton river from the north. From this point this ridge, known as Towakhow or Hook mountain, runs a little north of west three miles, then bends around, having approached within a mile of the base of the Highlands, and runs due south into the valley, dropping off at Pine Brook. This ridge reaches an elevation of 512 feet near Pompton, but elsewhere is a little below 500 feet. The interval between where the ridge bends southward and the Highlands, is filled with a mass of glacial drift, about Montville. This ridge encloses a portion of the north end of the Passaic valley known as Pompton Plains, six miles long from north to south and one mile wide at Pompton, at the north end, and four miles wide at the south end. It is exceedingly level and generally sandy. The fall from north to south is only seven feet to the mile. From east to west it is almost a dead level, excepting the slight lowering of the surface at the bed of Pompton river. Swamps occupy about two square miles, but the remainder of the surface is cultivated. At the southwest corner is the Bog-and-Vly, a peaty swamp of about a thousand acres in extent.

The Boonton branch of the Delaware, Lackawanna and Western railroad, and the Morris canal, come through the gaps in First and Second mountains at Paterson and Little Falls, and, running northwest across the outlet of Preakness valley three miles, enter Pompton plains at Mountain View gap, and run west along their southern border to the Highlands at Boonton. The New York and Greenwood Lake railroad crosses First mountain through Great Notch, and thence runs through the gap in Second mountain at Little Falls, entering the Pompton plains by Mountain View, and, traversing the plain northward, enters Wanaque valley at Pompton. The New York, Susquehanna and Western railroad crosses the extreme north edge of the plain at Pompton.

The Pompton river is formed, at Pompton village, by the confluence of the Pequannock from the northwest, the Wanaque from the north and the Ramapo from the northeast, three remarkably pure and

clear streams. The Pompton flows southward through the gap at Mountain View, emptying into the Passaic about a mile below.

At the southwest end of the Passaic valley a ridge of sandstone and trap puts off from near Bernardsville, at the base of the Highlands where Second mountain comes in from the southwest, and runs south by Basking Ridge about three miles, with an elevation generally above 400 feet. At Lyon's Station it falls to 310 feet and meets the north slope of Long Hill, a trap ridge which rises at Liberty Corners and runs east and northeast down the center of the valley eleven miles, to Chatham, with a general elevation of 450 feet, rising to a maximum of 508 feet, near Chatham. It is an extremely narrow ridge, its base breadth usually not exceeding half a mile. It rises but a little over 200 feet above the valley. It is curved throughout in plan, and is about five miles from the crest of Second mountain at its southwest end, and two and one-half miles at the northeast. Between the two ridges lies the curved valley of the Upper Passaic. The Passaic flows close to the foot of Long Hill, and is sluggish, falling only four inches to the mile. It is usually bordered by flat and rather wet meadows. A straggling line of low hills, from forty to seventy feet high, runs through the center of the valley. The surface is generally cleared.

From the northeast end of Long hill, at Chatham, a broad, flat-topped ridge of gravel runs due northwest across the valley to the base of the Highlands at Morristown. Its general elevation is about 380 feet. Just northeast of Convent station are two notable bowl-like depressions in the top of the ridge, having no outlets. They are about 45 feet deep, and the larger one is half a mile in length by a quarter in breadth. This ridge appears to be merely a portion of the terminal moraine which has been leveled down by the action of water.

These ridges enclose, south of Morristown, a portion of the Passaic valley nearly square, measuring six miles from the Highlands northwest to Long hill on the southeast, and seven miles from the Chatham-Morristown ridge northeast to Basking Ridge on the southwest. The north corner of this square, about New Vernon, is occupied by trap and sandstone hills ranging from 400 feet to 485 feet in elevation, but separated by valleys generally below 300 feet. The rest of the area is occupied by Great Swamp, about six miles long by three miles wide. The outlet of this basin is at the south corner, through a narrow gap in Long hill, at Millington, where the river is 221 feet above tide, and there are fourteen square miles of wet land lying below 240 feet

elevation, of which nearly nine square miles are marsh and swamp. About half the area of the basin is wooded.

The Delaware, Lackawanna and Western railroad crosses Second mountain at the depression at Summit, and thence crosses the outlet of the Upper Passaic valley to Chatham. From here it climbs the northeast slope of the drift ridge to Convent station, then follows the top of the ridge to Morristown. Turning northward it then climbs the slope of the Highlands to Denville where it turns west entering the Highlands by the valley of the Rockaway. From Chatham, northeast to Towakhow mountain is the Central Passaic valley, about 12 miles square. The Passaic river enters this division of the valley at Chatham, falling in a mile from an elevation of 200 feet to 177 feet at Chatham bridge. Thence it flows in a sinuous channel through wet meadows, reaching an elevation of 167 feet at lower Chatham bridge, two and one-half miles below, then proceeding sluggishly, with an average fall of but four inches to a mile, reaching an elevation of 160 feet at Two Bridges, 23 miles below Chatham by the stream, but only 12 miles in a straight line. The general course of the river from Chatham is a little east of north until the end of Hook mountain is reached, at Pine Brook. From here the stream follows the ridge north and then east, around its concave side, and runs six miles east-southeast to the outlet of the valley at Little Falls. All along the river the ground is flat, and subject to overflow during freshets. The largest area of this wet land is enclosed on the north and west by Hook mountain, and is known as the Great Piece meadows, five square miles in extent. Between this and Swinefield bridge are four square miles more of meadow and swamp. These, with the Troy meadows and Black meadows on the Whippany, make up an aggregate area of over 20 square miles of wet lands, rising nowhere more than six feet above the ordinary water-level of the streams which drain them. These wet lands are a blemish to an otherwise beautiful valley.

East of the Passaic is an area of low level, from two to three miles wide, then the surface rises in the northwest slope of Second mountain. Three miles below Chatham, Riker hill rises from the valley east of the Passaic. It is a trap ridge about three miles long, running a little east of north, parallel to the general course of the Passaic. Its elevation is 473 feet.

The Black and Troy meadows spoken of above lie in a second line

of low level, about two miles west of the Passaic. This begins just north of Madison and runs a little east of north, to Montville, being below 200 feet for 10 miles and about 168 feet at the middle, where its waters pass eastward to the Passaic. It is separated from the Passaic flats on the north by Hook mountain, and on the south by a broad, low ridge of redshale and drift, ranging in elevation from 200 to 300 feet and known as Hanover Neck; but between the ends of these ridges the two depressions are connected by a belt of flats half a mile wide. Whippany river, coming out of the Highlands at Morristown with an elevation of 300 feet, flows easterly, through a gorge in the drift hills, to this depression at Whippany, thence follows it northeast and east to the Passaic. The Rockaway, after its plunge from the Highlands at Boonton, also flows easterly through a deep gorge, reaching the depression near its north end, then flowing southeast diagonally across it by the south end of Hook mountain, and joining the Whippany about half a mile from the Passaic.

Westward from this westerly line of flats the country rises away toward the Highlands, reaching above 500 feet near their base, where are accumulated immense masses of drift. In fact all of this Central valley is characterized by the prevalence of drift, and borings have shown that in places the actual bed-rock bottom of the valley is below 100 feet elevation.* This shows the great thickness of the body of drift. At the ridge at Madison it cannot be less than 300 feet. The flats represent the deeper parts of the great lake which once filled this valley, and here the finer mud was deposited, and as the lake was drained off by the cutting down of the outlet shallow ponds were left to be silted up with the sediment of the streams. About 30 per cent. of the area of the valley remains in forest. Of the remaining 70 per cent. 20 is marsh or meadow. This is either used for pasture or for raising hay, but as the crops are frequently lost by overflow it is not very productive. The cleared upland, like all drift soil, varies in productiveness. Morristown lies close to the foot of the Highlands, at an elevation of 380 feet, on the moraine hills. The peculiarly varied and graceful slopes of the drift here and at Madison have been utilized for country residences, enabling the landscape gardener to secure most pleasing effects. The same is true of Summit, at the same elevation on Second mountain. Boonton overlooks the valley from

*Geology of New Jersey, p. 226. Annual Report of the State Geologist for 1880, p. 85.

the slope of the Highlands north. It lies between 400 and 600 feet in elevation, and its white spires and buildings form a landmark for the whole valley south.

PALISADES MOUNTAIN.

Beyond where the Ramapo river issues from the Highlands into the Ramapo valley, at Suffern, New York, that valley is continued northeast, as the valley of the Mahwah, 13 miles along the base of the Highlands, where it heads at an elevation of 608 feet. From the north end of First mountain, near Darlington, the southeast side of this valley is bordered by a series of short sandstone ridges, running due north and south, and rising from 450 feet to 720 feet above sea-level, while the elevation of the intervening hollows ranges from 350 feet to 450 feet. From near the head of the Mahwah, in Rockland county, New York, this elevation is continued by a trap ridge, which runs first northeast then curves around in a long sweep eastward, running south of Haverstraw, where the West Shore railroad passes through it from the enclosed plain south to the banks of the Hudson, then turns and runs south and southwest, down the west bank of the Hudson and at the east border of the plain, to the shore of the Kill van Kull at Bergen Point. Crossing the kill we may consider the moraine hills of Staten Island a continuation of this ridge; these rise to an elevation of 370 feet at the northeast, but fall to about 100 feet near Amboy, New Jersey, where Arthur Kill cuts through at tide. From here the moraine ridge runs northwest to Metuchen, just east of which place it rises to 235 feet in Bloomfield's hill, although its general elevation is about 160 feet; thence running north, to the east of Plainfield, with increasing elevation, it reaches the foot of First mountain near Scotch Plains.

This line of ridges encloses an area 50 miles long by from 10 to 13 miles wide. There are three outlets through the enclosing rim. One at Piermont gives passage to the waters of Sparkill creek, and, although almost down to sea level, but 10 square miles of the basin is drained through it; a second is Kill van Kull, the outlet for nearly the whole basin, and the third is Arthur Kill, at Perth Amboy. These last two outlets are both tidal. Elsewhere, although to the southwest the enclosing ridges are but little above the level of the plain, they are high enough to separate the drainage of the basin from that of the outlying country.

The trap ridge running south along the Hudson from the New York State line is well known as Palisades mountain. Its maximum elevation is 550 feet less than two miles from the State line. Its eastern escarpment at this point is vertical for a height of from 200 to 300 feet, a solid wall of trap rock, at the foot of which is a slope of fallen rock reaching to the bank of the river. This perpendicular eastern face prevails from the State line to Weehawken, 17 miles, forming a prominent feature of the scenery of the Hudson known as the Palisades. Southward the ridge falls uniformly. At Fort Lee, it is but 300 feet high, and at Hoboken 240. At Greenville it falls off from 100 feet to the gap through which the Morris canal passes at tide. From here to Kill van Kull it does not rise above 50 feet. Northward, the ridge has a width at its base of two miles, and this decreases to less than a mile at the south end. The western slope is quite gentle. In Bergen county the ridge is timbered, excepting as small spaces have been cleared for building sites. Englewood and several other places on its west slope and crest are popular places of residence for business and professional men of the metropolis. The whole ridge offers attractive sites for this purpose, which will in time be occupied. In Hudson county, the ridge is being rapidly occupied by a city.

HACKENSACK VALLEY.

The area enclosed by Palisades mountain on the east, the Haverstraw mountains northeast and the moraine southwest, as outlined above, has no distinctive name, but since the Hackensack river occupies its main drainage axis and embraces in its water-shed a large part of the surface, no better name than this offers itself. Southwest of Newark, the surrounding ridges are so low that there is hardly a suggestion of a valley, but for most of the basin lying between Palisades mountain and the Watchung mountains, with the ridges south and east of Suffern, we readily recognize the valley, although it is very broad compared with its depth. The main axis of drainage lies well toward the southeast side. Entering the State five miles west of the Hudson, with an elevation of 45 feet, the Hackensack meanders through a strip of meadow, in a course a little west of south, to Hackensack town, where it reaches tide level. From here it flows through a broad belt of tide marsh, which, with Newark bay, gives a tidal area four miles wide, extending sixteen miles southwest to the

mouth of Kill van Kull, where the drainage turns an acute angle and flows eastward to New York bay. Southwest, beyond this point, the tide level area is continued along Arthur Kill with a width of two miles, but diminishes to half a mile as we approach the rim of the basin at Amboy.

The Passaic river enters through the gap in the Watchung mountains, at Paterson, and after its leap at the falls proceeds northeast three miles, to Hawthorne. Here it turns and runs southeast to Passaic. Here, having fallen nearly to high-water mark, it is joined by Saddle river. This stream enters the State about five miles from the base of the Highlands, having its source two miles beyond the State line, in Rockland county. A mile south of the line it has fallen to an elevation of 200 feet. Thence it runs due south through a sub-valley, 250 feet deep and one and one-half miles wide, to Paramus, six miles below. Here the valley opens out and the river proceeds through a plain with scattering knolls, southward to the Passaic. Above Paramus this stream falls about twenty feet per mile, and below about nine feet. It receives the drainage of most of the valley west through Hohokus creek, which comes in below Paramus.

From Passaic city the Passaic river flows south-southwest through a narrow sub-valley to Newark, being separated from the tidal plain east by a ridge of sandstone one and one-half miles wide, and about 140 feet high which falls off at Newark and allows the river to pass eastward to join the Hackensack at the head of Newark bay.

West of the Passaic the country is rolling, and rises from the river to an elevation of about 300 feet along the base of the Orange mountain. Montclair lies upon this slope, at the foot of the mountain, between 250 and 400 feet high. Bloomfield is lower down, at about 150 feet. Orange lies at an average elevation of about 200 feet, occasionally rising to 270 or 280 feet. This elevated land continues southwest of Newark, extending out three or four miles from the face of Orange mountain, but falls off abreast of where the mountain falls off at Millburn. Between this place and Elizabeth the plain does not rise much above 100 feet. Newark city lies upon the slope west of the Passaic, reaching an elevation of 225 feet near its western limits.

Northward of a line drawn from Paterson by Paramus and Westwood to the Hackensack river at the State line there is high ground, consisting of a large number of parallel sandstone ridges trending due north and south. On this line the land lies mostly between 50 and 100 feet in elevation, but the ridges rise steadily northward, reach-

ing 627 feet between the Ramapo and Saddle rivers, at the New York line, and 497 feet between the Saddle and Hackensack rivers. The slopes here are steep, and 50 per cent. of the area is uncultivated. The effect of glaciation has been here, as in the Highlands, to leave most of the hollows between the ridges filled with swamps.

About Ramseys, Wyckoff, Crystal lake and Franklin lake there are heavy bodies of drift, evidently of great depth. Some of this is in the form of flat-topped terraces, and over it are many pond holes, with no outlets.

Excepting this area and the country along the foot of Orange mountain, already noticed, almost all of the valley of the Hackensack is below 100 feet elevation, but over this plain, here and there, ridges and knolls rise to 160 or 170 feet, the highest being 211 feet, at Carlstadt school-house. This last is on a ridge, which is continuous from Hackensack to Newark between the Passaic and Hackensack rivers, having a general elevation of 140 feet. It also extends northward from Hackensack to Westwood with less continuity but with its higher parts at about the same elevation.

By passing up the Hackensack and through the swamp lying east of Norwood and Neuvy to the headwaters of Sparkill creek we may make a complete circuit of Palisades mountain without exceeding 30 feet in elevation. By way of Overpeck creek, keeping along the line of the Northern Railroad of New Jersey, and close to the foot of Palisades mountain, there is another line of depression not exceeding 60 feet elevation. Between these two Teaneck ridge rises to a maximum elevation of 171 feet.

Southwest of Millburn and Lyon's Farms the valley is mainly below 100 feet elevation, reaching about 150 feet near the foot of First mountain. Drift hills are scattered all over it, and sometimes rise to nearly 200 feet. The greatest masses of drift are north of Westfield, and about Lyon's Farms and Connecticut Farms. Rahway river flows from Millburn, where its elevation is 110 feet, south to tide at Rahway, thence east to Arthur Kill. The western portion of this area has 30 per cent., and the eastern 15 per cent. of forest land.

THE VALLEY OF THE RARITAN.

Southwest of the valley just described lies the valley of the Raritan. It is broad and shallow, yet its limits are well defined. The moraine

hills, from Metuchen north to Scotch Plains; the Watchung mountains, from here southwest to Bound Brook, thence curving around to the Highlands, at Bernardsville; thence the face of the Highlands west by Peapack to Pottersville, and the end of Fox Hill from here around to High Bridge, form the north border. Then we follow southwest six miles along Musconetcong mountain to Pattenburg, and from here we follow the edge of the sandstone plateau of western Hunterdon county east-southeast ten miles, to Flemington; thence southwest seven miles, to Sergeantsville, the top of the plateau descending from 930 feet elevation, near Pattenburg, to 500 feet at the latter point, and from 500 feet to 300 feet above the valley. From Sergeantsville we follow a low, flat ridge or rather water-shed line east-southeast five miles, to Sourland mountain, crossing a minimum elevation of 240 feet between the Raritan and Delaware water-sheds. Sourland mountain runs up northeast seven miles into the Raritan basin. Crossing it we descend to another minimum point of the water-shed line at an elevation of 235 feet, one mile southwest of Hopewell, at a pass where the Philadelphia and Reading railroad passes from the plain south into Raritan valley. From this point the rim of the Raritan basin is Rocky Hill, a trap ridge running three miles east-southeast to Mount Rose, where it reaches its maximum elevation 415 feet above tide; thence it runs northeast five miles to a point where Millstone river passes northward through a narrow gap at an elevation of 40 feet, carrying the drainage of over 100 square miles of the plain east and south back from the ocean northward to the Raritan basin, reversing the natural order of things. Beyond this gap the ridge rises again to 321 feet, then falls off to the sandstone, and from Franklin Park to New Brunswick we follow a broad, low sandstone ridge at a general elevation of 120 feet. Here the ridge is cut down to tide by a narrow clove, through which the Raritan carries the drainage of the basin. Northeast it continues at an elevation of 120 feet, to the moraine at Metuchen. While the drainage passes through this ridge, from Bound Brook to New Brunswick, the plain slopes back northwest from it, and Bound Brook, where the Raritan is at an elevation of 17 feet, is the point toward which all of the slopes of the Raritan basin tend.

East of the confluence of the north and south branches of the Raritan, most of the valley is below 100 feet elevation, and a dam 100 feet high at New Brunswick would flood Plainfield, Somerville

and 100 square miles of surrounding country. It would be necessary to close the gap at Rocky Hill also to accomplish this, however, for the divide between the Delaware and Millstone water-sheds at the point where it is crossed by the Delaware and Raritan canal is only 60 feet above the sea. By following up the Raritan and Millstone rivers this canal passes across the State from tide-water in the Raritan to tide-water in the Delaware, without encountering higher ground than this. This is lower by nearly 40 feet than any other pass across New Jersey.

The western part of the Raritan basin is mainly below 300 feet, but rises higher near the base of the Highlands. Cushetunk mountain, a trap hill south of Lebanon, rising to an elevation of 839 feet, is a curious feature of this valley; it almost cuts off the extreme west end of the basin from the rest, forming a beautiful valley about six miles square, with the village of Clinton near its center. This mountain is exactly the shape of a horseshoe, so far as its inner slope is concerned; it encloses a pleasant little valley known as Round valley. The toe of the shoe is turned southeast; the distance across, between the heels, is one and one-half miles, and the length two and one-half miles. Just back of the heels, a cluster of hills, from 500 to 600 feet in elevation, complete the closure of Round valley, leaving outlets just back of the two heels.

Raritan valley is characterized by a smooth, undulating surface; the hilliest portion is at the extreme north, about New Germantown and Peapack; everywhere it is highly cultivated. Hackensack valley is a valley of cities, but this is purely an agricultural region. Excepting the trap ridges, not more than 3 per cent. of the surface remains in timber; smiling fields, neat farm buildings and many shining white spires of village churches meet the eye in any extended view of its area.

Plainfield, in an angle between the moraine hills and the face of First mountain, standing on a level, sandy plain at an elevation of 100 feet above the sea, is a beautiful and growing place of suburban residence. Bound Brook, Somerville and Raritan are also neat and thriving towns of this valley. Flemington, the county seat of Hunterdon county, lies at the south side of the valley, at an elevation of 190 feet.

From the outlet at New Brunswick, west-northwest to Pattenburg, at the head of the valley, is 32 miles. From Peapack southwest to

Sergeantsville, or from Plainfield southwest to Hopewell, is 25 miles. The area of the basin is about 450 square miles.

WEST HUNTERDON SANDSTONE PLATEAU.

In the description of Raritan valley the edge of this plateau was given. Running out from the southeast face of Musconetcong mountain, just southwest of Pattenburg, it is known as Barren ridge, and has an elevation of 913 feet, being the most elevated part of the whole red sandstone plain. At Pittstown, Cakepoulin creek, running northeast from the top of the plateau, cuts down the northeast edge, but it rises again at Quakertown and Cherryville, reaching an elevation of 706 feet. Sweeping round west of Flemington the escarpment runs due southwest to the Delaware at Stockton. The top surface of the plateau is inclined gently toward the Delaware in a southwest direction from its high northeast border. One mile back from the Delaware the elevation at Frenchtown is from 370 to 395 feet, and above Tumble station 546 feet. Just above Bull's Island it is 466 feet. Thus, for the five miles from Barren ridge southwest to the bluff above Milford and Frenchtown the average slope is 100 feet per mile, but from Cherryville southwest 12 miles, toward Tumble, it is but 13 feet per mile. At the extreme western corner of the plateau Gravel hill puts off from the face of Musconetcong mountain toward Milford, with an elevation of 865 feet. In this vicinity the plateau is cut down in deep ravines by the streams running southwest to the Delaware, but the southeastern portion is more level, the streams running southwest through very shallow valleys. About 10 per cent. of this plateau is wooded. It is famous for the large crops of peaches which it produces.

SOURLAND MOUNTAIN.

This is another of the trap ridges which stud the red sandstone plain. It rises from Raritan valley at Neshanic, attaining its maximum elevation of 563 feet two and one-half miles beyond, and runs southwest seventeen miles to the Delaware just below Lambertville. Here it has, in Goat hill, overlooking the river, an elevation of 457 feet. The river passes through it in a narrow gap at an elevation of 50 feet.

The trap rock is confined to the axis of this ridge, the outcrop not usually exceeding a mile in width, and this portion is mostly timbered; but on the southeast sandstone foot-hills, usually exceeding 400 feet in elevation and mainly cleared, bring the width of the ridge up to four miles. Southwest for six miles, near the Delaware, these hills are faced by the trap outcrops of Mt. Canoe, 480 feet, and Pennington mountain, 460 feet above tide, making the total width of the high ground here over five miles.

Southward, from Sourland mountain and Rocky Hill to Trenton, is a portion of the red sandstone plain, about nine miles square, which lies mainly between 100 and 240 feet in elevation, falling off to the Delaware on the southwest and to the low country along the Delaware and Raritan canal southeast. It is rolling and well cultivated, not more than 5 per cent. of its area being wooded. The city of Trenton is at its southernmost corner, standing mainly on a gravel terrace at an elevation of 50 feet above tide. Pennington village is a little northwest of its center, at an elevation of 213 feet. Princeton is at its eastern corner, beautifully situated on a ridge 220 feet above tide and overlooking all of the low country east and south.

The Delaware river flows across the red sandstone plain from northwest to southeast. It receives but little of the drainage of the plain and has no true valley, but cuts across the ridges in a shallow cañon, with sides steep and in places vertical. It comes in with an elevation of 120 feet at Holland, and reaches tide at Trenton, 38 miles below, the average fall being three feet two inches per mile. Above Milford bluffs rise on both banks of the river, the highest vertical face being near Narrowsville, Pennsylvania. The clove here is about 300 feet deep, with a bottom width of less than half a mile. The bottom is gravelly and flat, the terraces rising 20 feet or more above the river bed. From Milford to Frenchtown, the bluffs lower somewhat and are not so steep. At Frenchtown the river is 101 feet above tide. From here to Bull's Island, nine miles below, it runs south through a narrow gorge increasing in depth from 200 feet at Frenchtown to 470 feet at Tumble.

At Bull's Island there is a dam in the Delaware, above which its elevation is 69 feet. Water passes from here down the Delaware and Raritan canal feeder to Trenton, thence by the canal across the State to Raritan bay, the river here being higher than any land met with on this route. From Bull's Island to Lambertville the banks are

lower and not so steep. Lambertville lies along the Delaware below the bluff at an elevation of 80 feet, on a gravel terrace, the elevation of the river being 50 feet. For five miles below the river passes through Squrland mountain by a clove 400 feet deep, coming out to the plain at Titusville. Thence to Trenton, it flows through a more open valley.

Beyond the State limits this red sandstone plain ends at Tompkins' cove, New York, in a point; being confined between the Hudson east and the Highlands northwest. In Pennsylvania it extends southwest in a narrowing belt, being reduced to a width of but 10 miles at the point where Reading stands at its northwest border. From here it runs nearly west to the Susquehanna, below Harrisburg, thence it turns southwest and leaves the State. Gettysburg is at about the middle of the belt. The Highlands, falling off at Reading, leave Kittatinny valley and this plain unseparated for 60 miles. South mountain, rising 10 miles beyond the Susquehanna, again shuts in the Great valley.

THE CRETACEOUS AND TERTIARY PLAIN.

Although the aspect of the Cretáceous country differs materially from that of the Tertiary, because of its more fertile soil, there is no topographical distinction except in some minor details, and the two can be best treated as one. Of the 4,400 square miles of New Jersey south of the red sandstone plain, not more than 1,200 square miles rise above 100 feet elevation, and the portion above 200 feet does not exceed 15 square miles in extent. The highest point of the whole area is just northeast of Crawford's Corner, on the road from Keyport to Holmdel, in Monmouth county. Its elevation is 391 feet above sea level. One-third of the surface is less than 50 feet above sea level.

The plain is 25 miles wide at the north end, 57 miles at the south, and 102 miles in length. Its periphery measures 310 miles following the general direction of the shore lines, and not their intricate windings. Of this distance all but the 28 miles from Trenton to the Raritan is on tidal waters. The highest part of this 28 miles is, as already noted in bounding the red sandstone plain, about 80 feet, at Monmouth Junction.

Beginning with the Highlands of Navesink, which rise to 269 feet, a line of gravelly hills runs westward to Beacon hill, near Morgan-

ville, ranging in elevation from 200 to 391 feet. From here the water-shed line is a broad, flat ridge running south, with a general elevation of 200 feet on the crest-line, to Freehold. This village is at an elevation of from 170 to 190 feet. The ridge now runs southwest to Clarksville. In this vicinity is another group of gravel hills rising above 300 feet, the highest being Pine hill, southwest of Manalapan, 372 feet above tide. The dividing ridge now runs due south to Whitings and Woodmansie, generally above 150 feet, but very rarely rising to 200 feet. The elevation of 150 feet is carried within three miles of Barnegat village. Southwest of here it extends to within three miles of Harrisville, with elevations exceeding 100 feet. The water-shed line between the drainage east and west, however, runs southwest from Woodmansie toward Tabernacle. Here for sixteen miles the divide between the Rancocas and Mullica water-sheds is much of it depressed below 100 feet, reaching a minimum of 85 feet. Between a line drawn from Bordentown on the Delaware to Tuckerton on the seashore, and one drawn from Camden to Atlantic City, is a belt more generally depressed than any other crossing Southern New Jersey. It includes the Assiscunk, Rancocas and Pensauken water-sheds northwest, and the water-shed of Mullica river southeast. Most of it is below 50 feet, and only a part of the water-shed line reaches 100 feet.

Near the line of the Camden and Atlantic railroad the ground again rises across the whole breadth of the State. Two miles north of Berlin, on the line between Camden and Burlington counties, it reaches 214 feet. Four miles southwest, Pine hill, near Clementon, reaches 202 feet. It may be here noted that these hills, with Applepie hill, three miles southwest of Shamong station, which rises from the plain at a general elevation of 100 feet to a height of 208 feet, and a point on the ridge extending southward from Whitings and Woodmansie four miles northwest of Cedar Bridge, on the line between Ocean and Burlington counties, are the last points going south which rise above 200 feet. These hills are all on about the same parallel of latitude.

From the high ground at Berlin the water-shed line runs southwest to Glassboro, ranging from 140 to 170 feet in elevation, thence to Pittsgrove. About here there is quite an extent of country above 100 feet in elevation. A spur extends down along the line of the Camden and Atlantic and Philadelphia and Atlantic City railroads

to Elwood, and carries an elevation of 80 feet to Pomona. Another spur extends northwest nearly to Haddonfield. Between the Great Egg Harbor and Maurice river water-sheds, the ground is above 100 feet to beyond Vineland and Landisville; between the Maurice river and Cohansey water-sheds it extends to the New Jersey Southern railroad, and between the Cohansey and Stow creek to within four miles of Delaware bay. Westward, spurs extend out to Swedesboro and Woodstown. Westward, this high ground falls off suddenly to a level plain. Through Salem county there is a belt along the Delaware from five to nine miles in width, which is all below 50 feet, and mostly below 30 feet. Upper Penns Neck precinct has less than a square mile of its surface above 30 feet; Lower Penns Neck is all below 20 feet; the highest point in Salem and Elsinborough is 17 feet, and not more than four square miles of Lower Alloways Creek precinct is above 30 feet. This area below 50 feet extends northeast to Camden in a belt about five miles wide, most of which is below 30 feet. From Bridgeton northward to Camden the ground between 50 and 100 feet is limited in extent as the slope is quite steep. The drainage of this slope of the plain is generally northwest, and the streams issue from the high ground through deep, broad U-shaped ravines, sometimes 200 or 300 yards in breadth and 100 feet deep. Their bottoms are usually marshy, and through them the streams flow in a sinuous course. Across the lower plain the streams pursue a winding course through belts of tide-marsh, the tide usually flowing up to the line of the slope of the higher ground.

The drainage of all of Southern New Jersey is extremely simple, the streams everywhere flowing straight away from the water-shed line down the slope southeast to the ocean, or northwest to the Delaware and other streams. The peculiar U-shaped ravines noted above, however, prevail everywhere on the streams of the northwest slope, while on the southeast slope most of the streams flow through very broad, flat valleys, the surface rising from either bank in gentle slopes. This causes a marked difference in the topography of the two slopes. Its reason lies in the fact that all of the State south of the red sandstone plain is made up of alternating beds of sand, gravel and clay, or marl. These beds dip southeast at a slope of about 25 feet per mile. On the northwest slope, the outcropping edges of these beds are all exposed, and streams running northwest are compelled to cut across all of them. Some of the beds resist

erosion, and these protect the softer strata and prevent the stream from broadening its valley and working down the slopes. Erosion proceeds downward alone, and the steep-banked ravine is the result.

From Camden to Bordentown, and extending back from the Delaware 16 miles, beyond Mt. Holly, Pemberton and Medford, is a large area half of which is below 50 feet elevation. Detached parts rise to 80 or 90 feet, but hardly any of it reaches 100 feet, and it is as high within two miles of the river as it is further inland. Arney's Mount, 230 feet above the sea; Mt. Holly, 183 feet, and Mt. Laurel, 173 feet, are small, round hills rising from its surface. This is a portion of the depressed belt extending across the State to Atlantic City and Tuckerton, which has been previously referred to. It is a very fertile section. The surface is well drained although so flat, there being very little swampy land.

THE CLAY AND MARL REGION.

Most of this northwest slope of Southern New Jersey is included in the clay and marl region. Taken as a whole, this is the most fertile and productive part of the State. It extends southeast from the red sandstone country to a line drawn from Long Branch south of Freehold to New Egypt, thence on southwest, passing two miles southeast of Pemberton and Medford, to Clementon, Mullica Hill and Salem. It is 20 miles wide at the northeast end, diminishing to 10 miles at the southwest, and is 100 miles in length. Of the portion already described, lying in Salem, Gloucester, Camden and Burlington counties, the percentage of forest in the different townships varies from 1 to 18 per cent., averaging for the whole section about 8 per cent. The rest of the area is also under a high state of cultivation. In Mercer the wooded area ranges from 7 to 18 per cent., averaging about 12 per cent. Upper Freehold township, Monmouth county, has but 4 per cent.; the rest of Monmouth averages about 18 per cent., ranging from 11 to 24 in the different townships. In Middlesex county, on the clay, South Brunswick and East Brunswick townships have over 40 per cent. of their area in timber. Madison has 57 and Sayreville 59 per cent. There is much gravel deposited over this area, which accounts for the inferiority of the soil to that of the clay in Mercer county and the consequently larger unimproved area.

From Bordentown to Jamesburg the slope is quite uniform from

the water-shed line northwest to the line of the Delaware and Raritan canal. The upper half of the slope is sand and marl, and is generally above 100 feet, while the lower half is on the clay, and mostly below 100 and above 50 feet elevation. The drainage is west-northwest to the Assanpink and Millstone. The streams here are often fringed with marsh, especially on the clay. Bear swamp, northeast of Trenton, and Devil's Brook swamp, south of Monmouth Junction, are of considerable area. Northeast of Jamesburg the slope is cut into two by the broad, flat valley of South river, running northeast from that village, and mostly below 50 feet. Lawrence's brook runs northeast from Monmouth Junction, and is also mostly below 50 feet. Both streams receive nearly all of their drainage from the southeast. The drift-strewn and therefore uncultivated character of this region has already been noted. The Lawrence's brook and Devil's brook water-sheds are covered by an intricate maze of swamps, interspersed with low gravel hills.

On the eastern slope of the plain, but still in the clay and marl region, we have the valley of the Shrewsbury and Navesink rivers, lying between Navesink Highlands on the north, and the spur of gravel hills running off from the ridge at Freehold to near Asbury Park, which has an elevation of 180 feet within three miles of the coast. This valley is some 10 miles broad by 13 in length, and is mostly below 50 feet elevation, the broad tidal portions of the two rivers themselves occupying a considerable portion of the valley. In fact, although called rivers, these are little more than estuaries. All about their banks are clustered pleasant resorts for pleasure-seekers. Red Bank is situated at the head of tide on the Navesink, six miles from the sea. Three miles south of it is Eatontown. Along the ocean front are Long Branch and the almost continuous line of seaside resorts which have sprung up in recent years. The surrounding hills rise just high enough to distinguish this portion of the coast from that south. Aside from these attractions the valley is fertile and highly cultivated.

THE PINE PLAINS.

Occupying the higher parts of the western and all of the eastern slope south from Long Branch is the extensive region known as the Pines, the wildest and most undeveloped portion of the State. In shape it is triangular, beginning in a point at Long Branch and

widening to 50 miles at Delaware bay, with a length of 96 miles. The general aspect of this region is well known to all who have traveled between Philadelphia and the seaside resorts. The New Jersey Southern railroad also traverses it for 100 miles, from Eatontown to Bay Side.

From Long Branch southward 16 miles, to Bay Head, the fast land comes out to the ocean front, and rises at the north in a bluff, 30 to 40 feet high; southerly, it is a low coast, fringed with sand dunes. There is a continuous line of places of summer resort along this distance, and their popularity and prosperity are on the increase. The shore is broken by Shark River bay, some three miles long, which has a contracted inlet which occasionally closes, cutting off the tides, and by Manasquan river a tidal estuary five miles long with a width of from one-quarter to one-half a mile, and bold, picturesque banks from 70 to 100 feet high in places. Deal lake and Wreck pond are smaller estuaries. A line of fresh-water ponds, just back from the coast-line, have been utilized to add to the attractiveness of the several seaside settlements.

The ridge running off from Freehold east to Asbury Park, and forming the divide between the Navesink and the Manasquan and Shark river water-sheds, has been already noticed. It is an irregular line of gravel-capped hills. The highest of these, known as the Hominy hills, two and one-half miles south of Colts Neck, is 308 feet above tide. A spur of this irregular, gravelly ridge runs off southeast between Shark and Manasquan rivers to Manasquan village, carrying an elevation of 100 feet within two miles of the ocean.

Of the area of the Tertiary pine plain lying in Monmouth county, 50 per cent. is cleared and cultivated. The wooded portions are usually the higher parts—the gravel hills. It is a fact noticeable throughout the pine region that the character of the soil generally varies with the elevation, the higher parts being gravelly, the intermediate sandy, and the low parts a sandy loam. This last lies entirely below 50 feet, and usually below 35 feet. It is the most fertile soil of the region, being alluvial in origin.

Southward from Bay Head the piney region is fringed along the ocean front by a strip of tide-marsh, bays and creeks from three to six miles in width. At the inner edge of this tidal plain the upland generally rises promptly to a height of from 30 to 40 feet, presenting a continuous front the general line of which is very straight for the

65 miles from Manahawken to Cape May, being only broken by the basin of Mullica river where the tide flows in 15 miles back from this line, and by the Great Egg Harbor river which sends its tides 12 miles back, both streams being fringed by tidal plains.

The drainage of the eastern slope of Southern New Jersey is southeast along lines running quite direct from the water-shed line to the ocean. The streams are almost invariably bordered by strips of cedar swamp, and near the headwaters of Toms river, Mullica river with Wading river, its tributary, and Great Egg Harbor river, on the eastern slope, and Crosswicks creek and the Rancocas, on the western, there are extensive areas of these swamps. These are valuable for the timber which they produce, and portions of them have been made very productive by clearing and transforming them into cranberry bogs.

As we proceed southwest the slope becomes more gentle. It rises from 10 to 20 feet per mile, or in places steeper, north of Tuckerton, but southward from there the rise from the brow of the first slope up from the marsh back to 100 feet elevation averages only three feet per mile. In this portion the area above 100 feet elevation within twenty-five miles of the sea is very trifling. The highest point of Cape May county is but 50 feet above mean sea level, and more than half of Atlantic county is below 50 feet, as is nearly half of Cumberland. The fall of the streams of this slope is quite uniform. Above the head of tide the average fall of the Manasquan is 5½ feet per mile. The Metedeconk falls 6⅝ feet, and Toms river 6½ feet, the distances used in each of these three cases being 12 miles. Cedar creek falls 7 feet per mile for 7 miles, Mullica river 5 feet for 16 miles, and Great Egg Harbor river 5 feet for 25 miles. Maurice river averages 5½ feet for 20 miles. The head of tide, however, while it is but 3 to 5 miles back from the edge of the fast land on the first three streams, is 17 miles back on the Mullica and 12 miles on the Great Egg Harbor rivers. These figures are sufficient to show that it is not a lack of fall along the stream lines which causes the swampy borders, but a lack of lateral fall at right angles to these lines.

Ridges and valleys and slopes have been spoken of in a way which may distract the reader's attention from the extremely level character of this whole pine country, but to guard against this he must keep in mind the figures which have been given. Casting the eye over this plain from any point of vantage, such as one of the small round hills

which rise from its surface here and there at wide intervals, we see an unbroken extent of dark-green pine forest, as far as the limit of vision, stretching away in long, gentle swells, level as the ocean itself. So level is it in places that the greater height of the timber in the swamps gives the appearance of a ridge on what is really the lowest ground of the plain, and the uninitiated may be easily deceived thereby. It is often impossible for even a practiced eye to judge which way the ground descends, and in passing along the long, straight roads cut through the timber, it frequently seems that one is always at the bottom of a hollow, the ground appearing to rise in both directions, whereas it is either level or sloping all one way.

Only 13 per cent. of the upland area of Ocean county is cleared, and nearly all of this is in the township of Plumstead, near New Egypt, just north of Toms River, and in a narrow strip on the alluvial land at the edge of the upland next to the tide marshes. This strip is well populated all along the seashore and the shore of Delaware bay. The "shore road" is lined throughout with the residences of retired and active sailors, oystermen, fishermen or baymen, as one class is called, who have their small farms along the ocean front to occupy their attention when their more congenial occupations do not demand it. Here and there they have clustered together in neat and pleasant villages.

With these exceptions, Ocean county is an almost unbroken wilderness. Frequent fires have left much of the timber scarred and stunted, especially near the railroad lines, but farther back there is often taller woods. The absorbent character of the pine woods and the sandy soil, which leaves the air dry and wholesome and laden with the fragrance of the pines, has attracted attention to this region's desirableness as a winter resort, and Lakewood, at the extreme northern end of the county, on the Metedeconk river, 9½ miles from the ocean and from 60 to 90 feet above it, is now a well-known retreat.

Burlington county southeast of Pemberton and Medford is in the pine belt, and includes some of the most desolate and barren parts of it. The various townships have from 1 to 17 per cent. of their areas cleared, the average for the piney portion of the county being 10 per cent. Southeast of the New Jersey Southern railroad and along the line of Ocean county, including much of the water-shed of Wading river, is an area of several thousand acres known as "the plains," where the only growth is short brush two or three feet high. About

Tabernacle and Indian Mills, in Shamong township, there are clearings of some 7,000 acres in extent, and the land seems good. It is probable that several thousand acres along the border of the marl region could be profitably cleared and worked, but in general but little has yet been done to develop the pine plains north of Mullica river.

From Manchester southward to the Mullica river is one of the wildest, most desolate portions of the State. If we except the clearings on the shore road and along the marl border, not more than 2 per cent. of this area is under cultivation. Here and there narrow roads, barely wide enough for a single vehicle to pass clear of the trees, thread their lonely way from clearing to clearing. Some of these are merely kept as traditions. They are relics of a time when the manufacture of iron from bog ore found in the swamps was an important industry of the region. These roads were then important highways. Now they scarcely retain a reason for existence. Here and there one comes upon abandoned forge sites, or still more suggestive abandoned villages, the relics of unsuccessful ventures in glass manufacture in the heart of the wilderness. An indescribable speaking silence prevails. The soughing of the wind through the pines saddens and oppresses, and the crowing of a cock or barking of a dog, which indicate that we approach a clearing and human habitation, come to be most welcome sounds. This stillness may have a charm for reasoning man, but the poor domesticated brute, accustomed to the sounds of human life, quails and trembles at it. Still deeper is the gloom of the dark-green cedar swamps, often growing so close that the very trunks of the tall, straight trees limit vision to a few yards. The light of the sun scarce penetrates to the earth at all. The swamp is usually very wet, and if the timber be old, or if it has been recently burned over, fallen logs impede our progress. Trailing moss hangs in graceful festoons from the branches. The streams, in many cases, are not confined strictly to their channels, but flow through a broad belt of swamp hither and thither in countless little streamlets, for the peaty earth is porous, and indeed the swamp bottom for many feet in depth is only a mass of logs fallen in bewildering confusion with the interstices filled with more or less decayed vegetable matter—leaves, twigs and moss—the whole the product of thousands of years of growth, of scores of successive generations of trees. Percolating through this accumulation and taking on a clear, rich

coffee color and slightly pungent cedar taste, while it is shaded from the sun's heat by the dense growth overhead, the stream issues cool and palatable; "cedar swamp water" being most agreeable to many, and apparently most wholesome to all.

Not less dense are the swamps growing oak, beech, gum and poplar, although the lighter green of the foliage makes them look less dark and forbidding. The growth of timber and brush in these, is most luxuriant, and trees 100 feet in height are not uncommon.

Southward from Mullica river, the same general wildness prevails throughout Atlantic county, eastern Cumberland and northern Cape May. Atlantic county has but 11 per cent. of its upland area under cultivation. Hammonton, Egg Harbor, the vicinity of Vineland and the "shore road" contain most of the cleared areas. The center of the county is a wilderness Hamilton township having but 2 per cent. of its area cleared.

The remainder of the region is being rapidly improved and brought under profitable cultivation. Twenty-five per cent. of the pine region is cleared in Camden county, 30 per cent. in Gloucester and 63 per cent. in Salem. Perhaps the most advancing portion of the region is Cumberland county, 36 per cent. of which is now cleared. It is true that a good part of this is the older-settled country west of the Cohansey, but large inroads have been made in the eastern portion within 25 years, particularly in the vicinity of Vineland. All along the Delaware bay shore there is a belt of fertile alluvium, stretching down into the marsh in long necks most of which is below 20 feet elevation.

THE TIDAL PLAIN.

The tide-marshes which lie in the valley of the Hackensack, as well as those which fringe the sea and Delaware bay shores, have been already noticed. The area of marsh, including creeks less than 100 yards in width, is, for the whole State, 296,500 acres. The included bays and creeks more than 100 yards wide have an area of 125,570 acres, making about 660 square miles for the area of the tidal plain within the coast lines.

The marshes are formed by the growth of grass-roots and turf and the deposit of sediment. Masses of muscles are also seen in places and may aid considerably in the formation. The usual process of growth is, however, first the shoaling of the water by the building up

of mud flats, then comes the scattering growth of sedge, which collects and holds sediment, and hastens the accretion. The thickening of the grass and formation of turf, and the addition of sediment continue until the marsh has been built up to the level of the highest tides, when growth ceases. This process is constantly going on and lessening the area of water surface. There has been a noticeable growing up of bays, creeks and channels since the first accurate surveys of the coast, about 1840.

The strip of tidal plain along the seashore is everywhere fringed by narrow sand-beaches. The waves cast up the sand and it is caught up by the wind and piled in dunes which rise usually from 15 to 25 feet, but on Seven Mile beach a height of 43 feet is reached. Many of these beaches rest on the tide-marsh, and a very heavy storm will sometimes cut away the sand and expose the marsh on the ocean front. This is evidence that the beach has traveled back inland its whole width since the marsh was formed. In fact the shape and position of these beaches are constantly changing. At New inlet, Long beach extended three miles farther southward in 1885 than it did in 1841, while Island beach, south of Little Egg Harbor inlet, had grown one mile northward in the same time. Five Mile beach had its south end three-quarters of a mile further south and half a mile more to seaward than its position in 1772. These beaches vary in width from a few rods to half a mile. Some of them have a scrubby growth of cedar on the inner slope. All of the seaside resorts from Bay Head to Cape May are situated on these beaches, as are those northward from Monmouth Beach to Sandy Hook. The latter is a broad sand beach, from half a mile to a mile in width, and four miles long. The inner part is old beach, composed of high sand hills, covered with cedars, and was in existence in 1685. The sea front, from a quarter to half a mile in width, and a mile of the north end are new beach which has formed since that time. It is joined to the mainland by a long strip of new beach running south five miles, and only from 100 to 200 yards in width, back of which the waters of Navesink and Shrewsbury rivers find their way to Sandy Hook bay, through a narrow channel. Before 1848 this beach was cut through by Shrewsbury inlet, opposite the Navesink river, and another inlet farther north, leaving Sandy Hook an island, although in 1685 it was undoubtedly connected directly with the Highlands of Navesink,* and probably as

*See map in the Annual Report of the State Geologist for 1885.

late as 1777 also. From Bay Head to Cape May the beaches are cut through by ten inlets through which the tide ebbs and flows to the bays inside. The interval between these inlets is over 20 miles at the north, but decreases to 2 miles near Cape May. There has been a tendency to decrease in the number of inlets and at least six have been permanently closed during this century. Corson's inlet, in Cape May county, has recently shown a tendency to closure.

The wear and rapid change in the neighborhood of these inlets will be better understood when we note the enormous volume of water which passes through them. It is within the truth to estimate the average rise and fall of the surface of Barnegat bay at each tide at one foot. This, on an area of 72⅓ square miles, means a volume of 2,016 million cubic feet of water to be passed through Barnegat inlet at each tide, or four times daily. In other words, the amount of water which passes through Barnegat inlet in one year is more than three times the amount which flows from the water-shed of the Hudson river in the same time. To the scouring effect of this current must be added the effect of wave-action, which is nowhere more important than at the inlets.

Inside of this line of beaches is a series of bays and sounds connected by a network of narrow, crooked channels, called thoroughfares, in such a way that boats of light draft can pass from the head of Barnegat bay over 90 miles down to Cape May, keeping entirely inside of the beaches. Barnegat bay is the largest of these, being nearly 30 miles long, with an area of 72 square miles. Its depth northward from the inlet scarcely exceeds 10 feet anywhere, a considerable area next to the beach being less than 5. Southward it reaches 20 feet near Lovelady island. It varies from two to four miles in width, leaving the beaches well cut off from the mainland.

Northward from Barnegat village the marsh nowhere exceeds a mile in width and is usually much less. Southward it widens, encroaching more on the bay, but there is still most of the way down back of Long beach a width of from two to four miles of water. The tides from Barnegat and from Little Egg Harbor inlets meet at the Cedar Bonnets, about where the Long Beach railroad now crosses, which is the most contracted part of the water area. Between Tuckerton and Beach Haven Little Egg Harbor bay is four miles wide. It has a depth of from five to ten feet at mean tide, but there is a channel running down from the Cedar Bonnets to the inlet in which

the minimum depth is ten feet and the maximum thirty-two feet. Through this bay are scattered many islands of marsh, and at its foot a long tongue of marsh puts out from the mainland toward the south end of Long beach, four and one-half miles. It is from one to two miles wide and is cut up into numerous islands by thoroughfares. It separates Little Egg Harbor bay from Great bay at the mouth of Mullica river. This bay is six miles long and four miles wide, with a depth of from two to ten feet, nearly all of it being less than ten. Above, in Mullica river, the depth ranges from twenty to over forty feet. Little Egg Harbor inlet, called New inlet formerly, to distinguish it from the old inlet which was just south of Bond's boarding-house, opens directly into this bay. In 1871 it was over two miles wide, but now, in 1888, it is less than one mile, and there is dry beach where there was then sixty feet of water. Observations on tidal bench-marks, set in 1872, seem to show that this contraction of the inlet has reduced the height of high water in Great bay at least six inches. It has taken place in the face of the scour produced by the passage of 3,000 million cubic feet of water twice at each tide. It will be noted that this volume is greater than that passing Barnegat inlet. The area tributary to this inlet is but 50 square miles against 72 at Barnegat, but the range of tide in the bays is about double. The areas of the various tidal waters of the State will be found in the chapter on areas. Little Egg Harbor bay measures 31.4 square miles and Great bay 17.7 square miles. Southward the bays are much smaller.

Going from Great bay southward to Great Egg Harbor bay, the tidal plain diminishes in width from six and one-half miles to less than three. It is fronted by Island, Brigantine and Absecon beaches, back of which the marsh is cut up by a series of small bays and broad channels into countless islands, the areas of marsh and of water being nearly equal. The water in these bays rarely reaches ten feet in depth. Atlantic City, the famous seaside resort, is on the north end of Absecon beach and has five miles of water and marsh between it and the mainland. This isolation and the opportunities for sailing and fishing afforded by the inside waters form prominent attractions for all seaside resorts south of Bay Head, as the connection with the mainland and consequent facilities for driving and nearness to the great cities attract patrons to the more northern resorts, while the leading allurements of sea air and surf-bathing are common to all.

Southward, in Cape May county, the plain varies from two to four miles in width, and is of the same character as that already described.

On Delaware bay the marsh is partially faced by a very narrow strip of sandy beach, but in most places is entirely unprotected. Coming out to the bay and exposed to the action of its waves, it is being rapidly cut away. At Egg Island point the shore line has retreated fully a quarter of a mile since 1842. The wear at the mouth of Dennis creek has also been large. The width of these marshes is variable, the edge of the upland being very irregular. South of Salem it runs from one to five miles. There are no large bays included, but north of Egg Island point there are large numbers of small ponds, and a most intricate network of small creeks make it extremely difficult to cross the marsh. This marsh is largely soft and rotten, unlike the smooth, hard turf which prevails on the seashore. Indeed, it is a rule throughout the State that the salter the water the solider the marsh. The fresher portions are soft, spongy and reedy, and, in general, disagreeable. Many of the marshes on the seashore are, in the spring and early summer, as smooth, hard and clean as a well-kept lawn.

As has been already remarked, the marsh corresponds in elevation, generally, to the level of the highest tide, since when it ceases to be overflowed it ceases to receive sediment and increase in elevation. This level does not necessarily correspond with high-water level in the ocean, however, for high water in the bays is usually much lower. The inlets are too contracted to allow the bays to fill up to the level of high water outside, so high water inside of the beaches ranges from one to nearly two feet lower. It is not unusual, therefore, to find the marsh more than a foot lower than mean high water in the ocean outside. For the same reason the marsh is found to be low near the upland at the head of the long tidal creeks on Delaware bay shore.

Where the marshes have been embanked and improved they have shrunk considerably. Instances have been noted where this shrinkage or settlement amounts to three feet.

In this connection, the following list of observed elevations of tide-marsh and of high, mean and low tides in the bays and creeks, will prove of interest. At Sandy Hook, the United States Coast and Geodetic Survey has taken a series of observations, with a self-registering tide-gauge, extending continuously from October 21st, 1875, to October 31st, 1881. The mean of all the readings of this series

is taken as mean sea level at this place and is the datum-plane (the zero) for all elevations. This series of observations makes the mean rise and fall of the tide at Sandy Hook 4.7 feet. The gauge was placed at the New Jersey Southern railroad wharf on the inner side of the Hook.

The observations were made during the progress of the leveling operations of the Topographic Survey. Those marked U. S. C. S. are based on tidal observations made by the United States Coast Survey and connected by these levels. They are most reliable. The others, on high water, are as accurate as they could be made without a series of observations to determine the mean high-water mark. It should be remarked that as the inlets are constantly changing their cross-sections, it is hardly probable that mean high water in the several bays rises to the same height two years in succession.

ELEVATIONS OF TIDE-MARSH, HIGH, MEAN AND LOW WATER REFERRED TO MEAN TIDE AT SANDY HOOK.

LOCALITY.	ELEVATION IN FEET.			
	TIDE-MARSH.	HIGH WATER.	MEAN TIDE.	LOW WATER.
Sandy Hook, U. S. C. S.	....	2.35	0.00	-2.35
On Overpeck creek, Nordhoff station	2.46	....	....	....
" " " Leonia station	2.77	....	....	....
" " " opposite Palisades Park	2.29	....	....	....
" " " north of Ridgefield	2.58	....	....	....
Hackensack river, at Hackensack	....	3.22	....	....
Little Ferry	2.60	2.60	....	....
One mile south of Little Ferry	2.30	....	....	....
Bellman's creek, at N. Y. S. & W. railroad	....	2.70	....	....
New Durham	1.96	....	....	....
Erie railroad, west of tunnel, Jersey City	2.73	....	....	....
East of Harrison, near turnpike (embanked)	-0.90	....	....	....
Waverly, half mile north of station	2.06	....	....	....
Elizabeth river, at Pennsylvania railroad	....	2.48	....	....

LOCALITY.	ELEVATION IN FEET.			
	TIDE-MARSH.	HIGH WATER.	MEAN TIDE.	LOW WATER.
Rahway river, at Rahway	....	2.56	....	....
Woodbridge, at railroad, south of village	3.28	....	....	....
Woodbridge creek, Woodbridge and Sewaren road	3.02	....	....	....
Mouth of Cove's Mill creek, north bank of Raritan	3.08	....	....	....
Cheesequakes creek, at railroad bridge	2.45	....	....	....
Perth Amboy, Lewis street	....	2.40	....	....
One-quarter mile northwest of Matawan	2.84	....	....	....
Flat creek; road from Keyport to Keansburg	3.14	....	....	....
Two miles west of Port Monmouth	....	2.76	....	....
Red Bank, Navesink river, 1884	....	1.62	....	....
Clay-pit creek, Navesink river, 1884	....	1.76	....	....
Parker's creek, 1 mile north of Oceanport, 1884	1.91	....	....	....
Manasquan river, north side	2.05	....	....	....
Mantoloking, on Barnegat bay	1.40	....	....	....
Bay Head, Barnegat bay	0.98	0.67	....	....
Metedeconk river, 1 mile east of Cedar bridge, range of tide about 0.70 ft.	....	0.85	....	....
Kettle creek, U. S. C. S., gives range of tide, 0.47	....	....	....	....
Toms river, U. S. C. S., observations of 1876, west of Island Heights	....	0.89	0.52	0.16
Toms river, 1885, at village bridge	....	0.80	....	....
Seaside Park, U. S. C. S., 1876, range of tide, 0.88	....	....	....	....
Cedar creek, 1885, at shore road	....	2.76	....	....
Cedar creek, U. S. C. S. observations, 1874, range of tides, 0.75	....	....	....	....
Waretown (Barnegat bay)	....	1.31	....	....
Barnegat. End of Bay avenue	1.40	....	....	....
Barnegat Landing, on Double creek, range of tides, U. S. C. S. observations, 1874, 0.75	....	....	....	....
Barnegat inlet, range of tides in the bay, 2.04, from U. S. C. S. observations, 1866	....	....	....	....
Inside of Long Beach, 1 mile south of Barnegat inlet	1.26	....	....	....

LOCALITY.	ELEVATION IN FEET.			
	TIDE-MARSH.	HIGH WATER.	MEAN TIDE.	LOW WATER.
Near Harvey Cedars	1.65	....	....	....
Near railroad at Cedar Bonnets	1.89	....	....	....
Long Beach railroad draw-bridge, Manahawken bay	....	0.94	....	....
Near Long Beach railroad, west side of Manahawken bay.	1.94	....	....	....
Dinner Point, U. S. C. S., 1873, gives range of tide, 2.21 feet.	....	....	....	....
Osborne's island, north side of Great bay	....	1.59	....	....
Great bay, mouth of Mullica river	....	1.94	....	....
Willett's house, north shore of Great bay, 1 mile back from New inlet.	2.21	....	....	....
Willett's house, from U. S. C. S. *observations of tides* in Great bay, 1872. (Compare above for 1885)	....	2.70	1.00	-0.70
[For reason for this change of about -0.70 in height of high water, see maps showing changes at New inlet, in report for 1885.]	-			
Wharf at Bond's Long Beach house, range of tide 2.35 feet, from U. S. C. S. observations, 1873	....	....	....	....
Oswego river, at Bridgeport, 1884	....	1.42	....	....
Mullica river, at Lower Bank bridge, 1884	....	1.45	....	....
Mullica river, at Gloucester landing, 1884	....	1.26	....	....
Port Republic, Nacote creek, 1884	....	1.80	....	....
Absecon creek, shore road, 1883	....	1.75	....	....
Absecon bay, west side, 1883	2.17	....	....	....
Absecon inlet, range of tide inside of beach, 3.95, from U. S. C. S. observations, 1872	....	....	....	....
Atlantic City, draw-bridges	2.08	....	....	....
Great Egg Harbor bay, Somers Point, April, 1883	....	2.01	....	....
Great Egg Harbor bay, Somers Point, September 8th, 1885	....	2.05	....	....
Great Egg Harbor bay, mouth of Tuckahoe river	2.36	....	....	....
Tuckahoe bridge, 1884	2.37	....	....	....
End of shore road, Beesley's point, 1884	2.46	....	....	....
Great Egg Harbor bay, mouth of Great Egg Harbor river	2.06	....	....	....

LOCALITY.	ELEVATION IN FEET.			
	TIDE-MARSH.	HIGH WATER.	MEAN TIDE.	LOW WATER.
Lake's creek, English creek road	....	2.52	....	....
English creek, at English Creek village	....	2.84	....	....
Gibson's creek, Gibson's Landing	3.37	2.79	....	....
Great Egg Harbor river, mouth of Miry run	....	2.40	....	....
Steelman's Landing, Estellville creek	....	2.50	....	....
South river, Mays Landing and Estellville road	....	1.01	....	....
Great Egg Harbor river, High Bank Landing	....	2.20	....	....
Great Egg Harbor river, Mays Landing	....	2.00	....	....
Embanked meadow, Mays Landing	(1.51)	....	....	....
Corson's inlet	2.67	....	....	....
Sea Isle City	2.56	....	....	....
Ocean View, at Van Gilder's mill-pond, 1884	1.74	....	....	....
Jenkins' sound, Shell-bed landing, 1884	2.40	....	....	....
Cape May Landing, 1884, from a short series by the U. S. C. and G. S.	....	2.05	-0.15	-2.35
Fishing creek, Delaware bay shore, 1884	2.59	....	....	....
Dyer's creek, bay shore road, 1884	2.60	....	....	....
Dennis creek landing, embanked meadow, 1884	(1.37)	....	....	....
Mauricetown, Maurice river, 1884	....	2.32	....	....
Manantico creek, Millville and Port Elizabeth road	....	3.25	....	....
Maurice river, Millville	....	3.10	....	....
Dividing creek, Port Norris road	1.16	1.96	....	....
Oranoken creek, Beaver Dams (very low meadow)	0.77	....	....	....
Cedar creek, Cedarville	....	2.77	....	....
Nantuxent Neck, near edge of upland	2.70	....	....	....
Fortesque road, near edge of upland	2.37	....	....	....
Fortesque Beach, U. S. C. S. observations, 1880, give as range of tides 6.00 ft.	....	....	....	....
Sea Breeze, U. S. C. S. observations, 1880, give as range of tides 6.18 ft.	....	....	....	....
Sea Breeze road, near edge of upland	2.75	....	....	....

LOCALITY.	ELEVATION IN FEET.			
	TIDE-MARSH.	HIGH WATER.	MEAN TIDE.	LOW WATER.
Greenwich wharf, Cohansey creek	3.40	3.40	....	....
Buena Vista, embanked meadow	(-0.46)	....	....	....
Fairton (embanked meadow on Mill creek)	(0.39)	3.55	....	....
Cohansey creek, 1½ miles below Bridgeton, embanked	(-0.12)	....	....	....
Cohansey creek, Bridgeton	....	3.30	....	....
Bayside	3.71	2.76	....	....
Strathem's Neck	2.91	....	....	....
Strathem's Neck, embanked meadow	1.04	....	....	....
Stow creek, 1 mile below Canton	2.69	2.61	....	....
Canton, embanked meadow	0.42	....	....	....
Stow Neck	2.84	....	....	....
Stow Neck, recently-embanked meadow	(2.11)	....	....	....
Alloway's Creek Neck, 3 miles below Hancock's bridge,	1.58	....	....	....
Alloway's creek, Hancock's bridge	....	1.92	....	....
Alloway's creek, Quinton	....	2.49	....	....
One and a half miles west of Hancock's bridge, embanked	-0.83	....	....	....
One and a half miles northeast of Elsinborough Point, embanked	-1.57	....	....	....
Half mile west of Salem, embanked	-1.99	....	....	....
Salem creek, at Salem	....	3.30	....	....
Salem creek, 2 miles below Sharpstown	....	2.30	....	....
Raccoon creek, at Swedesboro	....	3.06	....	....
Timber creek, Westville	....	3.35	....	....
Philadelphia, Old Navy Yard, U. S. C. S. observations of 1878, compared by bench-mark at Swanson and Reed streets	....	2.67	-0.34	-3.34
Rancocas creek, Mount Holly	....	3.33	....	....
Delaware river, Burlington	....	3.80	....	....
Delaware river, Bordentown	....	3.70	....	....

NOTE.—When no other date is given, observations were made in 1885, 1886 and 1887.

DRAINAGE SYSTEMS AND PUBLIC WATER-SUPPLY.

New Jersey is well watered throughout. The drainage leaves the State as follows: 252 square miles of area is drained by the Hudson river, including the Wallkill and other smaller tributaries which flow across the northern boundary into New York; 982 square miles drains through Kill van Kull, into New York bay, being mainly the Hackensack and Passaic water-sheds; Arthur Kill drains 100 square miles into Raritan bay, the drainage being supposed to flow each way out of Arthur Kill, from the meeting of the tides; Raritan river drains 1,105 square miles into Raritan bay; 239 square miles along the south shore of Raritan bay, drains directly into the bay; 2,141 square miles drains directly into the Atlantic ocean by the various streams of the eastern slope of Southern New Jersey; 1,060 square miles drains directly into Delaware bay, and 2,345 square miles of area is drained by the Delaware river. In each case the areas of water of the bays lying within the State, are included in the above figures. Excepting the small area on Wawayanda creek, the water of which flows into New Jersey only to flow out again immediately by the Pochuck, the only areas which discharge their drainage into New Jersey from neighboring States, are 148.6 square miles on the water-shed of the Passaic, in Orange and Rockland counties, and 64.1 square miles on the Hackensack water-shed in Rockland county, New York.

The following table shows the area of each water-shed, the percentage of this area which remains in forest, and the population per square mile. Other things being equal, the higher the percentage of forest, the more equable will be the flow, and the clearer and purer the quality of the water. It is, however, also necessary to take into account the soil, in judging as to the amount of solids carried by the streams. Reference to the geological maps of the State will suffice for this. The streams of the Archæan Highlands are perhaps the purest of the State; even after heavy rains they are but little roiled, and during the dry seasons their waters are clear, cool and sparkling. They are flashy because of the steep and rocky character of the surface, although they maintain a fair flow through the driest months. The streams of the Kittatinny valley carry much solid matter, particularly from the limestone but also from the slate soils, when swollen

by rains. The streams of the red sandstone country become very red and muddy in wet weather, and are rarely entirely clear, excepting where the harder sandstones prevail, in limited areas. In the clay and marl region also, the soluble character of the soil renders the streams undesirable for domestic consumption much of the time. Next to the streams of the Highlands come the streams of the pine plains of Southern New Jersey for purity. It is true that those flowing through cedar swamps are colored a dark brown by the organic matter which they hold in solution, but this is not deleterious, and the water is very pleasant. The other streams known as white-water are wonderfully clear and pure. These southern streams are also noted for their equable flow. They are fed by the great swamps which act as storage reservoirs, as does the loose, sandy soil itself, taking up the water as it falls on the surface to deliver it gradually into the streams lower down, instead of shedding a large portion of it immediately from its surface into the drainage channels, as is done on the more compact soils and steeper slopes farther north.

In the following table the main streams are given first in large type and the subdivisions follow in smaller type. Where names are in the same style of type and begin at the same distance from the margin the water-sheds are independent. Where a name is in smaller type and begun farther from the margin its water-shed is included in one already given just above.

Areas of Water-Sheds.

	Square miles.	Percentage of forest.	Population per square mile.
HUDSON RIVER TO CONSTABLE HOOK	251.9	32	†73
WALLKILL, TO STATE LINE	210.1	20	41
POCHUCK CREEK, TO STATE LINE	53.7	55	25
Wawayanda lake	6.5	64	35
PAPAKATING CREEK	62.2	14	58
WALLKILL TO FRANKLIN FURNACE	31.3	51	26
Morris pond	1.5	66	....
KILL VAN KULL (total area 1194.4), area in New Jersey	981.7	41	410
HACKENSACK RIVER, TOTAL WATER-SHED	201.6	*36	†216
HACKENSACK ABOVE NEW MILFORD	114.8	*60	125
Hackensack in New York	64.1	....	152
PASSAIC RIVER, TOTAL WATER-SHED	949.1	*44	338
PASSAIC RIVER ABOVE FALLS AT PATERSON	796.9	....	85
PASSAIC RIVER IN NEW YORK	148.6	....	42
SECOND RIVER	17.2	10	1,400
THIRD RIVER	14.4	23	276
SADDLE RIVER, TOTAL WATER-SHED	60.7	*28	122
Saddle river in New York	8.0	....	84
Hohokus creek above Hohokus	15.7	34	59
POMPTON RIVER, TOTAL WATER-SHED	379.9	*69	48
Ramapo river, total water-shed	160.7	*72	58
RAMAPO IN NEW YORK	112.4	....	52
Wanaque river, total water-shed	109.6	*83	30
WANAQUE IN NEW YORK	28.2	....	22
GREENWOOD LAKE, TOTAL WATER-SHED	28.0	*81	26
Greenwood lake in New York	10.2	....	22

*Percentage of portion lying within New Jersey. † Exclusive of Jersey City and Hoboken.

Areas of Water-Sheds.—Continued.

	Square miles.	Percentage of forest.	Population per square mile.
Pequannock river	84.8	78	42
Macopin lake	2.5	50	30
Stickle pond	1.7	100	....
Hank's pond	.7	100	....
Cedar pond	1.0	100	....
Buck-a-bear pond	1.2	100	....
Dunker pond	2.7	70	15
ROCKAWAY RIVER, TOTAL WATER-SHED	157.2	80	110
Rockaway above Boonton	148.9	82	113
Shongum pond	2.9	65	138
Splitrock pond	5.3	98	5
Green Pond brook	16.4	87	51
Green pond to outlet	1.7	82	....
Rockaway above Port Oram	29.9	90	42
WHIPPANY RIVER	71.1	36	124
Troy brook	15.2	34	87
Whippany above Morristown	25.4	55	107
PASSAIC ABOVE CHATHAM	99.8	23	121
Passaic above Millington	53.6	26	140
Elizabeth River to Lake Ursino	17.4	13	228
ARTHUR KILL, VIA PERTH AMBOY	100.5	25	337
Rahway River	83.3	24	338
ROBINSON'S BRANCH	22.8	22	183
RAHWAY RIVER ABOVE RAHWAY CITY	41.0	30	350
West branch of Rahway above Orange reservoir	5.2	44	70
RARITAN RIVER	1,105.3	16	105
South River	132.8	25	83
MANALAPAN BROOK TO JUNC. WITH MATCHAPONIX	42.2	19	84
MATCHAPONIX BROOK	45.2	14	86

Areas of Water-Sheds.—Continued.

	Square miles.	Percentage of forest.	Population per square mile.
Lawrence's Brook above Weston's Mills	45.0	17	59
Raritan above New Brunswick	895.2	13	93
Bound brook, including Green brook	51.5	22	330
Middle brook above Chimney rock	16.7	24	43
Millstone river	285.7	9	78
Beden's brook	49.9	11	59
Stony brook	64.8	8	79
Millstone above forks of Stony brook	98.8	12	75
North branch of Raritan	191.6	13	72
Lamington or Black river	91.8	14	80
Rockaway creek	39.4	12	66
North branch, above forks of Lamington	63.6	16	79
South branch of Raritan	276.5	13	79
Neshanic river	56.3	6	81
Spruce run, including Mulhockaway creek	41.2	15	83
Budd's lake	4.5	24	62
RARITAN BAY SHORE	238.8	14	127
Swimming River above Red Bank	65.4	11	58
Hockhockson brook above Tinton Falls	11.7	52	51
SEASHORE FROM SANDY HOOK TO CAPE MAY	2,141.3	68	37
Whale Pond Brook	5.1	35	151
Shark River, to Bridge at Head of Bay	16.9	59	162
Wreck Pond	12.8	29	118
Manasquan above Upper Squan Bridge	64.7	32	82
Metedeconk above Burrsville	73.9	68	25
South branch of Metedeconk above Lakewood	24.5	75	18
Toms River above Village Bridge	163.8	94	17
Cedar Creek above Village	55.8	99	7
Forked River above Village	14.7	98	7

Areas of Water-Sheds.—Continued.

	Square miles.	Percentage of forest.	Population per square mile.
Mill Creek above Manahawken	19.7	97	6
Westecunk Creek above West Creek Bridge	21.0	96	5
Tuckerton Creek above Tuckerton	11.9	93	25
Mullica River	569.6	90	22
Bass river above New Gretna road	16.8	95	11
Wading river	188.9	97	7
East branch of Wading river	65.5	98	6
West branch of Wading river	92.1	99	7
Mullica river above forks of and including Batsto river	221.6	88	19
Absecon Creek above Absecon	18.3	97	8
Patcong Creek above Steelmansville	22.1	81	53
Great Egg Harbor River	337.7	88	21
Great Egg Harbor river above Mays Landing	215.8	88	26
Babcock's creek, Mays Landing	21.2	98	12
Tuckahoe River	99.8	81	15
Tuckahoe river above Tuckahoe	60.2	95	9
DELAWARE BAY SHORE	1,060.1	51	48
Maurice River	386.4	70	72
Manumuskin creek	38.7	94	17
Manantico creek	38.7	79	38
Maurice river above Millville	218.4	67	63
Maurice river above Landis avenue	114.1	66	55
Cohansey Creek	105.4	20	140
Cohansey above Bridgeton	45.8	13	54
DELAWARE RIVER	2,344.8	30	129
Alloways Creek above Hancock's Bridge	51.6	27	58
Salem Creek	113.6	10	123
Salem creek above Sharptown	22.6	8	112

Areas of Water-Sheds.—Continued.

	Square miles.	Percentage of forest.	Population per square mile.
Oldman's Creek	44.4	14	52
oldman's creek above auburn	26.3	18	46
Raccoon Creek	44.4	12	91
raccoon creek above swedesboro	32.2	12	68
Mantua Creek	51.2	16	106
mantua creek above berkeley	46.7	17	83
Big Timber Creek	59.3	25	83
north branch of big timber creek	19.8	27	68
south branch of big timber creek	25.5	27	62
Cooper's Creek	40.5	16	208
cooper's creek, south branch	18.1	21	62
cooper's creek, north branch	11.7	16	65
Pensauken Creek	35.4	10	109
south branch of pensauken	14.9	12	118
north branch of pensauken	17.1	7	71
Rancocas Creek	341.4	61	58
south branch of rancocas	167.1	57	40
north branch of rancocas	143.7	75	62
Assiscunk Creek	45.3	4	58
Crosswicks Creek	139.2	20	52
Assanpink Creek	89.6	9	253
Jacob's Creek	13.3	9	72
Alexsocken Creek	14.9	18	60
Wickecheoke Creek	26.9	13	67
Lockatong Creek	23.8	15	45
Nichisakawick Creek	10.5	13	45
Harihokake Creek	10.1	13	46
Hakihokake Creek	17.4	16	48
Musconetcong River	157.6	39	71

Areas of Water-Sheds.—Continued.

	Square miles.	Percentage of forest.	Population per square mile.
LUBBER'S RUN	24.1	87	15
LAKE HOPATCONG	25.4	94	30
POHATCONG CREEK	56.2	19	129
PEQUEST RIVER	158.2	18	58
BEAVER BROOK	37.1	18	47
PAULINS KILL	177.4	27	54
SWARTSWOOD LAKE	16.3	22	33
CULVER'S POND	6.3	83	30
Long pond	2.5	80	30
FLAT BROOK	65.7	54	21

The population per square mile given above is a measure of the danger of contamination from the deadliest of all sources, animal and chemical waste. The question of river pollution is growing in importance rapidly in this State. When it becomes necessary much can be done by legislation to prevent such pollution, but the fact should not be lost sight of that streams, especially the larger ones, are the natural and legitimate sewers of the country, and may be as valuable and indispensable for this purpose as for any other.

WATER-POWER.

The census of 1880 gives as the total water-power used in manufactures in New Jersey, 27,066 horse-power, while the steam-power in use amounts to 72,792 horse-power. The water-power is therefore about 27 per cent. of the total power used. In 1870 it was 44.4 per cent., which shows a rapid gain of steam over water-power. This gain must continue, because the use of water-power restricts the location of establishments, and advantages lost in this way very often overbalance the saving effected by the use of this power, rather than

steam. Nevertheless it would seem that the water-power of the State must be more fully utilized than it is at present, for much of it can be made available at very convenient points near the centers of population. Massachusetts has utilized 17.21 horse-power per square mile against 3.63 per square mile in New Jersey. New Jersey ranks eleventh among the States in total power used; fifteenth in water-power and eighth in steam-power. In water-power, per square mile, she is ninth. Of the 27,066 horse-power of water-power used in the State, 12,183 is used in flouring and grist mills, 3,903 in saw mills and 2,321 in paper mills. These three industries, therefore, consume 68 per cent. of the water-power of the State. The flouring and lumber mills are well distributed over the State, the former averaging a power of less than 30 horses each, and the latter rather less than 20 horse-power. Some of the finest water-powers in the State are on the Passaic river and its branches. Between Little Falls and Dundee, this stream falls 152 feet in all. Forty feet of this occurs at Little Falls, within a distance of a mile; 70 feet in a single fall at Paterson, and 21 feet at Dundee dam. The area of the Passaic water-shed above Little Falls, is 774.2 square miles, and above Paterson, 796.9 square miles. The flow of the stream was measured at Paterson, at a time of exceptionally dry weather, October 11th, 1878, when it was supposed that the discharge was as small as it had been for 30 years. The quantity of water which flowed in the stream for 48 hours, was 33,689,000 cubic feet.* This is at the rate of a yearly flow of 3.32 inches of water from the water-shed. It is safe to estimate that 12 inches of the rainfall on the Passaic water-shed could be utilized by a system of storage reservoirs for which the water-shed offers many favorable sites. It is interesting to compute the value of this amount of water utilized for power on the 152 feet of fall above noted, on the basis of the prices obtained by the Society for the Encouragement of Useful Manufactures, at Paterson. They now lease and sell 300 cubic feet per second for 12 hours per day, at the rate of about $270 per cubic foot per second yearly, for the total fall of 70 feet.† Three hundred cubic feet per second is equal to a yearly flow of 5.14 inches from the water-shed, which is 1.82 inches more than the above minimum flow, but this is provided for by the long storage-ponds in the

* Newark Aqueduct Board. Report on Additional Water-Supply, by J. J. R. Croes and Geo. W. Howell, p. 35.

† Id., p. 47.

stream channel, as the flow has to be kept up but 12 hours per day. One foot on the water-shed would give a 12 hours' flow of 1,409 cubic feet per second, and supposing we could utilize 140 of the 152 feet of fall, this would be worth a yearly rental of $760,860, or 5 per cent. interest on $15,000,000. Estimating that 5 inches of flow from the water-shed is available without storage works, other than the channel ponds now existing, the total power of the Passaic, between Little Falls and Dundee, may be placed at 4,773 horse-power, and an efficiency of 75 per cent. would give an actual power of 3,580 horse-power. The amount of power which would be developed here by a flow of 12 inches yearly from the water-shed, would be 224,159 horse-power for 12 hours per day.* Several other fine water-powers are to be found on the Passaic water-shed, at locations where there are excellent facilities for transportation, and all within 40 miles of New York. Among these may be noted that on the Rockaway, at Boonton, where the stream has a drainage area of 148.9 square miles and falls 280 feet in 2 miles. A flow for 12 hours daily at the rate of 5 inches on the water-shed, would give here 1,754 horse-power, and 12 inches would produce 8,379 horse-power. The Pequannock falls 500 feet in the 9 miles between Charlottesburgh and Pompton. Taking the water-shed at 70 square miles, 1,472 horse-power are developed here with a five-inch flow, and 7,038 horse-power from a twelve-inch flow.

Taking the area of the Highland region at 700 square miles, and the average fall of the streams issuing from it, at 200 feet, a five-inch flow would give for the borders of the whole region a total of 5,890 horse-power, and a twelve-inch flow 29,152 horse-power.

The Highland region is remarkable for the massing of power at certain points, usually near its borders, and those powers on the eastern border particularly are favorably situated. There is no lack of water-power through the Kittatinny valley, but it is distant from the

*In these estimates it is deemed safe to use a flow for 12 hours at the rate of 5 inches on the water-shed, annually, as the present power of the stream without extensive storage works; for a dry-month flow of 0.21 inch with pondage to store a 12 hours' flow of the stream at this rate, will secure this amount of power at all times. This requires, usually, only the small channel pond at the millseat. The 12 inches' flow given as the maximum is supposed to be secured by storage works so controlled that the whole flow shall be confined in dry seasons to 12 hours per day, and the actual flow for that period, therefore, would be at the rate of 24 inches annually from the water-shed.

cities, and not likely to be utilized. The water-powers of the red sandstone region are more favorably situated; that at Paterson has been already noted; it is the only really large power utilized, although but a small part of the total power developed between Little Falls and Dundee is yet in use. Most of the water-power of the district exists in the form of comparatively small powers, well distributed over the area. At Raritan, the Water Power Company has a dam and raceway, giving a fall of about 12 feet, with a water-shed of 468 square miles. There is little or no storage, and the power must fall to 160 horse-powers or less in dry weather. There is opportunity to increase the fall here to 30 feet, and then, with storage, to maintain a flow at the rate of 12 inches on the water-shed annually, the power could be raised to 2,824 horse-powers for 12 hours daily, and the location is good. This is more power than is now leased at Paterson.

A large amount of power is developed by the Delaware river between Port Jervis and Trenton, and portions of it are utilized at various points. The Trenton Water Power Company is the chief user of it.

As already remarked, the streams of Southern New Jersey are distinguished by a very even flow, and therefore, while the fall is usually rather small, many fine water-powers are found on them. Among these may be mentioned Batsto and Pleasant Mills, Atsion and Harrisville, on the Mullica water-shed; Mays Landing and Weymouth, on the Great Egg Harbor water-shed; Willow Grove and Millville, on Maurice river; Smithville, on the Rancocas, and many smaller powers. The pond at Millville is the largest entirely artificial body of water in the State. It covers 926 acres. A dam 2,200 feet long raises the water of Maurice river 24 feet. The water-shed is 218 square miles in area. Supposing that 12 inches of the annual rainfall on the water-shed is utilized here during 24 hours per day, the power should be 438 horse-power. The average fall of Southern New Jersey streams above the head of tide is five feet per mile, and much water-power here remains undeveloped.

WATER-SUPPLY.

The importance of the subject of water-supply for domestic consumption may be gathered from the fact that while the population of

the State, as given by the census of 1885, was 1,278,133, the portion of that population supplied by public water works is 760,796, or about 60 per cent. of the whole. More than half of this large population are supplied with water which is unsatisfactory in character, while 65,593, living in towns of 1,500 population and upward, are still unsupplied. It may be estimated that half a million of our people are in need of a supply of pure water at once. There is no lack of water. The Passaic river delivers at Little Falls, at an elevation of 158 feet above tide, enough water of excellent quality to supply 5,000,000 or 6,000,000 of people. The streams of the Archæan Highlands are unsurpassed for purity, and are destined to remain unpolluted, for the population scarcely increases at all in that region, the surface is generally wooded and there is little manufacturing. At present, the danger of private corporations securing control of the supply is being seen. It had been pointed out some years since, but no steps were taken to prevent it. It is safe to say, however, that when this evil comes to be seriously felt, means will be found to eradicate it, although it must be at increased expenditure.

POPULATION.

While it is possible that New Jersey was settled temporarily at an earlier date, there is little doubt that effectual settlement was begun at Bergen, in 1618, by the Dutch. It has been estimated that the aboriginal population, fifty years later, did not exceed 2,000. It may have been somewhat greater at the time of the settlement at Bergen, but it is doubtful if the area which now teems with a million and a quarter of souls, then embraced an Indian population exceeding 3,000. The Dutch spread over Bergen, Passaic and Hudson counties, and their descendants still constitute a large portion of the population of these counties, which are all formed from the soil of the original Bergen county. From here and elsewhere about New Amsterdam, they soon found their way into the beautiful and fertile Raritan valley, populating Somerset county; and as the advantages of this new country became known, New Brunswick became settled by immigrants from the distant Dutch colony at Albany. Monmouth county, too, received a scattering Dutch population soon after. Away back in the Minisink valley the nucleus of another Dutch settlement was formed, at about the beginning of the eighteenth century, by immigrants from the banks of the Hudson, at Esopus, now Kingston. These were the principal centers of Dutch settlement in East Jersey, and they have remained nuclei about which the Holland blood still lingers, as is very evident in the family names of the present residents. At Elizabethtown, the English made their first settlement in New Jersey, in 1664, after the English conquest of New Amsterdam. These settlers came from New England. Newark was settled in the same way, in 1666. Thence the English spread to the limits of, and soon began to blend with, the Dutch settlements at Bergen and on the Raritan. They populated the old county of Essex, which included what is now Union, and Middlesex north of the Raritan. Monmouth also received early an influx of English settlers, and as the Province remained under English rule, and was the property of English proprietors, the English filled up the greater part of East Jersey, which the Dutch had not already occupied in 1664. The fusion of these two peoples began almost immediately, and had proceeded far enough to bring them into

complete accord when the pressure of the English yoke began to be seriously felt a century later.

There were Danes and Norwegians among the settlers at Bergen, and Scotch and Irish among the English settlers, but the English and Dutch far outnumbered all other nationalities.

In West Jersey, the Dutch were the first to attempt settlement, but their settlements at Fort Nassau, in 1623 and again in 1630, met with disaster and so disheartened them that they abandoned the country.

In 1637, the Swedes settled at Tinicum, and soon after the Dutch again occupied Fort Nassau. The English came from New Haven, Connecticut, and settled on the Delaware in 1640; and although resisted by both Swedes and Dutch they eventually occupied all of West Jersey, leaving only a trace of the Swedish and Dutch blood along the Delaware, about Salem. Fairfield, Cumberland county, was named after Fairfield, Connecticut, from which place the settlers came. Greenwich, Cumberland county, was settled from New England also, with some Irish settlers added to the English. English whalers from Long Island settled Cape May, probably as early as 1640.

In 1677, 230 English Quakers settled in West Jersey. They found some scattering Swedish habitations about Raccoon creek. Yorkshire Quakers chose the land below Trenton, about Burlington, and those from London the country about Gloucester. They all settled at the town of Burlington, however. They were soon followed by others who settled at Salem. We are told that about 1680 West Jersey became quite populous by the accession of many settlers. They were mostly Friends, and in West Jersey, from this time, English blood preponderated largely.

It is estimated that in 1682 the population of the State was 6,000, and at the beginning of the eighteenth century it was 20,000, of which 12,000 belonged to East Jersey and 8,000 to West Jersey. The militia amounted to 1,400 men. In 1737, the population amounted to 47,369, of which 26,469 belonged to East Jersey and 20,900 to West Jersey. This proportion seems to verify the above estimate. Holmes' Annals gives an estimate of 15,000 for the year 1701.

The following tabular statement shows the population by counties at various periods during the last one hundred and fifty years. The counties are grouped, so that those which have been formed last may be near those from which they were taken off:

Population of New Jersey at Different Periods.

COUNTIES.	1737.	1745.	1785.	1790.	1800.	1810.	1820.	1830.	1840.	1850.	1860.	1865.	1870.	1875.	1880.	1885.
Bergen	4,095	3,006	......	12,601	15,956	16,603	18,178	22,412	13,223	14,725	21,618	21,636	30,122	35,516	36,786	39,880
Passaic	......	......	......	......	......	......	......	......	16,734	22,569	29,013	34,856	46,416	53,775	68,860	83,374
Hudson	......	......	......	......	......	......	......	......	9,483	21,822	62,717	87,819	129,067	163,000	187,944	240,342
Essex	7,019	6,988	......	17,785	22,269	25,984	30,793	41,911	44,621	73,950	98,877	124,441	143,839	166,812	189,929	213,764
Union	......	......	......	......	......	......	......	......	......	......	27,780	35,410	41,859	51,758	55,571	61,839
Morris	......	4,436	......	16,216	17,750	21,828	21,368	23,665	25,844	30,158	34,677	36,513	43,137	49,019	50,861	50,675
Sussex	......	......	......	19,500	22,534	25,549	32,752	20,346	21,770	22,989	23,846	23,929	23,168	24,010	23,539	22,401
Warren	......	......	......	......	......	......	......	18,627	20,366	22,358	28,433	31,523	34,336	37,389	36,589	37,737
Hunterdon	5,570	9,151	......	20,153	21,261	24,556	28,604	31,060	24,787	28,990	33,654	40,758	36,963	37,473	38,570	37,420
Mercer	......	......	......	......	......	......	......	......	21,502	27,992	37,419	41,478	46,386	49,884	58,061	66,785
Somerset	4,505	3,239	......	12,296	12,815	14,725	16,506	17,689	17,455	19,692	22,057	21,610	23,510	27,453	27,162	27,425
Middlesex	4,764	7,612	......	15,956	17,890	20,381	21,470	23,157	21,893	28,635	34,812	35,916	45,029	48,813	52,286	56,180
Monmouth	6,086	8,627	......	16,918	19,872	22,150	25,038	29,233	32,909	30,313	39,346	42,868	46,195	48,500	55,538	62,324
Ocean	......	......	......	......	......	......	......	......	......	*10,032*	*11,176*	*14,262*	*13,628*	*13,707*	14,455	15,586
Burlington	5,238	6,803	......	18,095	21,524	24,972	28,882	31,107	32,831	43,203	49,730	50,719	53,639	53,155	55,402	57,558
Camden	......	......	......	......	......	......	......	......	......	25,422	34,457	38,464	46,193	52,994	62,942	76,685
Gloucester	3,267	3,506	......	13,363	16,115	19,744	23,089	28,431	25,438	14,655	18,444	20,134	21,562	24,486	25,886	27,603
Atlantic	......	......	......	......	......	......	......	......	8,726	8,961	11,786	11,344	14,093	15,138	18,704	22,356
Salem	5,888	6,847	......	10,437	11,871	12,761	14,022	14,155	16,024	19,467	22,458	23,162	23,940	22,701	24,579	25,373
Cumberland	......	......	......	8,248	9,529	12,670	12,668	14,093	14,374	17,189	22,605	26,233	34,665	35,311	37,687	41,982
Cape May	1,004	1,188	......	2,571	3,066	3,632	4,265	4,936	5,324	6,433	7,130	7,625	8,349	8,190	9,765	10,744
Total	47,369	61,403	140,435	184,193	211,949	245,555	277,426	320,823	373,306	489,555	672,035	773,700	906,096	1,019,414	1,131,116	1,278,033

ELEMENTS OF THE POPULATION.

This table shows an increase from 1785 to 1790 of 43,704, which seems very large. If correct, this must be accounted for by immigration following the peace with Great Britain. It appears that the whole immigration to the United States from 1790 to 1800 did not exceed 5,000 annually. New Jersey's share of this could not have been large. There was a steady increase in immigration up to 1850, when it reached 310,004 for the United States. We may estimate that New Jersey at that time was receiving from this source 8,000 people yearly. The proportion of foreign-born residents of the United States living in New Jersey in 1850 was 2.64 per cent. In 1870 it was 3.39 per cent., and in 1880 3.65 per cent. It will be seen that the State has continued to receive her full share of the immigration, for her total population is but 2.25 per cent., and her area only one-quarter of one per cent. of that of the United States.

The following table shows the number of natives of the United States and of foreign-born residents in New Jersey at each census year since 1850:

Year.	Native.	Foreign-born.	Foreign-born to each 100 Inhabitants.
1850	430,441	58,364	11.93
1860	549,245	122,790	18.27
1870	717,153	188,943	20.85
1880	909,416	221,700	19.60
1885	1,027,687	250,346	19.59

It will be seen that since 1860 the increase of native-born residents has kept pace with the increase of foreign-born; but it is to be noted that much of the native population since then has sprung from foreign parentage. It may be estimated that 40 per cent. of the total population have both parents foreign-born. The table below gives the distribution of natives and foreigners by counties. More than one-quarter of the population of Essex, and over one-third of that of Hudson, is foreign. In Passaic, also, it is nearly one-third; in Union it is less than one-quarter, and in Middlesex less than one-fifth. These five counties have more than two-thirds of the total foreign-born population of the State.

Native and Foreign-Born Population by Counties, 1880.

COUNTIES.	NATIVE.					FOREIGN-BORN.				
	Total.	Born in the State.	New York.	Pennsylvania.	All other States.	Total.	England and Wales.	Ireland.	German Empire.	All other Countries.
Atlantic	16,629	12,755	532	2,016	1,326	2,075	287	306	1,160	322
Bergen	29,028	20,994	6,520	284	1,230	7,758	850	2,459	2,643	1,806
Burlington	51,401	43,991	639	4,997	1,774	4,001	520	2,154	938	389
Camden	55,776	36,916	1,026	12,140	5,694	7,166	1,789	2,761	1,757	859
Cape May	9,542	8,475	126	653	288	223	28	124	37	34
Cumberland	35,802	30,418	1,238	1,996	2,150	1,885	490	402	563	430
Essex	137,336	109,489	16,977	2,988	7,882	52,593	6,405	19,831	20,167	6,190
Gloucester	24,139	21,022	216	2,028	873	1,747	199	635	729	184
Hudson	122,380	77,269	35,302	2,810	6,999	65,564	6,248	29,845	22,018	7,453
Hunterdon	36,749	33,800	416	2,117	416	1,821	236	1,179	271	135
Mercer	48,271	40,784	1,414	4,238	1,835	9,790	2,484	4,207	2,352	747
Middlesex	42,161	35,861	3,786	1,051	1,463	10,125	1,019	5,160	2,246	1,700
Monmouth	50,817	44,570	4,054	857	1,336	4,721	591	3,010	654	466
Morris	41,882	37,269	2,742	722	1,149	8,979	2,972	4,116	829	1,062
Ocean	13,963	12,841	459	222	441	492	96	196	119	81
Passaic	46,205	36,466	6,944	759	2,036	22,655	5,414	7,307	2,961	6,973
Salem	23,697	21,913	96	845	843	882	88	427	289	78
Somerset	24,136	21,252	1,769	438	677	3,026	389	1,388	883	366
Sussex	22,535	20,738	1,130	489	178	1,004	254	504	140	106
Union	43,146	29,922	8,763	1,229	3,232	12,425	1,440	6,095	3,428	1,462
Warren	33,821	28,869	543	3,875	534	2,768	349	1,333	751	335
The State	909,416	725,614	94,692	46,754	42,356	221,700	32,148	93,079	64,935	31,538

The following table shows the growth of the colored population of the State since 1790:

Date.	Colored Population.	Percentage of Total Population.
1790	2,762	7.7
1800	4,402	7.9
1820	12,460	7.2
1850	23,810	4.9
1870	30,658	3.4
1885	41,841	3.3

PERCENTAGES OF VARIOUS ELEMENTS OF THE POPULATION.

	1850.	1870.	1885.
Native white	83.16	75.77	77.14
Foreign-born	11.93	20.85	19.59
Colored	4.91	3.38	3.27

The number of colored residents born in other States was, in 1880, 11,184, and at that time the living immigrants exceeded the living emigrants by 6,649. This influx comes mainly from Delaware, Maryland and Virginia. The increase of colored population has not kept pace with the increase of the native whites. Proximity to the coast, and a milder climate, have given this State a somewhat larger proportion of colored population than States west, on the same parallel of latitude.

MOVEMENT OF POPULATION.

There is a considerable influx of people from other Eastern States, but this is nearly counterbalanced by the movement of population westward. New Jersey supplies her quota of native-born to people the great West. The following table shows the movement from each State into New Jersey, and from this State to the several States. It will be observed that the first column shows the loss by emigration to each State, and the second shows the gain by immigration from the States into New Jersey. From every New England and Middle State the gain has exceeded the loss, as it has, also, from Virginia, North Carolina, South Carolina, Georgia and Louisiana. To the other Southern and the Western States, more has been contributed than has been gained. Illinois has drawn most largely; next comes Ohio, then Michigan, Iowa, Indiana, Kansas, California and Missouri. This table is prepared from the census of 1880:

STATES.	Residents of each State born in New Jersey.	Natives of each State residing in New Jersey.	STATES.	Residents of each State born in New Jersey.	Natives of each State residing in New Jersey.
Alabama	227	150	North Carolina	248	650
Arkansas	270	26	Ohio	10,487	2,409
California	3,760	236	Oregon	457	12
Colorado	1,479	55	Pennsylvania	44,843	46,754
Connecticut	4,067	6,071	Rhode Island	854	1,075
Delaware	2,238	4,113	South Carolina	175	660
Florida	369	191	Tennessee	377	240
Georgia	469	493	Texas	1,024	118
Illinois	14,636	1,140	Vermont	262	1,337
Indiana	5,448	427	Virginia	1,349	4,789
Iowa	6,357	272	West Virginia	470	107
Kansas	4,631	104	Wisconsin	2,907	426
Kentucky	710	483	TERRITORIES.		
Louisiana	249	388	Arizona	156	3
Maine	212	1,961	Dakota	402	11
Maryland	2,354	4,556	District of Columbia	1,107	691
Massachusetts	3,137	6,583	Idaho	98	2
Michigan	7,903	627	Montana	234	2
Minnesota	1,862	109	New Mexico	81	39
Mississippi	144	146	Utah	372	14
Missouri	3,497	442	Washington	229	3
Nebraska	2,318	34	Wyoming	134	3
Nevada	344	13	Indian Territory	....	10
New Hampshire	178	1,121			
New York	47,266	94,692		180,391	183,788

ANALYSIS OF GROWTH BY COUNTIES.

County.	Increase from 1850 to 1885.	Remarks.
Atlantic	13,395	Atlantic City, Hammonton and Egg Harbor City have increased 10,950. It may be estimated that 4,000 of the increase of population is due to the development of pine lands, and 9,000 to seaside development.
Bergen	25,155	Hackensack and Englewood, 5,906. Increase due to growth of a large number of suburban towns and villages quite uniformly distributed over the county.
Burlington	14,355	Mt. Holly, Bordentown, Burlington and Beverly, 8,000; remainder due to agricultural development.
Camden	53,377	(Exclusive of Washington township, 1850). Camden, Gloucester, Haddonfield and Merchantville, 49,030; remainder rural, of which over 1,000 is due to development of pine lands.
Cape May	4,311	Seaside development, 3,171.
Cumberland	24,793	Bridgeton, Millville and Vineland, 18,281; remainder due to improvement of pine lands.
Essex	161,799	Newark, Orange and East Orange, 130,840; remainder in villages and country.
Gloucester	10,834	Mainly rural.
Hudson	218,520	All urban.
Hunterdon	8,430	Lambertville, 2,650; remainder rural.
Mercer	38,793	Trenton, Chambersburg, etc., 37,925. Growth of county entirely urban.
Middlesex	27,545	New Brunswick, 8,239; remainder largely due to development of clay districts.
Monmouth	32,010	Seashore townships, 24,034; remainder largely due to agricultural development.
Morris	20,617	About 10,000 of this increase may be attributed to the development of iron mining and an equal amount to the growth of small towns. There has been no growth due to agricultural development.
Ocean	5,554	Most of this is due to seaside development.
Passaic	60,805	Paterson and Passaic cities, 59,900.
Salem	5,906	Mostly from agricultural development.
Somerset	7,733	About 4,000 in the villages of Somerville, Raritan and Bound Brook; mainly due to agricultural development.
Sussex	588	Decrease. This county is purely agricultural.
Union	40,854	Population estimated at 20,985 in 1850; county not then formed. Elizabeth, Plainfield and Rahway, 37,000. The remainder in small villages.
Warren	15,379	Phillipsburg and smaller towns, 12,000; the remainder rural.

CAUSES OF INCREASE.

The above analysis gives an insight into the causes which have led to the growth of New Jersey. A large proportion of the increase has been in the towns, and arises from the promotion of manufactures and from an influx of persons from the neighboring cities seeking suburban residences. But a small part of the increase has been in the agricultural districts, for the increase in the number of farms has been offset by the introduction of agricultural machinery. According to the census returns, there are now 10,402 more farms than there were in 1850. This would correspond to an increase of some 60,000 in the agricultural population. The development of the pine lands has brought some 20,000 people to the State since 1860. Seaside resorts have built up rapidly since 1870, and have brought an increase of some 40,000. The development of the clay lands in Middlesex and of the iron mines in Northern New Jersey has also added somewhat to the population.

CITIES.

By far the larger part of the growth of the State, since 1850, has been in the cities, as the following table shows:

	Population of Cities over 8,000.	Population of Cities and Towns over 2,000.	Village and Rural Population.
1850	81,119	142,232	347,323
1870	355,862	461,269	444,827
1885	672,537	813,039	464,994

In 1885, there was a population of 50,000 in villages having from 1,000 to 2,000 inhabitants, and it is safe to estimate that practically all of the increase shown above in the village and rural population, from 1870 to 1885, was in the villages alone.

Population of Towns and Cities of Over 2,000 Inhabitants.

	1885.	1880.	1870.	1850.	REMARKS.
Asbury Park	3,301	2,260			Including Ocean Grove.
Atlantic City	7,942	5,477	1,043		
Bayonne	13,080	9,372	3,834		
Belleville Township	3,285	3,004	3,644	1,800	
Bloomfield Township	6,502	5,748	4,580	2,000	
Boonton	2,390	2,277	2,000		
Bordentown	4,683	4,258	4,000	2,725	
Bridgeton	10,065	8,722	6,830	2,446	
Burlington	6,653	6,090	5,817	4,536	
Camden	52,884	41,659	20,045	9,479	
Chambersburg Township,	8,542	5,437			Now a part of Trenton.
Dover	3,170	2,958	1,900		
East Orange Township	10,328	8,349	4,315		
Elizabeth	32,119	28,229	20,832	4,000	
Englewood Township	4,429	4,076			
Freehold	2,124	2,432			
Glassboro Township	2,377	2,088			
Gloucester	5,966	5,347	3,682	2,188	
Hackensack	4,983	4,248	4,929	3,506	Includes New Barbadoes Twp. In 1871 part to Midland.
Hackettstown	2,645	2,502	2,202	1,200	
Harrison	6,806	6,898	4,129		
Hoboken	37,721	30,999	20,297		
Hudson County	240,342	187,944	129,067	21,822	Practically all urban population.
Jersey City	153,513	120,722	82,546	6,856	
Keyport	3,063	2,753	2,366		
Lambertville	4,067	4,183	3,842	1,417	
Long Branch	5,140	3,833			
Millham	2,338	1,585	677		Now a part of Trenton.
Millville	8,824	7,660	6,101	2,332	
Montclair Township	6,327	5,147	2,853		
Morristown		5,418	5,000	3,300	

Population of Towns and Cities of Over 2,000 Inhabitants—Continued.

	1885.	1880.	1870.	1850.	REMARKS.
Mount Holly	5,006	4,630	4,018	2,000	Includes Northampton Township.
Newark	152,988	136,508	105,059	38,894	
New Brunswick	18,258	17,166	15,058	10,019	
Orange	15,231	13,207	9,348	4,385	
Oxford	....	2,656	....	....	
Passaic	8,326	6,532	3,400	....	
Paterson	63,273	51,031	33,579	11,334	
Perth Amboy Township,	6,311	4,808	2,861	1,865	
Plainfield	8,913	8,125	5,095	2,447	
Phillipsburg	8,058	7,181	5,932	....	
Princeton	3,438	3,209	2,798	....	
Rahway	6,861	6,455	6,258	3,306	
Raritan	2,244	2,046	1,009	900	
Red Bank	3,186	2,684	2,086	....	
Rutherford	....	2,299	....	....	
Salem	5,516	5,056	4,555	3,052	
Somerville	3,316	3,105	2,236	1,300	
South Amboy	4,054	3,648	....	....	
South Orange	....	2,178	....	....	
Trenton	34,386	29,910	22,874	6,461	
Union	8,398	5,849	4,640	....	1870. Includes Union Township.
Van Vorst	....	....	....	4,617	Now a part of Jersey City.
Vineland	3,170	2,519	2,000	....	
Washington	2,597	2,142	1,880	....	
West Hoboken	7,162	5,441	....	....	
Woodbury City	3,278	2,298	1,965	1,000	

DISTRIBUTION OF THE POPULATION.

In New Jersey, within 18 miles of New York city hall, there is a population of 607,000. If we add to this the population of Plainfield and Summit, which is essentially suburban to New York also, we have 617,000, or nearly half of the population of the State included in the great center of population of which New York is the nucleus. If we complete our circle, we include a population of two and one-half millions in all in the metropolitan district. Long Island and New Jersey contain one-quarter of this, each, and the other half is in New York city itself.

It is difficult to determine just how much of this 617,000 in New Jersey should be considered suburban to New York. Newark and Paterson both lie within this area, and are each important manufacturing centers. Their prosperity is in a large degree independent of their proximity to New York. Jersey City is more distinctly suburban, and many of the smaller towns and villages are very largely made up of the suburban residences of business and professional men of New York. The growth of that portion of the metropolitan district above described, which lies in New Jersey, has been more rapid than that of the remainder. From 1860 to 1880, Hudson county increased 200 per cent. and Essex 93 per cent. In New York city the increase was 45 per cent., in Kings county 110 per cent., and the average for the whole district was 75 per cent. If the facilities of communication with the New Jersey portion are improved as rapidly as they are for other portions of the district, it must continue to grow very rapidly.

Philadelphia also lies on the borders of the State, but does not exert so wide an influence as New York. A radius of 12 miles will include about all of the suburban population. The population within this circle, in New Jersey, is 89,000, or about 100,000 if we include Burlington and Mount Holly. Apart from the cities which form a part of the great centers of population, and which have national rather than local causes for existence, Trenton has the largest collection of people in the State. It now has a population exceeding 45,000. It is a manufacturing center, as are also New Brunswick, with 18,258; Bridgeton, with 10,065, and Millville, with 8,824 population respectively.

Arranged geologically and topographically, we have the following distribution of the population of the State:

District.	Total.	In Cities of over 2,000 Population.	Rural Population.	Rural Population per Square Mile.
Archæan and Paleozoic......	113,324	27,063	86,261	60.7
Triassic...	789,824	642,710	147,114	95.5
Cretaceous....................	223,225	102,824	120,401	80.8
Tertiary	151,660	40,442	111,218	36.8
The State........	1,278,033	813,039	464,994	61.9

The whole population of the State, divided by the number of square miles of land surface, gives 170.0 per square mile. Rhode Island, in 1880, had 254.9, and Massachusetts, 221.8 per square mile. New Jersey comes next in density of population.

In the Archæan and Paleozoic districts, Sussex county, on the glaciated Paleozoic mainly, has 42 people per square mile, and northern Passaic, representing the glaciated Archæan region, has 34 per square mile of rural population. Warren county has 68, and the unglaciated portions of the Archæan district have from 85 to 95 inhabitants per square mile.

The Triassic or red sandstone country contains nearly two-thirds of the population of the State, although it comprises but one-fifth of the area. This population is largely in cities. Exclusive of towns of 2,000 inhabitants and upward, Bergen county has 115 per square mile; Essex, 130, and Union, 214. In the exclusively agricultural counties, Somerset has 72 and Hunterdon 62 per square mile. The rural population of the Cretaceous district is almost entirely agricultural and is quite uniformly distributed. In the various agricultural townships, the range is from 60 to 90 per square mile. In Monmouth and Burlington, the average is about 70 per square mile, and in Gloucester and Salem, the range is from 60 to 116, and the average is about 80.

On the Tertiary pine plains, if we exclude the area of the tide-marsh which is uninhabitable, the average per square mile is 42.4; but this population is not uniformly distributed. Ocean county has 24.6 per square mile. Jackson township has 18, and Lacey township but 7 per square mile. Half of the county has a population of only 7 per square mile. In Burlington county, Woodland township has but 2.6 inhabitants per square mile. Randolph has 6, Washington 8,

Bass River 11 and Shamong 13. The rural inhabitants of Atlantic county average 20 to the square mile. Hamilton township has 13, Mullica 15, and Weymouth but 8. South and west the pine lands are being developed, and the portion lying in Camden county has 37 inhabitants per square mile. That in Cumberland has 33, and in Salem there are 59 to the square mile.

OCCUPATIONS.

The table below gives the number of persons employed in each special occupation. Under each class the total number of persons occupied is given, and then follow those occupations of that class which employ 1,000 or more persons. About one out of every three inhabitants of the State is engaged in remunerative employment. As there were 232,309 families in the State in 1880, the average is 1.71 to each family, or 1.43 males and .28 females. Agriculture employs 15 per cent., professional and personal services 28 per cent., trade and transportation 17 per cent., and manufacturing, mechanical and mining industries 40 per cent. of the total number of persons occupied. Of the females, 40 per cent. of the total number employed are domestic servants, and 43 per cent. are engaged in manufacturing. It will be noticed that they are represented in most of the occupations given.

Number of Persons Engaged in each Special Occupation.—1880.

OCCUPATIONS.	Total number of persons.	Males.	Females.
ALL OCCUPATIONS	396,879	330,103	66,776
Agriculture	59,214	58,819	395
Agricultural Laborers	22,672	22,254	148
Farmers and Planters	33,578	33,381	197
Gardeners, etc.	2,113	2,110	3

Number of Persons Engaged in each Special Occupation.—1880 —Continued.

OCCUPATIONS.	Total number of persons.	Male.	Female.
Professional and Personal Services	110,722	75,763	34,959
Barbers and Hairdressers	1,457	1,398	59
Clergymen	1,654	1,649	5
Clerks and Copyists (not otherwise specified)	1,378	1,332	46
Domestic Servants	29,777	2,919	26,858
Employes of Hotels and Restaurants	1,797	1,183	614
Hotel-keepers	1,095	1,046	49
Laborers	52,707	52,389	318
Launderers and Laundresses	2,479	327	2,152
Lawyers	1,557	1,555	2
Officials of Government	1,711	1,683	28
Physicians and Surgeons	1,595	1,540	55
Teachers and Scientific Persons	4,606	1,318	3,288
Trade and Transportation	66,382	63,874	2,508
Boatmen and Watermen	2,509	2,509	....
Book-keepers and Accountants in Stores	2,821	2,765	56
Clerks in Stores	11,545	10,815	730
Draymen, Hackmen, Teamsters, etc	5,163	5,163	....
Employes of R. R. Companies (not clerks)	6,317	6,299	18
Hucksters and Peddlers	2,034	1,999	35
Porters and Laborers in Stores and Warehouses	1,007	853	154
Sailors	2,609	2,609	....
Salesmen and Saleswomen	1,709	1,401	308
Saloon-keepers and Bartenders	2,674	2,515	159
Traders and Dealers (not specified)	3,133	2,979	154
Traders and Dealers in Dry Goods, etc	1,449	1,153	296
Traders and Dealers in Groceries	3,902	3,659	243
Traders and Dealers in Produce and Provisions	1,840	1,827	13

Number of Persons Engaged in each Special Occupation.—1880—Continued.

OCCUPATIONS.	Total number of persons.	Male.	Female.
Manufacturing, Mechanical and Mining Industries.	160,561	131,647	28,914
Apprentices to Trades	1,889	1,805	84
Bakers	2,135	2,097	38
Blacksmiths	4,928	4,928	....
Boot and Shoe Makers	6,832	6,086	746
Brick and Tile Makers	1,470	1,470	....
Butchers	3,587	3,587	....
Button Factory Operatives	1,172	659	513
Cabinetmakers	1,048	1,039	9
Carpenters and Joiners	12,354	12,354	....
Cigar Makers	1,668	1,613	55
Cotton Mill Operatives	3,539	1,185	2,354
Employes in Manufacturing Establishments (not specified)	2,805	2,288	517
Engineers and Firemen	3,702	3,702	....
Fishermen and Oystermen	2,529	2,529	....
Glass Works Operatives	2,751	2,737	14
Gold and Silver Workers and Jewelers	2,880	2,710	170
Harness and Saddle Makers	1,715	1,608	107
Hat and Cap Makers	4,198	3,525	673
Iron and Steel Works and Shops Operatives	4,842	4,814	28
Leather Curriers, Dressers, etc.	1,459	1,420	39
Machinists	5,397	5,397	....
Manufacturers	2,220	2,206	14
Masons (brick and stone)	3,943	3,943	....
Mill and Factory Operatives (not specified)	1,105	699	406
Millers	1,076	1,076	....
Milliners, Dressmakers and Seamstresses	9,087	94	8,993

Number of Persons Engaged in each Special Occupation.—1880 —Continued.

OCCUPATIONS.	Total number of persons.	Males.	Females.
Manufacturing, Mechanical and Mining Industries—Con.			
Miners	3,696	3,696	....
Painters and Varnishers	5,058	5,054	4
Potters	2,461	2,066	395
Printers, Lithographers and Stereotypers	2,460	2,372	88
Print Work Operatives	1,272	988	284
Rubber Factory Operatives	1,219	839	380
Shirt, Collar and Cuff Makers	1,284	465	819
Silk Mill Operatives	10,324	6,123	4,201
Tailors and Tailoresses	5,756	3,165	2,591
Thread Makers	1,011	221	790
Tinners and Tinware Makers	1,748	1,578	170
Wheelwrights	1,237	1,237	....
Woolen Mill Operatives	2,773	1,830	943

CENSUS OF 1885.

The following census shows in detail the distribution of the population of the State in its several political divisions:

Atlantic County.

Absecon		567
Atlantic City		7,942
Buena Vista Township		1,016
Egg Harbor City		1,317
Egg Harbor Township		3,919
Galloway Township (not including)	1,056	
Brigantine City	79	
Port Republic	474	
German Settlement	544	
		2,153

Atlantic County—Continued.

Hamilton Township		1,484
Hammonton Township		2,525
Mullica Township (not including)	126	
Columbia	106	
Pleasant Mills	106	
Elwood	403	
Weekstown	66	
		807
Weymouth Township (including)—		
Tuckahoe	442	
Estelville	184	
		626
Total in County		22,356

Bergen County.

Englewood Township		4,429
Franklin Township		2,194
Harrington Township		2,604
Hohokus Township		2,898
Lodi Township		4,347
Midland Township		1,617
New Barbadoes Township, co-extensive with Hackensack		4,983
Palisades Township		2,333
Ridgefield Township		4,487
Ridgewood Township		1,776
Saddle River Township (not including)	1,175	
Garfield	409	
		1,584
Union Township (including)—		
Rutherford	2,579	
Borough of Rutherford	1,335	
		3,914
Washington Township		2,714
Total in County		39,880

Burlington County.

Bass River Township		905
Beverly City		1,973
Beverly Township (not including)	974	
Delanco	409	
		1,383
Bordentown Township (not including)	638	
City of Bordentown	4,683	
Borough of Fieldsborough	536	
		5,857
Burlington Township (not including)	1,037	
Burlington City—		
First Ward	3,587	
Second Ward	3,066	
		7,690

Burlington County—Continued.

Chester Township		3,071
Chesterfield Township		1,453
Cinnaminson Township		2,640
Delran Township		1,932
Easthampton Township		655
Evesham Township (not including)	1,217	
Village of Marlton	339	
		1,556
Florence Township (not including)	571	
Town of Florence	1,011	
		1,582
Little Egg Harbor Township (Tuckerton)		1,885
Lumberton Township		1,735
Mansfield Township (not including)	681	
Columbus	1,034	
		1,715
Medford Township (not including)	1,072	
Medford	992	
		2,064
Mount Laurel Township		1,781
New Hanover Township		2,235
Northampton Township, co-extensive with Mount Holly		5,006
Pemberton Township (not including)	2,100	
Borough of Pemberton	844	
		2,944
Randolph Township		365
Shamong Township		933
Southampton Township (not including)	1,486	
Vincentown	777	
		2,263
Springfield Township		1,884
Washington Township		333
Westhampton Township		688
Willingboro Township		725
Woodland Township		305
Total in County		57,558

Camden County.

Camden City—		
First Ward	7,031	
Second Ward	8,007	
Third Ward	4,800	
Fourth Ward	9,464	
Fifth Ward	6,866	
Sixth Ward	4,198	
Seventh Ward	5,805	
Eighth Ward	6,713	
		52,884

Camden County—Continued.

Centre Township		1,723
Delaware Township		1,572
Gloucester City—		
First Ward	2,640	
Second Ward	3,326	
		5,966
Gloucester Township		2,542
Haddon Township (not including)	1,320	
Borough of Haddonfield	1,950	
		3,270
Merchantville, Borough of		741
Stockton Township		3,709
Waterford Township—		
Atco	303	
Atsion	115	
Berlin	676	
Gibbsboro	145	
Glendale	210	
Jackson	136	
Kirkwood	151	
Milford	159	
Waterford	203	
		2,098
Winslow Township—		
Bates' Mills	120	
Blue Anchor	175	
Brooklyn	100	
Cedar Brook	60	
Elm	221	
Sicklerville	229	
Waterford	101	
Wilton	480	
Winslow	624	
		2,180
Total in County		76,685

Cape May County.

Cape May City		1,610
Cape May Point, Borough of		200
Dennis Township—		
East Creek	111	
North Dennis	487	
Ocean View	191	
South Dennis	308	
South Seaville	498	
West Creek	175	
		1,770
Holly Beach, Borough of		210

Cape May County—Continued.

Lower Township		1,208
Middle Township		2,605
Ocean City, Borough of		465
Sea Isle City, Borough of		558
Upper Township		1,500
West Cape May, Borough of		618
Total in County		10,744

Cumberland County.

Bridgeton City—		
First Ward	4,830	
Second Ward	2,601	
Third Ward	2,634	
		10,065
Commercial Township (including)—		
Mauricetown	554	
Buckshutem	216	
Haleyville	424	
North Port Norris	319	
Port Norris	1,031	
		2,544
Deerfield Township		1,632
Downe Township		1,860
Fairfield Township		1,612
Greenwich Township (not including)	800	
Village of Greenwich	467	
		1,267
Hopewell Township		1,794
Landis Township (not including)	3,851	
Borough of Vineland	3,170	
		7,021
Lawrence Township		1,728
Maurice River Township (including)—		
Ewing's Neck	321	
Belleplain	164	
Heislerville	414	
Manumuskin	200	
Port Elizabeth	523	
Bricksboro	123	
Dorchester	305	
Leesburg	512	
		2,562
City of Millville—		
First Ward	2,805	
Second Ward	3,250	
Third Ward	2,769	
		8,824
Stow Creek Township		1,073
Total in County		41,982

Essex County.

Belleville Township (including)—		
Town of Belleville	1,818	
Borough	1,467	
		3,285
Bloomfield Township		6,502
Caldwell Township		3,336
Clinton Township (not including)	1,028	
Town of Irvington	1,802	
		2,830
East Orange Township—		
First District—Franklin	1,583	
Second District—Ashland, North	3,072	
Third District—Ashland, South	2,816	
Fourth District—Eastern	2,857	
		10,328
Franklin Township		1,602
Livingston Township (including)—		
Northfield	226	
Washington Place	120	
Squire Town	228	
Livingston	350	
Roseland	351	
		1,275
Millburn Township		2,023
Montclair Township		6,327
Newark City—		
First Ward	7,850	
Second Ward	7,113	
Third Ward	6,479	
Fourth Ward	6,199	
Fifth Ward	5,645	
Sixth Ward	20,028	
Seventh Ward	8,904	
Eighth Ward	14,781	
Ninth Ward	6,711	
Tenth Ward	11,803	
Eleventh Ward	8,010	
Twelfth Ward	15,162	
Thirteenth Ward	22,652	
Fourteenth Ward	4,242	
Fifteenth Ward	7,409	
		152,988
Orange City—		
First Ward	3,956	
Second Ward	4,149	
Third Ward	7,126	
		15,231

Essex County—Continued.

South Orange Township (not including)	2,368	
South Orange	1,857	
		4,225
West Orange Township		3,812
Total in County		213,764

Gloucester County.

Clayton Township (Clayton)		2,399
Deptford Township (not including)	1,220	
Town of Wenonah	287	
Westville	237	
		1,744
East Greenwich Township		1,233
Franklin Township		2,362
Glassboro Township (Glassboro)		2,377
Greenwich Township		1,729
Harrison Township		1,637
Logan Township		1,653
Mantua Township (Town of Mantua)		1,624
Monroe Township (Williamstown)		1,950
South Harrison Township		1,001
Washington Township		1,265
West Deptford Township		1,305
Woolwich Township (Swedesboro)		2,046
Woodbury City—		
First Ward	831	
Second Ward	1,427	
Third Ward	1,020	
		3,278
Total in County		27,603

Hudson County.

Bayonne City—		
First Ward	2,040	
Second Ward	3,660	
Third Ward	1,740	
Fourth Ward	2,820	
Fifth Ward	2,820	
		13,080
Guttenberg, Town of		1,615
Harrison, Town of—		
First Ward	2,020	
Second Ward	1,045	
Third Ward	1,438	
Fourth Ward	2,303	
		6,806

Hudson County—Continued.

Hoboken City—		
First Ward	8,070	
Second Ward	4,816	
Third Ward	13,257	
Fourth Ward	11,578	
		37,721
Jersey City—		
First District	25,590	
Second District	31,258	
Third District	24,010	
Fourth District	30,352	
Fifth District	17,575	
Sixth District	24,728	
		153,513
Kearney Township		3,338
North Bergen Township		5,459
Town of Union		8,398
Union Township		1,781
Weehawken Township		1,469
West Hoboken Township		7,162
Total in County		240,342

Hunterdon County.

Alexandria Township		1,235
Bethlehem Township (including)		2,780
Glen Gardner	71	
Junction	483	
West End and Valley Station	313	
Bloomsbury	572	
Clinton Township		2,004
Delaware Township		3,092
East Amwell Township		1,549
Franklin Township		1,387
Frenchtown, Borough of		1,066
High Bridge Township		2,024
Holland Township (not including)	1,200	
Milford	667	
		1,867
Kingwood Township		1,482
Lambertville City—		
First Ward	1,242	
Second Ward	1,195	
Third Ward	1,630	
		4,067
Lebanon Township		2,816
Raritan Township (not including)	2,070	
Flemington	1,909	
		3,979

Hunterdon County—Continued.

Readington Township		2,940
Tewksbury Township		2,081
Town of Clinton		896
Union Township		1,195
West Amwell Township		960
Total in County		37,420

Mercer County.

Chambersburg Borough		8,542
East Windsor Township (not including)	960	
Borough of Hightstown	1,608	
		2,568
Ewing Township		2,489
Hamilton Township		3,420
Hopewell Township		4,367
Lawrence Township		1,589
Millham Township		2,338
Princeton Township		4,577
Trenton—		
First Ward	4,738	
Second Ward	2,661	
Third Ward	7,185	
Fourth Ward	4,630	
Fifth Ward	6,122	
Sixth Ward	2,019	
Seventh Ward	7,031	
		34,386
Washington Township		1,196
West Windsor Township		1,313
Total in County		66,785

Middlesex County.

Cranbury Township		1,569
East Brunswick Township (not including)	2,390	
Town of Washington	1,307	
		3,697
Madison Township		1,519
Monroe Township (not including)	1,770	
Jamesburg	1,429	
		3,199
New Brunswick City—		
First Ward	2,773	
Second Ward	3,254	
Third Ward	1,981	
Fourth Ward	980	
Fifth Ward	4,517	
Sixth Ward	4,753	
		18,258

Middlesex County—Continued.

North Brunswick Township		1,272
Perth Amboy City—		
First Ward	1,963	
Second Ward	2,333	
Third Ward	2,015	
		6,311
Piscataway Township		3,155
Raritan Township		3,656
Sayreville Township		2,549
South Amboy Township		4,054
South Brunswick Township		2,714
Woodbridge Township		4,227
Total in County		56,180

Monmouth County.

Atlantic Township		1,656
Eatontown Township		2,812
Freehold Township (not including)	2,370	
Town of Freehold	2,124	
		4,494
Holmdel Township		1,640
Howell Township		3,308
Manalapan Township		2,143
Matawan Township (not including)	1,301	
Matawan	1,455	
		2,756
Marlboro Township		2,089
Middletown Township		5,802
Millstone Township		1,917
Neptune Township (not including)	3,120	
Asbury Park	2,124	
Ocean Grove	1,177	
		6,421
Ocean Township (not including)	1,740	
Long Branch	5,140	
Sea Bright	660	
		7,540
Raritan Township (not including)	1,175	
Keyport	3,063	
		4,238
Shrewsbury Township (not including)	4,372	
Red Bank	3,186	
		7,558
Upper Freehold Township		3,130
Wall (including)		4,820
Borough of North Brighton	169	
Borough of Ocean Beach	359	
Total in County		62,324

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Morris County.

Boonton Township (not including)	342	
Town of Boonton	2,390	
		2,732
Chatham Township		4,291
Chester Township		2,510
Hanover Township		4,459
Jefferson Township		1,559
Mendham Township		1,431
Montville Township		1,225
Morris Township		8,760
Mount Olive Township		2,005
Passaic Township		1,716
Pequannock Township		2,625
Randolph Township (not including)	3,875	
Dover	3,170	
		7,045
Rockaway Township		5,573
Roxbury Township		2,184
Washington Township		2,560
Total in County		50,675

Ocean County.

Berkeley Township		714
Brick Township		3,794
Dover Township		2,594
Eagleswood Township		681
Jackson Township (not including)	96	
Bennett's Mills	228	
Cassville	405	
Collier's Mills	227	
Jackson's Mills	251	
Vanhiseville	316	
Whitesville	240	
		1,763
Lacey Township		746
Manchester Township (Town of Manchester)		1,098
Ocean Township		541
Plumstead Township		1,546
Stafford Township		1,026
Union Township		1,083
Total in County		15,586

Passaic County.

Acquackanonck Township	2,038
Little Falls Township	1,701
Manchester Township	1,639

Passaic County—Continued.

Passaic City—		
First Ward	5,134	
Second Ward	2,099	
Third Ward	1,093	
		8,326
Paterson City—		
First Ward	6,690	
Second Ward	7,878	
Third Ward	9,750	
Fourth Ward	6,391	
Fifth Ward	9,576	
Sixth Ward	4,063	
Seventh Ward	7,445	
Eighth Ward	11,480	
		63,273
Pompton Township		2,109
Wayne Township		1,866
West Milford Township		2,422
Total in County		83,374

Salem County.

Elsinboro Township		571
Lower Alloways Creek Township		1,365
Lower Penns Neck Township		1,408
Mannington Township		2,161
Oldman's Township (not including)	888	
Pedricktown	390	
Auburn	185	
		1,463
Pilesgrove Township (not including)	1,564	
Borough of Woodstown	1,410	
Sharpstown	243	
Yorktown	180	
		3,397
Pittsgrove Township		2,135
Quinton Township		1,460
Salem City—		
East Ward	2,765	
West Ward	2,751	
		5,516
Upper Alloways Creek Township		1,749
Upper Penns Neck Township		2,216
Upper Pittsgrove Township		1,932
Total in County		25,373

Somerset County.

Bedminster Township		1,769
Bernards Township		2,504

Somerset County—Continued.

Branchburg Township		1,177
Bridgewater Township (not including)	1,883	
Bound Brook	1,011	
Raritan	2,244	
Somerville	3,316	
		8,454
Franklin Township (not including)	2,589	
Bloomington	660	
East Millstone	471	
		3,720
Hillsborough Township		3,151
Montgomery Township		1,800
North Plainfield Township		3,728
Warren Township		1,122
Total in County		27,425

Sussex County.

Andover Township		1,014
Byram Township		1,242
Frankford Township		1,495
Green Township		704
Hampton Township		938
Hardiston Township		2,500
Lafayette Township		816
Montague Township		900
Newton Township, co-extensive with Town of Newton		2,648
Sandyston Township		1,092
Sparta Township		1,901
Stillwater Township		1,366
Vernon Township		1,855
Wallpack Township		553
Wantage Township (not including)	2,556	
Deckertown	821	
		3,377
Total in County		22,401

Union County.

Clark Township		363
Cranford Township		1,251
Elizabeth City—		
First Ward	6,180	
Second Ward	6,296	
Third Ward	4,983	
Fourth Ward	2,198	
Fifth Ward	5,744	
Sixth Ward	2,243	
Seventh Ward	1,780	
Eighth Ward	2,695	
		32,119

Union County—Continued.

Fanwood Township		1,210
Linden Township		1,971
New Providence Twp., co-extensive with Town of New Providence		824
Plainfield City—		
First Ward	2,018	
Second Ward	2,238	
Third Ward	1,825	
Fourth Ward	2,832	
		8,913
Rahway City—		
First Ward	1,380	
Second Ward	1,596	
Third Ward	2,535	
Fourth Ward	1,350	
		6,861
Springfield Township		847
Summit Township		2,539
Union Township		2,589
Westfield Township		2,352
Total in County		61,839

Warren County.

Allamuchy Township		787
Belvidere, Town of		1,814
Blairstown Township		1,590
Franklin Township		1,382
Frelinghuysen Township		964
Greenwich Township		920
Hackettstown, Borough of		2,645
Hardwick Township		520
Harmony Township		1,256
Hope Township (not including)	1,278	
Village of Hope	270	
		1,548
Independence Township		1,134
Knowlton Township		1,456
Lopatcong Township (not including)	770	
Delaware Park	132	
Firthtown	376	
Pursel Hill	160	
Shimers	183	
Uniontown	104	
		1,725
Mansfield Township		1,600
Oxford Township		4,382
Pahaquarry Township		351

Warren County—Continued.

Phillipsburg City—		
First Ward	1,895	
Second Ward	2,107	
Third Ward	2,510	
Fourth Ward	1,546	
		8,058
Pohatcong Township		1,567
Washington Township		1,441
Washington, Borough of		2,597
Total in County		37,737

BENCH-MARKS.

DESCRIPTIONS AND ELEVATIONS OF BENCH-MARKS.

In the following list all elevations are in feet and refer to mean sea level at Sandy Hook, as determined by a series of observations by the United States Coast and Geodetic Survey, extending from October 21st, 1875, to October 31st, 1881, in a continuous series. Bench-marks marked U. S. C. S., are from the line of geodetic levels from Sandy Hook, through Phillipsburg, run in 1881, by the United States Coast and Geodetic Survey. All others were determined by the State Survey. Those described as "monuments," and numbered in the descriptions, are masses of masonry imbedded in the ground, with a rounded granite post, the summit of which is the bench-mark, projecting from the top, and usually raised about six inches above the surface of the ground. A detailed description of these monuments, and the manner of setting them, was given on pages 14 and 15 of the annual report of the State Geologist for 1885.

The objects of the primary lines of levels, run in connection with the Topographic Survey of the State, may be stated as follows: (1) To insure accuracy in the determination of elevations for topography; (2) To ascertain the exact elevation of a series of permanent bench-marks, above mean sea level, by which means any future elevation or depression of the earth's crust may be detected and measured; (3) To furnish a series of reliable bench-marks throughout the State for the use of city and railroad surveys and for all engineering purposes, in order that such surveys may constantly add to the general fund of information as to the surface of the State, and that the value of the Topographic Survey as an aid to such surveys may be increased by having all referred to the same datum plane.

In order that the full benefit of this work may be felt, it is desirable that all railroad and city engineers shall co-operate and refer their levels to the common datum.

LIST OF BENCH-MARKS.

ATLANTIC COUNTY.

ABSECON. . . . . Eleva., 24.232 ft.

Elevation of underground mark, 19.561 ft.

This monument (No. 10) is located in the small triangular grass plat where the main road from Philadelphia and Egg Harbor City enters the main shore road from Absecon to Leeds' Point. It is set in the center line of the Philadelphia road and 12.75 feet west of the center line of the shore road (the road being 49.5 feet wide). It is also 64 feet from the corner of old house standing in yard at the west street corner; 62.6 feet from corner of house on the south street corner, and about in range with its northeast end, and 131.9 feet from corner of new house on the east street corner.

The top is level with the surface of ground.

ABSECON. . . . . Eleva., 30.66 ft.

On east end of stone door-sill of Methodist Episcopal Church, about 220 yards west of the above primary monument.

ATLANTIC CITY. . . . . Eleva., 8.954 ft.

On an old United States Coast Survey tidal bench-mark cut on northwest side of base of Absecon light-house. It is under the south end of a window-sill, and is a small shelf cut in the convex water-table, with the letters "U. S. C. S." cut above it.

ATLANTIC CITY. . . . . Eleva., 10.184 ft.

A cross cut on north end of stone door-sill of Atlantic City National Bank, at northerly corner of Atlantic and North Carolina avenues, the door being on Atlantic avenue.

DA COSTA. . . . . Eleva., 80.14 ft.

A cross cut 0.40 feet from each edge of stone at southeast corner of coping of southeasterly culvert wall on Camden and Atlantic railroad, one mile west of Da Costa station.

DOUGHTY'S. . . . . Eleva., 25.75 ft.

A cross cut on coping stone at east end of south wall of culvert on

Camden and Atlantic railroad, 60 yards east of 11–49 mile-post, just west of Doughty's station. The cross is 0.75 feet from the corner.

EGG HARBOR CITY. . . . . Eleva., 56.573 ft.

Elevation of underground mark, 52.511 ft.

This monument (No. 17) is located on southwest side of Agassiz street and the southeast side of Buffalo avenue, 5 feet from the street and avenue lines, and 3 feet inside of center of hedge, which stands 2 feet from the street and runs around the School Park. There are three parks on the southwest side of Agassiz street, the School Park being in the middle. Excursion Park lies northwest of Buffalo avenue; School Park lies southeast of it and runs to Agricultural Fair Grounds, and these Fair Grounds extend from School Park to St. Louis avenue.

The monument is 251.8 feet to the northwest of the north corner of the school-house, 26.5 feet from center of a large maple tree on Buffalo avenue, 12.45 feet from center of another tree standing to northeast of former, and 44.93 feet from center of large maple tree standing on southwest side of Agassiz street.

EGG HARBOR CITY. . . . . . . Eleva., 60.27 ft.

A cross cut on south corner of upper outside flagstone step in front of side door of brick store on the north corner of Philadelphia avenue and Agassiz street.

HAMMONTON. . . . . Eleva., 102.82 ft.

A cross cut on the water-table on south side of front door, and 3.1 feet from corner of three-story concrete store standing on east side of Bellevue street, and on north side of Camden and Atlantic railroad.

LEEDS' POINT. . . . . Eleva., 52.691 ft.

Elevation of underground mark, 48.648 ft.

This monument (No. 9) is located just west of the hotel at forks of roads to Port Republic and to Absecon. It is at the intersection of the center line of Absecon road with the south line of Port Republic road. The following measurements were taken: To northeast corner of store at southwest corner of roads, 52.5 feet; to center of small cedar north of and opposite the store, 69.2 feet; to center of wild cherry tree at southeast road corner, 22.5 feet, and to center of maple

tree standing on the south side of Point road, east of forks of roads, 75.9 feet.

The top of this monument is just below the surface of the road.

MAYS LANDING. . . . . Eleva., 19.89 ft.

This bench-mark is a cross cut on west end of stone door-sill of front door of Atlantic county court-house.

MAYS LANDING. . . . . Eleva., 20.66 ft.

This bench-mark is the arrow-head engraved on the brass top of the south "true meridian" post standing in the court-yard.

MAYS LANDING. . . . . Eleva., 18.82 ft.

This bench-mark is a cross cut on east end of stone door-sill of front or north door of the American Hotel, just southeast of court-house.

MOUNT PLEASANT. . . . . . . Eleva., 13.96 ft.

A cross cut on bluestone door-sill of northerly door at east side of Atlantic City water-works pumping station, just north of Mount Pleasant.

SOMERS' POINT. . . . . Eleva., 26.160 ft.

Elevation of underground mark, 21.535 ft.

This monument (No. 11) is placed on the brow of the hill in front of the old Somers homestead, a brick building on the shore road just south of the railroad crossing, at Somers' Point. It is set in the center line of the road which runs to the west and is in the produced line of the curb along the northerly side of the street running down to the railroad depot, and 29 feet from the corner of the curb at the northwest corner of the streets, said corner bearing south 37° east from the monument. The southeast corner of the Somers homestead bears north 5° west, 75 feet distant, and a large cedar tree near the southwest street corner bears south 60° west, 53.5 feet distant. The center of the railroad track, where it crosses the shore road, is about 160.5 feet from the monument.

(NOTE.—On account of a change of the grade of the streets, No. 11 was reset May 31st, 1887, and the above description and elevations apply to its new position.)

BERGEN COUNTY.

ALLENDALE. . . . . Eleva., 270.39 ft.

A cross cut on the outside corner of the second step from the top of the east end of the retaining wall of the north abutment of the New York, Lake Erie and Western railroad bridge over a brook, about 300 yards south of the station.

BLAUVELTVILLE, N. Y. . . . . . Eleva., 182.80 ft.

A cross cut on the outside corner of the west end of the south abutment of the road bridge over the Piermont branch of the New York, Lake Erie and Western railroad.

CLOSTER. . . . . Eleva., 40.48 ft.

This bench-mark is on the east end of the sill of the most easterly of two doors in the south side of the brick building opposite the Northern Railroad of New Jersey station.

CLOSTER. . . . . Eleva., 40.00 ft.

A cross cut on the east corner of the sill of the front door of M. Kohler's feed store.

DEMAREST. . . . . Eleva., 38.87 ft.

A cross cut on the south end of the sill of the front door of the Northern Railroad of New Jersey station.

DUNDEE LAKE. . . . . Eleva., 41.14 ft.

This bench-mark is on the New York, Susquehanna and Western railroad bridge crossing the lake. The point is a cross on the northwest corner of the iron bed-plate on which rests the most easterly truss on the north side of the track.

ENGLEWOOD. . . . . Eleva., 24.05 ft.

A cross on the north end of the sill of the front door of the ladies' waiting-room of the Northern Railroad of New Jersey station.

ENGLEWOOD. . . . . Eleva., 44.84 ft.

A cross on the southwest end of the sill of the door of the post-office, at the northwest corner of Palisade avenue and Engle street.

HACKENSACK. . . . . Eleva., 12.50 ft.

A cross cut on the west end of the sill of the main front door of the First Reformed Church, on Court street.

HACKENSACK. . . . . Eleva., 14.22 ft.

A cross cut on the west end of the sandstone sill of the main front door of the Bergen county court-house.

HIGHWOOD. . . . . Eleva., 48.95 ft.

A cross cut on the northeast corner of coping of the retaining wall at the east end of the south abutment of the Northern Railroad of New Jersey bridge over a brook, about 500 yards south of the station.

HOHOKUS. . . . . Eleva., 194.69 ft.

A cross cut on the southwest corner of the coping of the west parapet of the New York, Lake Erie and Western railroad culvert over Hohokus creek.

MONSEY, N. Y. . . . . Eleva., 527.29 ft.

This bench-mark is on the summit of the large guard-stone at the northwest corner of the freight station.

NANUET, N. Y. . . . . Eleva., 297.98 ft.

A cross cut on the south end of the stone sill of the front door of William Hutton, Jr.'s, brick store, near the railroad station.

NORDHOFF. . . . . Eleva., 9.87 ft.

This bench-mark is on the north end of the sill of the most northerly window in the front of the lodge at the entrance of Hon. W. W. Phelps' Teaneck estate.

ORANGETOWN, N. Y. . . . . . . Eleva., 113.82 ft.

A cross cut on the east corner of the coping on top of and at the extreme south end of the long abutment of the bridge carrying the Piermont branch of the New York, Lake Erie and Western railroad over the West Shore railroad.

PALISADES MONUMENT. . . . . . Eleva., 460.21 ft.

This bench-mark is on the summit of the State line monument, on top of the Palisades.

PALISADES MONUMENT. . . . . . Eleva., 453.08 ft.

This bench-mark is a cross cut on a rounded knob of the bed-rock 7.8 feet southwest of the monument.

PASSAIC JUNCTION. . . . . . . Eleva., 53.20 ft.

A cross cut on the southeast corner of the lowest step at the east end of the north abutment of the bridge carrying the Bergen County railroad (Erie) over the New York, Susquehanna and Western railroad.

RAMSEY'S. . . . . Eleva., 344.25 ft.

A cross cut on the east end of the sill of the most easterly window in the north end of John Y. Dater's brick dwelling, near the station.

RIDGEFIELD. . . . . Eleva., 14.35 ft.

A cross cut on the south end of the sill of the front door of the ladies' waiting-room of the Northern Railroad of New Jersey station.

RIDGEFIELD PARK. . . . . . . Eleva., 6.77 ft.

This bench-mark is on the northwest corner of the west end of the culvert under the West Shore railroad, one-third mile north of the village.

RIDGEWOOD. . . . . Eleva., 140.33 ft.

A cross cut on the west end of the stone sill of Abraham J. Zabriskie's brick building (now used as a feed store), near the station.

SPRING VALLEY, N. Y. . . . . . Eleva., 448.94 ft.

A cross cut on the east end of the front door-sill of the Reformed Church.

SUFFERN, N. Y. . . . . Eleva., 283.50 ft.

This bench-mark is the top of the State line monument, between the two tracks of the New York, Lake Erie and Western railroad, about three-quarters mile south of Suffern.

SUFFERN, N. Y. . . . . Eleva., 287.45 ft.

This bench-mark is the top of the new fifteenth mile-stone of the State line.

TALLMANS, N. Y. . . . . . . Eleva., 482.58 ft.

A cross cut on the top of a large boulder in the railroad cut on the north side of the track, 25 yards west of a bridge and 100 yards east of the station.

TENAFLY. . . . . Eleva., 48.06 ft.

A cross cut on the south end of the sill of the north front door of the Northern Railroad of New Jersey station.

BURLINGTON COUNTY.

BIRMINGHAM. . . . . Eleva., 31.29 ft.

On the most southerly of two bolts on the top of northwest wing-wall of bridge over race, 100 yards north of Birmingham railroad station.

BORDENTOWN. . . . . Eleva., 15.53 ft.

A triangle cut on the west end of stone door-sill at the south entrance to fire-room of Bordentown Reservoir and Water Co.'s pump-house, near the outlet lock of the Delaware and Raritan canal.

BORDENTOWN. . . . . Eleva., 24.17 ft.

A triangle cut on coping-stone at the east end of the south abutment of railroad bridge over roadway, just north of lower Bordentown railroad station.

BURLINGTON. . . . . Eleva., 12.53 ft.

Cross cut on dressed stone at west end of door-sill of main entrance to Baptist Church at northwest corner of Broad and Stacy streets.

BURLINGTON. . . . . - Eleva., 11.30 ft.

A cross cut on northwest corner of projecting ledge of iron post at northwest corner of iron bridge over Assiscunk creek, on Main street.

DEACON'S. . . . . Eleva., 80.56 ft.

A triangle cut on water-table at southwest corner of brick school-house, on east side of turnpike, three-eighths mile southeast of Deacon's station.

MOUNT HOLLY. . . . . Eleva., 185.47 ft.

On the northwest corner of granite monument, located on the summit of Mount Holly, and which marks the United States Coast and Geodetic Survey triangulation point, Mount Holly.

MOUNT HOLLY. . . . . Eleva., 16.88 ft.

On northwest corner of door-sill of National Bank, on northeast corner of Main and Mill streets.

MOUNT HOLLY. . . . . Eleva., 42.97 ft.

On the northwest corner of marble door-sill of main entrance to Burlington county court-house.

PEMBERTON. . . . . Eleva., 39.23 ft.

On the southwest corner of granite block, upon which rests the south end of west iron arch of bridge over mill-pond, South Pemberton.

TUCKERTON. . . . . Eleva., 22.632 ft.

Elevation of underground mark, 17.972 ft.

This monument (No. 8) is set in the northwest corner of the Presbyterian church-yard, at the corner of Main and Cedar streets, 3.2 feet back from the front fence, being in line with the south fence line of Main street, west of Cedar street, and 3 feet east of the east line of Cedar street. It is 32.9 feet from the northwest corner of the church.

WHITE HILL. . . . . Eleva., 14.24 ft.

On a protuberance indicated by an arrow and the letters B. M., on the southeast corner of the flagstone coping of the northwest wall of bridge over ice-pond, on the road to Burlington, one mile west of White Hill.

CAMDEN COUNTY.

CAMDEN. . . . . Eleva., 30.64 ft.

A cross cut on southeast end of highest step of main entrance to new Camden county court-house, on Federal street.

CAMDEN. . . . . Eleva., 21.23 ft.

A cross cut on north end of north door-sill on east side of station

at junction of Camden and Atlantic and Pennsylvania railroads, at corner of Tenth and Market streets.

CAMDEN. . . . . Eleva., 34.53 ft.

On easterly corner of pedestal, over the builders' names (Krips & Shearman), of the soldiers' monument, on Haddon avenue, just north of city hall.

GLOUCESTER FERRY. . . . . Eleva., 5.91 ft.

A cross cut on southeast corner of slate slab on top of rubble wall, southeast of Gloucester ferry pier, and 56 yards in a southerly direction from Buena Vista Hotel.

KIRKWOOD. . . . . Eleva., 60.04 ft.

On cross on southeast corner of slate slab on south side of outlet of pond, on dam opposite railroad station.

MERCHANTVILLE. . . . . . . Eleva., 80.11 ft.

On the west end of marble door-sill (close by corner of brick work), of the east front door of new railroad station.

WINSLOW. . . . . Eleva., 112.019 ft.
Elevation of underground mark, 107.779 ft.

This monument (No. 18) is located in the grass plat, 22.5 feet west of flag-pole. It is in the center line of road running south of New Jersey Southern railroad station, and is about in center line of roads running to Hammonton and Waterford. The following measurements were taken from the monument: North 46° 30′ east, 57 feet to large oak; north 6° 30′ west, 41 feet to another large oak; 123.25 feet to southeast corner of Hay & Co.'s store; 50 feet to corner of glass works fence; 55 feet perpendicularly to south line of road to New Germany; 58 feet to southwest street corner, and 73 feet to northeast corner of house on this southwest corner.

WINSLOW. . . . . Eleva., 112.76 ft.

A cavity cut in foundation at south corner of brick chimney, at south corner of Hay & Co.'s steam flour mill, at Winslow. An arrow-head points to it, and it is 1.8 feet above surface of ground.

CAPE MAY COUNTY.

CAPE MAY COURT HOUSE. . . . . Eleva., 19.498 ft.
Elevation of underground mark, 14.961 ft.

This monument (No. 14) is set in the east corner of Cape May county court-yard, 4 feet from the front or street fence, and 5 feet from the line fence between the court-yard and the M. E. church-yard. It is also 81.7 feet from the center of the south "true meridian" post, 62 feet from the north one, 54 feet from east corner of court-house and 42 feet from south corner of M. E. Church.

CAPE MAY CITY. . . . . . . Eleva., 10.876 ft.

This bench-mark is a cross cut on stone, under east corner of West Jersey railroad station.

CAPE MAY. . . . . Eleva., 6.409 ft.
Elevation of underground mark, 1.829 ft.

This monument (No. 15) is located on the Cape May light-house lot, just southeast of Cape May Point and about two miles west of Cape May City.

The Cape May and Sewell's Point railroad divides the light-house property into two parts.

The monument is set in the east corner of the south part, 2 feet from the line fence of the railroad and 2 feet from the southeast line of the lot. The United States Life Saving Station stands on the south and the light-house on the north part of the lot. The corners of the lot are marked by square granite posts.

Beginning at the southwest corner of lot, the line runs south 62° 40′ east, 206.8 feet to south corner; thence north 28° 30′ east, 214.25 feet to a point 2 feet southeast of the monument, the whole distance to the next corner being 424.6 feet. From the first-mentioned corner the magnetic bearing is north 1° 40′ east, from the second north 10° west, and from the third north 28° west, to the center of the light-house.

CAPE MAY. . . . . Eleva., 8.244 ft.

On northwest corner of square stone monument in southeast corner of light-house lot.

Q

CAPE MAY. . . . . Eleva., 13.187 ft.

On United States Coast Survey tidal bench-mark of 1867, cut on east side of projecting water-table at base of Cape May light-house.

COLD SPRING. . . . . Eleva., 20.70 ft.

A cross cut on north end of northerly stone door-sill of Cold Spring Presbyterian Church (brick).

OCEAN CITY. . . . . Eleva., 10.298 ft.

Elevation of underground mark, 5.320 ft.

This monument (No. 12) is set about 3 feet south of the north corner of the new life-saving station lot, which runs from the corner of Atlantic avenue and Fourth street, northeasterly 100 feet along said avenue, and southeasterly 130 feet along said street. It is set about 2.1 feet southwest of the northeast line of the lot. It is about 400 feet from high-water line at this time.

SEA ISLE CITY. . . . . Eleva., 5.193 ft.

Elevation of underground mark, 1.130 ft.

This monument (No. 13) is set just south of the north corner of the new United States light-house lot, which is located on the east side of the Sea Isle and Ocean City railroad, in the south corner of block 62, and is bounded on the southeast by the beach, and on the southwest by Whelen street.

The monument is set 2 feet from the northwest line of the lot and 2 feet from the northeast line, which makes it 2.8 feet from the north corner of the lot.

SEA ISLE JUNCTION. . . . . . . Eleva. 15.86 ft.

This bench-mark is on the frog (1 foot from its point) of the switch just north of the station.

CUMBERLAND COUNTY.

BAY SIDE. . . . . Eleva., 7.51 ft.

This bench-mark is on root of oak tree in edge of grove near turntable of New Jersey Southern railroad.

BRIDGETON. . . . . Eleva., 29.61 ft.

This bench-mark is a cross cut on north end of store door-sill of east door of Bridgeton water works, on east side of East Lake.

BRIDGETON. . . . . Eleva., 22.41 ft.

This bench-mark is a cross cut on east end of door-sill of main front entrance of First Baptist Church, on Commerce street.

BRIDGETON. . . . . Eleva., 54.25 ft.

This bench-mark is a cross cut on west end of large upper stone step of front entrance of stone Presbyterian Church, on Commerce street, in West Bridgeton.

NEAR BRIDGETON. . . . . . . Eleva., 91.00 ft.

This bench-mark is on the east rail of West Jersey railroad, and the south rail of New Jersey Southern railroad, at their crossing about two miles north of Bridgeton.

MILLVILLE. . . . . Eleva., 33.45 ft.

This bench-mark is a cross cut on the water-table on southwest corner of Millville National Bank, on northeast corner Main and Second streets.

MILLVILLE. . . . . Eleva., 28.79 ft.

This bench-mark is a cross cut on south end of stone door-sill of main entrance to Workingmen's Institute.

VINELAND. . . . . Eleva., 108.10 ft.

This bench-mark is a cross on north end of stone door-sill of north door on west side of Vineland station of West Jersey railroad.

VINELAND. . . . . Eleva., 118.05 ft.

This bench-mark is a cross cut on east end of front or north door-sill of First Baptist Church, on south side of Landis avenue, just west of Ninth street.

VINELAND. . . . . Eleva., 115.76 ft.

This bench-mark is a cross cut on east end of stone door-sill of First M. E. Church, on northeast corner of Landis avenue and Seventh street.

ESSEX COUNTY.

BELLEVILLE. . . . . Eleva., 32.85 ft.

A cross cut on the top of the west wall of the bridge over Second river at Belleville avenue.

BLOOMFIELD. . . . . Eleva., 130.33 ft.

A cross cut on the highest of a series of steps, at the northeast end of the east abutment of the New York and Greenwood Lake railroad bridge over the canal. The point is under the truss and 4 feet below the track.

BLOOMFIELD. . . . . Eleva., 141.21 ft.

A cross cut on the west sill of the main front door of the old Presbyterian church.

BLOOMFIELD. . . . . Eleva., 181.06 ft.

A cross cut at the southeast corner of the east end of the north abutment of the first road bridge above Morris canal plane No. 11.

BLOOMFIELD. . . . . Eleva., 178.17 ft.

This bench-mark is on the west abutment of the bridge over the Morris canal, on the road from Watchung to Avondale, about 2 miles north of Bloomfield. The point is marked by a cross cut on the lowest step at the south end of the abutment.

BROOKDALE. . . . . Eleva., 177.52 ft.

This bench-mark is on the west abutment of the bridge over the Morris canal, on the road from Watchung to Peru, 3 miles north of Bloomfield. The point is a cross cut in the lowest step of the retaining wall at the north end of the abutment.

NEWARK. . . . . Eleva., 24.62 ft.

A cross cut on the south end of the sill of the front door of the German Methodist Church, at the northeast corner of Walnut and Mulberry streets.

NEWARK. . . . . Eleva., 42.12 ft.

A cross cut on the west end of the sill of the window at the south end of the custom-house. The point is 4.5 feet above the pavement.

NEWARK. . . . . Eleva., 109.92 ft.

A cross cut on the stone at the south end of a bridge over the Morris canal on Summit street, at the upper end of the inclined plane.

NEWARK. . . . . Eleva., 54.99 ft.

A cross cut on the southeast corner of the base of the most northerly of two large columns at the main entrance in the east front of the Essex county court-house, on Market street.

NEWARK. . . . . Eleva., 119.10 ft.

This bench-mark is on the east abutment of the bridge carrying Sussex avenue over the Morris canal. The point is a cross on the northeast corner of the stone on which the east end of the north truss rests.

GLOUCESTER COUNTY.

SWEDESBORO. . . . . Eleva., 40.43 ft.

This bench-mark is a cross cut on north end of marble door-sill of front door of brick M. E. church, on northwest corner of Main street and Railroad avenue.

SWEDESBORO. . . . . Eleva., 44.822 ft.

This bench-mark is a cross cut on north end of door-sill of National Bank.

WOODBURY. . . . . Eleva., 58.11 ft.

This bench-mark is a cross cut on south end of stone door-sill of front door of brick Presbyterian church, on Main street.

WOODBURY. . . . . Eleva., 62.32 ft.

This bench-mark is a cross cut on southeast corner of the lowest of three marble bases of soldiers' monument in front of court-house.

WOODBURY. . . . . Eleva., 37.28 ft.

This bench-mark is a cross cut on south end of stone door-sill of front entrance of G. G. Green's brick laboratory, which faces the railroad just south of West Jersey railroad depot.

HUDSON COUNTY.

BELMONT. . . . . Eleva., 11.63 ft.

A cross cut on the lowest sandstone step at the north end of the masonry of the west pier of the bridge carrying the West Shore railroad over the Northern Railroad of New Jersey.

EAST NEWARK. . . . . Eleva., 26.03 ft.

A cross on the west end of the stone sill of the front door of the small brick office building, at Peter Hauk & Co.'s brewery, on Harrison avenue, opposite Washington street.

JERSEY CITY. . . . . Eleva., 100.63 ft.

A cross cut on the sandstone water-table of the Hudson county court-house. The point is on the Newark avenue face of the building, 5.1 feet from the south corner, and 0.8 foot above the stone flooring of the portico.

JERSEY CITY. . . . . Eleva., 99.65 ft.

A cross cut on the east end of sandstone sill of the most westerly of two doors in the Newark avenue front of the Hudson county jail, opposite Oakland avenue.

JERSEY CITY. . . . . Eleva., 104.39 ft.

A cross cut on the north end and near the outer edge of the sill of the main front door of the First Baptist Church, on Summit avenue.

JERSEY CITY. . . . . Eleva., 94.93 ft.

A cross cut on the south corner of upper large square stone step at the main entrance (on Summit avenue) of the Westminster Presbyterian Church, at the east corner of Summit and Magnolia avenues.

JERSEY CITY. . . . . Eleva., 21.75 ft.

A cross cut on the south end of the sill of the front door of the post-office, Washington street.

JERSEY CITY. . . . . Eleva., 6.99 ft.

A cross cut on the outside of the top of the south wall (at the west

corner of the lock wall) of the Morris canal lock No. 22. This lock is at Washington street, and the bench-mark is also one of the canal levels.

NEW DURHAM. . . . . Eleva., 7.91 ft.

A cross cut on the lowest of a series of steps at the west end of the north abutment of the bridge carrying the road over the West Shore railroad, at the station.

HUNTERDON COUNTY.

ANNANDALE. U. S. C. S. . . . Eleva., 355.049 ft.

This bench-mark is about 1 mile east of Annandale station (New Jersey Central railroad). It is the bottom surface of a square cavity cut on a projecting stone, about the center of the north abutment of overhead road bridge. This bench-mark is a little below the level of the railroad track. The stone is hard, blue limestone.

BLOOMSBURY. U. S. C. S. . . . Eleva., 326.180 ft.

This bench-mark is the bottom of a square cavity cut on top stone of northwest corner of stone bridge (railroad) over wagon road, one-quarter mile west of Bloomsbury station, New Jersey Central railroad. It is marked thus— B. ☐ M.
1881.

FLEMINGTON. . . . . Eleva., 187.45 ft.

This bench-mark is a cross cut on south end of door-sill of front entrance of court-house.

FLEMINGTON. . . . . Eleva., 186.29 ft.

This bench-mark is on top of brass head of southern "true meridian" post in front of court-house.

FLEMINGTON. . . . . Eleva., 171.26 ft.

This bench-mark is a cross cut on west end of door-sill of door in southwest corner of stone Presbyterian church, at forks of street.

LAMBERTVILLE. . . . . Eleva., 70.01 ft.

This bench-mark is a cross surrounded by a triangle on the north-east corner of large corner-stone on north end of west wall of lock on canal feeder.

LAMBERTVILLE. . . . . Eleva., 72.87 ft.

This bench-mark is a cross cut on south end of door-sill of the center or ladies' waiting-room door, on east side of railroad station.

LAMBERTVILLE. . . . . Eleva., 81.38 ft.

This bench-mark is a cross cut on east end of stone door-sill under portico of Baptist church, on Bridge street.

MOUNT AIRY STATION. . . . . . Eleva., 137.35 ft.

This bench-mark is a cross cut on fourth stone step from bottom of south abutment of bridge over highway, on west side of railroad.

RINGOES. . . . . Eleva., 240.85 ft.

This bench-mark is a cross cut on second stone step from the bottom of north abutment on west side of railroad track, at road crossing just north of depot.

MERCER COUNTY.

MILLSTONE AQUEDUCT. . . . . . Eleva., 58.940 ft.

A triangle cut in the center of the memorial plate on top of the south end of the west abutment of aqueduct carrying the Delaware and Raritan canal over the Millstone river, two miles south of Kingston.

PRINCETON. . . . . Eleva., 208.510 ft.

Center of triangle cut on the north end of the door-sill at west entrance to the Hall of Science, on college campus.

PRINCETON. . . . . Eleva., 217.180 ft.

A cross cut on top of water-table at the northeast corner of East College, on college campus.

TITUSVILLE. . . . . Eleva., 63.23 ft.

This bench-mark is a cross cut on east end of stone door-sill of front door of brick Presbyterian church.

TRENTON. . . . . Eleva., 54.250 ft.

On broad water-table, 3.2 feet above pavement, in re-entrant angle of stone moulding. The point is indicated by an arrow-head, and is

1.1 feet south from produced line of south jamb of the most southerly window on the west side of the United States Government building, at the northeast corner of Montgomery and State streets.

TRENTON. . . . . Eleva., 56.36 ft.

A triangle cut on the coping of north side of stone pivot-pier of railroad bridge over canal at entrance of feeder, one block north of Perry street.

TRENTON. . . . . Eleva., 52.610 ft.

A triangle cut on the northeast corner of the most northerly coping stone of west lock wall of Prison lock of Delaware and Raritan canal.

WASHINGTON'S CROSSING. . . . . . Eleva., 57.01 ft.

This bench-mark is a cross cut on southwest corner of coping-stone on west end of wall on north side of outlet sluice of feeder, at south end of station platform.

MIDDLESEX COUNTY.

JAMESBURG. . . . . Eleva., 51.41 ft.

A cross cut on the west end of the stone door-sill of the First National Bank.

JAMESBURG. . . . . Eleva., 48.62 ft.

This bench-mark is on the southwest corner of the bed-stone, under the east end of the south truss of the iron wagon bridge, 45 yards west of the Lower Jamesburg railroad station. It is marked by a cross inside of a triangle, cut in the stone.

JAMESBURG. . . . . Eleva., 72.51 ft.

A cross cut on the northeast corner of the square marble stone under the northeast corner post of the Jamesburg hotel.

KINGSTON. . . . . Eleva., 57.71 ft.

A triangle cut on the east edge of west wall of Delaware and Raritan canal lock.

METUCHEN. U. S. C. S. . . . . . Eleva., 83.641 ft.

This bench-mark is a slight circular concavity, bounded by a triangle, cut on the west end of the south wall (near base) of the stone

bridge near Metuchen tank station of Lehigh Valley railroad. By means of this bridge the Pennsylvania railroad crosses over the Lehigh Valley railroad.

MONMOUTH JUNCTION. . . . . . Eleva., 87.39 ft.

A cross on the coping-stone over the center of the arch of stone culvert, on the east side of the main line of the Pennsylvania railroad, 170 yards north of the Monmouth Junction station.

MONMOUTH JUNCTION. . . . . . Eleva., 87.48 ft.

This bench-mark is on the head of the copper bolt surrounded by a square nut, on the northwest corner of the stone culvert on the west side of the main line of the Pennsylvania railroad, about 170 yards north of the Monmouth Junction station.

MORGAN STATION. U. S. C. S. . . . . Eleva., 5.611 ft.

This bench-mark is the surface of stone in center of triangle, cut on top of the southeast pier of the draw-bridge, at Morgan station, of New York and Long Branch railroad. The bridge crosses Cheesequake creek.

(This bench-mark has apparently settled. C. C. V.)

NEW BRUNSWICK. . . . . . . Eleva., 70.951 ft.

Elevation of underground mark, 65.709 ft.

This monument (No. 1) is on Rutgers College campus, at a distance of 35 feet, measured on a perpendicular from the face of the front wall of the main college building, the perpendicular being erected from the middle of front entrance door, which door is in the middle of south side of the building.

NEW BRUNSWICK. . . . . . . Eleva., 17.62 ft.

A cross cut on a large coping-stone at south end of lock-chamber and on the east wall of the second, or "deep" lock of the Delaware and Raritan canal.

NEW MARKET. U. S. C. S. . . . . Eleva., 49.179 ft.

This bench-mark is the bottom of a square cavity, cut on top stone of south end of west abutment of a small railroad bridge, about three-

quarters mile west of New Market station, Lehigh Valley railroad, and 200 meters (656 feet) west of mile-post (13 miles to Perth Amboy).

It is marked thus— B. ▭ M.
XI.

PERTH AMBOY. U. S. C. S. . . . Eleva., 7.782 ft.

This bench-mark is between Perth and South Amboy, on one of the piers of the long bridge across Raritan bay. It is on the pier on which the north end of the draw-bridge rests (east side of track), and is, as usual, the bottom surface of a square cavity, 1 inch square and one-half inch deep.

F.
It is marked thus— B. ▭ M.
U. S. C. & G. S.
1881.

N. B.—This bench-mark has settled. Its elevation in 1886, is 7.53 ft. C. C. V.

PERTH AMBOY. . . . . . . Eleva., 60.600 ft.
Elevation of underground mark, 55.855 ft.

This monument (No. 2) is located in a triangular grass plat in the public park on the center line of High street, 97.75 feet southwesterly from its intersection with the center line of Market street. The intersection of said streets is marked by a sunken monument from which the city surveys start.

PERTH AMBOY. . . . . . . Eleva., 57.400 ft.

This bench-mark is on the east end of stone door-sill of Market street entrance of the city hall.

PERTH AMBOY. . . . . . . Eleva., 29.62 ft.

A cross cut on a slight shelf on the sixth stone from the north end of the second tier, above the surface of the ground, of the eastern abutment of the bridge carrying the New York and Long Branch railroad over the Pennsylvania railroad, about one and a half miles north of Perth Amboy.

SOUTH PLAINFIELD. U. S. C. S. . . Eleva., 63.860 ft.

This bench-mark is the bottom surface of a square cavity (1 inch

square by one-third inch deep), cut on top of stone abutment at northwest corner of a small iron railroad bridge, about 150 meters (492 feet) east of South Plainfield station of Lehigh Valley railroad.

It is marked thus— B. ▭ M.

WOODBRIDGE. . . . . Eleva., 22.85 ft.

A cross cut on the water-table at the northeast corner of the Methodist church; over the corner-stone bearing the date "1870."

WOODBRIDGE. . . . . Eleva., 17.06 ft.

A cross cut on the north end of the stone sill of the south door on the east side of the Pennsylvania railroad station.

MONMOUTH COUNTY.

ASBURY PARK. . . . . Eleva., 22.184 ft.

On water-table at southwest corner, just over the corner-stone, of First M. E. Church, at corner of Grand and First avenues, Asbury Park.

ENGLISHTOWN. . . . . Eleva., 70.96 ft.

A cross cut on the southeast corner of the flag coping-stone on the east wing wall of the south abutment of the iron bridge over the Matchaponix at the Englishtown mill (between the village and the railroad station).

FARMINGDALE. . . . . Eleva., 71.70 ft.

On the most easterly intersection of rail in the frog at crossing of Freehold and Jamesburg and New Jersey Southern railroads.

FREEHOLD. . . . . Eleva., 186.63 ft.

A cross cut $2\frac{1}{2}$ inches south of the intersection of the three joints formed by the three most southerly stones in the south corner of the large triangular base of the Monmouth Battle-Field Monument. The cross is $2\frac{1}{2}$ inches south of the north apex of the stone which abuts on its south sides against the octagonal gun-pedestal, which is built at the south corner of the triangular base.

FREEHOLD. . . . . Eleva., 178.15 ft.

A cross cut on the east end of stone door-sill of the sheriff's office,

being the most easterly of two doors in the middle of the front of Monmouth county court-house.

HIGHLAND STATION. U. S. C. S. . . Eleva., 7.637 ft.

This bench-mark is a granite post, projecting about 2 feet above surface of the ground; it is on west side of track of New Jersey Southern railroad, about three-quarters mile north of Highland station. About 150 meters (492 feet) southwest of it there is a small, deserted shanty. The center of the top surface of the stone is the bench-mark.

LAKE TAKANASSEE BRIDGE. . . . Eleva., 16.715 ft.

A cross cut on north end of west wing wall of the northern abutment at the foot of the iron post at end of railing of bridge over Lake Takanassee (Green's Pond), on Ocean avenue, near Life Saving Station No. 5, West End.

MANASQUAN. . . . . . . Eleva., 21.78 ft.

A cross cut on east end of sandstone door-sill of the First National Bank, on Main street, just east of entrance to South street.

MATAWAN. U. S. C. S. . . . . Eleva., 55.083 ft.

This is the center of a triangle cut on the east corner of a flagstone in front of Benjamin Tuttle's front gate, Main street, Matawan. It is about one-third mile from the station of the New Jersey Central railroad.

MATAWAN. . . . . Eleva., 35.66 ft.

This bench-mark is a cross cut on south end of stone door-sill of Episcopal church, on Main street.

MONMOUTH BEACH. . . . . . . Eleva., 10.252 ft.

A cross cut on east end of lower stone step of southern flight at entrance, 40 feet from and in front of Episcopal church, near Life Saving Station No. 4.

NAVESINK LIGHT. U. S. C. S. . . Eleva., 202.464 ft.

This bench-mark is a mark on top surface of a heavy granite post near Navesink light-house. The post is deeply imbedded and its top

projects about 1½ feet above the surface of the ground. It is 13 meters (42.6 feet) south of the southernmost tower of Navesink Highlands light-house.

NAVESINK LIGHT. U. S. C. S. Primary Mark D. Eleva., 207.579 ft.

This bench-mark is the bottom surface of a square cavity (about 1 inch square) cut on a sloping ledge at southeast corner of base of southernmost light-house tower at Navesink Highlands light.

U. S.
It is marked thus— B. ▭ M.
1881.

NORTH LONG BRANCH. . . . . . . Eleva., 7.26 ft.

On a marble monument, 150 yards north of Charles Van Note's blacksmith shop, at east side of Ocean avenue, just north of a low place in the road.

OCEAN BEACH. . . . . Eleva., 20.151 ft.

A cross cut on south end of stone door-sill of front entrance of brick school-house, at Ocean Beach.

OCEANPORT. U. S. C. S. . . . . . Eleva., 3.499 ft.

This is the bottom surface of a square cavity cut on the south pier of the draw-bridge known as the Oceanport draw-bridge, about 1½ miles north of the Branchport station, New Jersey Central railroad.

It is marked thus— B. ▭ M.

It is on west side of railroad and some distance below its level.

RED BANK. U. S. C. S. . . . . . Eleva., 38.499 ft.

This bench-mark is the bottom surface of a cavity cut in center of top of a marble post set in the ground in the yard of the house of Rev. B. F. Leipner, at Red Bank, N. J. The marble post is over 5 feet in length, and buried so that the top projects about 5 inches above the surface of the ground. The house of Mr. Leipner stands at southwest corner of Monmouth and Pearl streets. The bench-mark is close to southeast corner of the house. The top of stone bears the following inscription:

U. S.
B. ⬭ M.
1881.

RED BANK. . . . . Eleva., 43.13 ft.

This bench-mark is a cross cut on northwest corner of lower stone step of west or Monmouth street entrance of M. E. church, on southeast corner of Broad and Monmouth streets.

RED BANK. . . . . Eleva., 45.77 ft.

This bench-mark is a cross cut on south end of front door-sill of First National Bank, on Broad street.

SANDY HOOK. U. S. C. S. Mark A. . Eleva., 11.432 ft.
Mark B. . . Eleva., 9.419 ft.

These two bench-marks are cedar posts, 4 feet long and 8 inches in diameter, sunk in the ground, with ends projecting above surface of ground about 4 inches. In the center of top of each post is a copper nail surrounded by 5 other similar nails, in the form of a pentagon. The posts are 12 meters apart, and bear east-northeast from the steamer landing (passenger wharf), and nearly northeast from the tide-house, and distant from it about 500 meters (1,640 feet). They are also 95 meters northwest of the red engine-house of New Jersey Southern railroad, and are placed in the edge of a strip of cedars, where the ground is elevated a few feet above the marsh. The southeasterly one is bench-mark B, and the other one, which is 2 feet higher, is bench-mark A.

SANDY HOOK. U. S. C. S. . . . . Eleva., 19.552 ft.

This bench-mark is a cross on the head of a copper bolt driven into the wall of the main light-house, at Sandy Hook. The main lighthouse is an octagonal tower, resting upon a circular foundation of unhewn stones. This foundation projects on all sides about 8 inches beyond the base of the tower, so as to form a sloping ledge. The copper bolt is a few inches westward of the northwest angle, and 9¼ inches above the ledge above referred to.

SANDY HOOK. U. S. C. S. . . . Eleva., 15.509 ft.

This bench-mark is the center of the inner edge of the second embrasure from the southwest corner of the fort, at Sandy Hook.

SEABRIGHT. U. S. C. S. Mark IV. . . Eleva., 9.283 ft.

This bench-mark is the bottom surface of a square cavity (1 inch square) cut on the north wing wall of the west abutment of bridge

over the South Shrewsbury river, at Seabright. The top of the wing wall forms a series of steps, and the bench-mark is cut on the first step below the top.

It is marked thus— B. □ M.

SEA GIRT. . . . . Eleva., 19.47 ft.

A point of an arrow-head cut in the stone under second pillar of the piazza at northeast corner of the northern of the two four-story buildings of the Beach House, Sea Girt.

SPRING LAKE. . . . . Eleva., 18.351 ft.

Elevation of underground mark, 13.978 ft.

This monument (No. 4) is located on the lot of Life Saving Station No. 8, Spring Lake, on the east side of Ocean avenue, between Ocean Beach and Spring Lake. At the time of setting the monument the station building was so located that the northerly edge of the roof was about on the line of the lot, but the front was about 25 feet on the avenue. The monument was set 27.6 feet back from the west end of station, and 5 feet south of its south side.

It may also be located as follows: Beginning at the point where the line of south curb of St. Clair avenue intersects the center line of Ocean avenue, and running thence N. 22′ 15″ E., 973 feet along center line of said avenue to a point in line with south side of station; thence along the station 52.6 feet; thence at right angles to station, 5 feet to the monument.

The monument was set with its top level with the surface of ground, which was a little higher than the surrounding surface.

TENNENT. . . . . Eleva., 89.91 ft.

This bench-mark is on a large oak tree at the east end of the Freehold and Jamesburg railroad station.

WEST END. . . . . Eleva., 12.256 ft.

Elevation of underground mark, 7.574 ft.

This monument (No. 3) is erected according to the description already given (page 14, report 1885), but its top is placed even with the surface of ground. It is located on the lot of Life Saving Station No. 5, West End, and is placed at a distance of 10 feet, measured perpendicularly from the middle of the west end of station building. The

line of face of north abutment of the Ocean avenue bridge, over Lake Takanassee, passes 6 feet to south of center of monument, and the magnetic bearing of this line is S. 75° 30′ E.

The monument is 224½ feet back from the line of Ocean avenue.

MORRIS COUNTY.

BOONTON. . . . . Eleva., 412.94 ft.

A cross cut on the east corner of the coping-stone, level with the railroad at the north corner of the Delaware, Lackawanna and Western railroad bridge over the Rockaway river.

BOONTON. . . . . Eleva., 398.76 ft.

A cross cut on the upper granite step at the east end of the north wall of the Morris canal lock, 300 yards northeast of Main street. This is also a canal bench-mark.

DENVILLE. . . . . Eleva., 512.86 ft.

A cross cut on the northeast corner of a stone on the top of the south wall of the Morris canal lock No. 7, right at the end of the gate, when open.

DENVILLE. . . . . Eleva., 508.77 ft.

This bench-mark is on the north abutment of the Morris and Essex railroad bridge over Den brook. The point is on the outside corner of the third step from the top of the east end of the abutment.

DOVER. . . . . Eleva., 575.15 ft.

A cross cut on the southwest corner of the west parapet of the bridge over the Rockaway river at Sussex street.

DOVER. . . . . Eleva., 572.99 ft.

A cross cut on the water-table at the southeast corner of George Richards' brick building at the northwest corner of Blackwell and Sussex streets.

LAKE HOPATCONG. . . . . . . Eleva., 925.67 ft.

A cross cut on the east corner of the north end of the west wall of the race of the Morris canal lock at the outlet of the lake. This is also a canal bench-mark.

LINCOLN PARK. . . . . . . Eleva., 182.60 ft.

A cross cut on the southwest corner of the stone forming the upper step at the east end of the north wall of the Morris canal lock No. 12, east.

MONTVILLE. . . . . Eleva., 239.57 ft.

A cross cut on the summit of a very large rounded boulder imbedded in the tow-path at the edge of the canal, 200 yards east of the lower plane.

MONTVILLE. . . . . Eleva., 387.87 ft.

A cross cut on a projecting stone on the top of the wall at the south side of the square well into which the water falls at the top of the upper plane of the Morris canal.

MORRISTOWN. . . . . Eleva., 403.79 ft.

A cross cut on the east end of the sill, close by the west side, of the most easterly of two wooden pillars at the entrance of the Morris county court-house.

MORRISTOWN. . . . . Eleva., 378.09 ft.

A cross cut on the south end of the sill of the entrance to the First National Bank.

MORRISTOWN. . . . . Eleva., 376.89 ft.

This bench-mark is on the flat surface, directly under the carved stone cannon at the west corner of the base of the soldiers' monument in the city park.

MOUNT TABOR. . . . . Eleva., 502.06 ft.

A cross cut on the northwest corner of the coping of the wall over the north end of a culvert, under the Morris and Essex railroad, for carrying off the overflow of a pond about one mile east of Mount Tabor.

PORT MORRIS. . . . . Eleva., 916.13 ft.

This bench-mark is on the southeast corner of the pier at the southeast corner of an iron bridge over the race at the top of the Morris canal plane.

PORT ORAM. . . . . Eleva., 665.61 ft.

A cross on the northeast corner of the cast-iron bed-plate at the northeast corner of the bridge by which the High Bridge branch of the Central Railroad of New Jersey crosses the Delaware, Lackawanna and Western railroad.

PORT ORAM. . . . . Eleva., 585.25 ft.

A cross cut on the southwest corner of the east abutment of the Delaware, Lackawanna and Western railroad bridge over the Rockaway river, one and one-half miles west of Port Oram.

PORT ORAM. . . . . Eleva., 612.60 ft.

A cross on the outside corner of the upper step at the north end of the western abutment of the Delaware, Lackawanna and Western railroad bridge over the Rockaway river, three-quarters mile southeast of Port Oram.

POWERVILLE. . . . . Eleva., 494.92 ft.

This bench-mark is on the north corner of the coping at the northwest end of the southwest wall of the Morris canal guard lock. This is also the canal bench-mark No. 46.

ROCKAWAY. . . . . Eleva., 523.18 ft.

This bench-mark is on the northeast corner of the flange of the cast-iron foot-plate at the northeast corner of the iron bridge over the Morris canal, at the foot of the plane.

ROCKAWAY. . . . . Eleva., 524.16 ft.

A cross cut on the outside corner, on top and at the west end of the south abutment of the Hibernia Mine railroad bridge.

SHIPPENPORT. . . . . Eleva., 875.84 ft.

A cross cut on the outside corner of the highest of a series of steps at the south end of the west abutment of the Delaware, Lackawanna and Western railroad bridge over the Morris canal.

WHITEHALL. . . . . Eleva., 183.51 ft.

On a point indicated by an arrow on top of the lowest course of masonry at the southwest corner of the east abutment of the road bridge under the Delaware, Lackawanna and Western railroad, at the foot of the Morris canal plane No. 10, east.

OCEAN COUNTY.

BARNEGAT. . . . . Eleva., 35.76 ft.

A cross cut in east end of lowest flagstone step on south side of the basement front door of Baptist church.

BARNEGAT CITY. . . . . Eleva., 13.28 ft.

A cross cut on the center of the rib on the iron sill of the inner door of Barnegat light-house.

BARNEGAT CITY. . . . . Eleva., 13.14 ft.

This bench-mark is on a square shelf cut on the top of the stone water-table under the center of the windows on the north side of Barnegat light-house.

MANTOLOKING. . . . . Eleva., 4.146 ft.

Elevation of underground mark, 0.780 ft.

This monument (No. 5) is located on the lot of Life Saving Station No. 11, Mantoloking, on the beach about half a mile south of the railroad station. It is placed north 67° east, 2 feet from the southwest corner of the lot. The location with reference to property line surveys is as follows: Beginning at a corner on the salt meadows, which is south 14° west, 281 feet from the point of meadows at east side of mouth of a small creek, and north 85° west, 150 feet from head of same creek; running thence north 86° east, 550 feet to the intersection of this line with the produced west line of above-mentioned lot; thence north 22° east, 33½ feet to southwest corner of lot; thence north 67° east, 2 feet to the monument.

[This monument is set 3½ feet deep, and rests on the old meadow which underlies the beach at this place. The turf of the meadow was not disturbed, but an area of cement was spread right upon it. It can scarcely be entirely depended upon, but shrinkage of the new cement and settlement of stone had only amounted to .014 foot one month after setting.]

TOMS RIVER. . . . . Eleva., 30.38 ft.

Elevation of underground mark, 25.40 ft.

This monument (No. 6) is placed in the southwest corner of the Ocean county court-yard, 3 feet back from the iron front fence and 3

feet east of west line of lot. Measured parallel with Washington street, it is 28.75 feet west of the west line of Allen street produced, 72.3 feet west of center line of court-house, and 145 feet west of southern marble true meridian monument which stands in southeast corner of the yard. The monument is also distant 69.6 feet southwesterly from the southwest corner of court-house.

TOMS RIVER. . . . . Eleva., 32.67 ft.

A cross cut on east end of stone door-sill of main entrance of Ocean county court-house, Toms River.

WARETOWN. . . . . Eleva., 12.664 ft.

Elevation of underground mark, 8.429 ft.

This monument (No. 7) is located at the cross-roads at the Hopkins House, where the center line of the road from Waretown station, New Jersey Southern railroad, to the shore of Barnegat bay, intersects the easterly fence line of the main shore road. It is 86.2 feet from southwest corner of hotel, 17.7 feet from northeast stone pier under porch of store, and 20.7 feet from center of willow tree standing just to southwest of it. Measuring along the produced first course of the road running by a small graveyard to the bay, the distances are, to edge of upland, 1,540 feet, to ordinary high-water mark, 2,850 feet. The top of monument was placed just below the surface of the road.

WARETOWN. . . . . Eleva., 20.72 ft.

On center of southwest side of large granite (Falkinsburg) monument, on top of small, flat projection of the top base-stone directly under the polished inscription-face, upon the bottom of which is cut, "Died May 10, 1855." The monument is in the Waretown cemetery, east of main shore road.

WHITINGS. . . . . Eleva., 173.46 ft.

Elevation of underground mark, 170.583 ft.

This monument (No. 16) is located at the cross-roads in Whitings, where the road from New Egypt to Toms River crosses the road running along the west side of the New Jersey Southern railroad from Woodmansie to Manchester. It is set in the center line of the former road, and in line with the trees planted along the west side of the latter road, between the sidewalk and wagon track. It is 41.5

feet southwest of the southwest corner of Mr. Wright's store; 11 feet from the west line of the street running nearly north and south; 88 feet to center of the main track of the New Jersey Southern railroad; 21 feet to center of nearest maple tree of the row on the north; 45.4 feet to center of the next; 21.7 feet to center of nearest maple tree of the row on the south, and 46.9 feet to the next.

The top of this monument is below the surface.

WHITINGS. . . . . Eleva., 172.53 ft.

On granite monument marking northwest corner of roads. It is 7 yards distant from southeast corner of large hotel, now unoccupied.

PASSAIC COUNTY.

CENTERVILLE. . . . . Eleva., 179.50 ft.

This bench-mark is on a small cut in a projecting stone, 4.6 feet above the ground, at the west end of the north abutment of the road bridge over the Morris canal, 1 mile southwest of Centerville. The point is indicated by an arrow-head.

HAWTHORNE. . . . . Eleva., 42.83 ft.

A cross cut on the outside corner of the east end of the coping of the north abutment of the New York, Lake Erie and Western railroad bridge over the Passaic river.

LITTLE FALLS. . . . . Eleva., 194.90 ft.

A cross cut on the northeast corner of the stone sill of the main front door of the Dutch Reformed church.

LITTLE FALLS. . . . . Eleva., 174.67 ft.

A cross cut on the stone coping at the end of the iron railing on the west side of the Passaic river, Morris canal aqueduct.

MOUNTAIN VIEW. . . . . Eleva., 175.74 ft.

A cross cut on the north corner of the west end of the coping of the circular wall at the north end of the west abutment of the aqueduct by which the Morris canal crosses the Pompton river.

PATERSON. . . . . Eleva., 108.51 ft.

A cross cut on the south end of the sill of the Main street entrance of St. Boniface Church, at the southeast corner of Main and Slater streets.

PATERSON. . . . . , Eleva., 100.37 ft.

This bench-mark is a cross cut on the corner-stone at the northeast corner of the Passaic county court-house.

PATERSON. . . . . Eleva., 89.92 ft.

A cross cut on the east end of the sill of the main front door of the Market Street M. E. Church.

PATERSON. . . . . Eleva., 95.94 ft.

A cross cut on the north end of the sill of the main entrance of the First Presbyterian Church.

PATERSON. . . . . Eleva., 175.96 ft.

A cross cut on a projection in the lowest corner-stone at the southeast end of the west abutment of the Delaware, Lackawanna and Western railroad bridge over the Morris canal, between Little Falls and Paterson.

RICHFIELD. . . . . Eleva., 182.56 ft.

A cross cut on the north end of the east abutment of the bridge over the Morris canal. The point is at the end of the timber on which the bridge rests.

SALEM COUNTY.

DARETOWN. . . . . Eleva., 127.80 ft.

This bench-mark is a cross cut on north end of stone door-sill of front entrance of Daretown Presbyterian church.

ELMER. . . . . Eleva., 116.83 ft.

This bench-mark is a cross cut on west end of marble door-sill of front entrance of brick public school-house.

RIDDLETON JUNCTION. . . . . . Eleva., 41.25 ft.

This bench-mark is on the frog (1 foot from its point), at the junction of the railroad from Swedesboro with the railroad from Elmer to Salem.

SALEM. . . . . Eleva., 14.67 ft.

This bench-mark is a cross cut on south end of granite door-sill of front entrance of Episcopal church, on Market street.

SALEM. . . . . . . Eleva., 15.88 ft.

This bench-mark is a cross cut at the foot of fluted column, on south side of entrance to surrogate's and clerk's office.

WOODSTOWN. . . . . Eleva., 47.67 ft.

This bench-mark is a cross cut on south end of marble door-sill of front entrance of brick Baptist church, on Main street.

WOODSTOWN. . . . . Eleva., 46.12 ft.

This bench-mark is a cross cut on north end of lowest stone step of front entrance of Woodstown Hotel.

WOODSTOWN. . . . . Eleva., 58.74 ft.

This bench-mark is a cross cut on southwest end of marble door-sill of brick National Bank of Woodstown.

SOMERSET COUNTY.

BOUND BROOK. U. S. C. S. . . . Eleva., 32.483 ft.

This bench-mark is the bottom surface of a square cavity cut on top of stone abutment (northeast corner) of New Jersey Central railroad bridge, about one-fourth mile east of Bound Brook station.

It is marked thus— B. □ M.

BOUND BROOK. U. S. C. S. . . . Eleva., 35.744 ft.

This is the bottom of a square cavity (1 inch square by one-third inch deep), cut on top stone of west end of north abutment of road bridge over Raritan river, at Bound Brook.

It is marked thus— B. □ M.
XIII.
1881.

EAST MILLSTONE. . . . . . . Eleva., 45.48 ft.

A triangle on the southwest corner of a stone supporting south gate-post at entrance to N. S. Wilson's brick residence, south of Thatchler's drug store, at easterly corner of Market street and Railroad avenue.

GRIGGSTOWN. . . . . Eleva., 44.07 ft.

On summit of stone, indicated by an arrow, standing at east corner of Edgar's mill, on west side of canal, at Griggstown.

GRIGGSTOWN. . . . . Eleva., 50.53 ft.

A triangle on the coping of west lock wall under east edge of bridge, at Delaware and Raritan canal lock, half a mile south of Griggstown.

NORTH BRANCH STATION. U. S. C. S. . Eleva., 84.880 ft.

This bench-mark is the bottom surface of a square cavity cut near the top of the southwest corner of New Jersey Central railroad bridge over the north branch of Raritan river, a short distance east of the North Branch railroad station.

It is marked thus— B. □ M.
XV.

ROCKY HILL. . . . . Eleva., 43.91 ft.

Center of triangle cut on the east end of stone door-sill at entrance of old stone grist-mill beside race, 50 rods west of railroad station.

SOMERVILLE. U. S. C. S. . . . . . Eleva., 81.800 ft.

This is the bottom surface of a circular cavity in the metal on top of the southern "true meridian" granite post, in grounds of the court-house, Somerville.

SOMERVILLE. U. S. C. S. . . . . . Eleva., 91.280 ft.

This bench-mark is, as usual, the bottom surface of a square cavity cut in stone, at the base of the easternmost pillar of the front of the court-house, Somerville.

G.
It is marked thus— B. □ M.
U. S. C. & G. S.
1881.

SOMERVILLE. . . . . Eleva., 46.28 ft.

This bench-mark is indicated by a cross cut inside of a triangle on the east edge of the west abutment under the center of the railroad track on the truss bridge carrying the South Branch railroad over the Raritan river.

WESTON. . . . . Eleva., 42.97 ft.

A triangle cut on the coping of Delaware and Raritan canal lock and six feet north of east edge of lock bridge.

SUSSEX COUNTY.

ANDOVER. . . . . Eleva., 638.05 ft.

This bench-mark is on the large gneiss rock on the bank, on the east side of the Sussex railroad, 145 yards north of the station and 9 yards north of the cattle-pens.

ANDOVER. . . . . Eleva., 584.80 ft.

This bench-mark is on the frog on the east rail of the Sussex railroad and on the north rail of the Lehigh and Hudson River railroad, at their grade crossing, just north of Andover.

BRANCHVILLE. . . . . Eleva., 526.77 ft.

A cross cut on the center of the large stone (one foot from its west edge) in the top course on the west end of the north abutment of the Sussex railroad bridge over Dry brook, 25 yards south of crossing, over the railroad, of the road to Augusta and southeast of the entrance of the road to Swartswood. The bench is not on the single stone which is upon the top of the wall.

BRANCHVILLE. . . . . Eleva., 579.69 ft.

A cross cut on the southeast corner of the first step below the wide surface-stone at the entrance to the cellar on the front of the west corner of Stivers Hall, on the north side of the road forks.

BRANCHVILLE JUNCTION. . . . . . Eleva., 560.73 ft.

This bench-mark is on the east rail of the Sussex railroad (Branchville branch) and the north rail of the New York, Susquehanna and Western railroad, at their crossing.

CARPENTER'S POINT. . . . . . . Eleva., 452.30 ft.

This bench-mark is the top of State line monument, at the road which runs from Port Jervis to Montague.

CARPENTER'S POINT. . . . . . . Eleva., 421.36 ft.

This bench-mark is the top of the State line monument, on the east shore of the Neversink river.

CARPENTER'S POINT. . . . . . . Eleva., 414.99 ft.

This bench-mark is on the Tri-State monument, at the meeting of the boundary lines of New Jersey, New York and Pennsylvania, on the extreme point at the forks of the Delaware and Neversink rivers.

CARPENTER'S POINT. . . . . . . Eleva., 480.93 ft.

This bench-mark is on the State line monument on the east side of the turnpike to Deckertown, at the Two States Hotel.

COLEVILLE. . . . . . . Eleva., 791.95 ft.

A cross cut on the east corner of the most easterly of three large flagstones under the porch of the lower hotel.

COLEVILLE. . . . . . . Eleva., 908.30 ft.

A cross cut on the large boulder at the entrance of the road to Sand pond, about 1 mile northwest of Coleville.

CULVER'S GAP. . . . . Eleva., 915.35 ft.

This bench-mark is on the summit of a conglomerate boulder on the northeast corner of the roads meeting in the gap.

DECKERTOWN. . . . . Eleva., 440.92 ft.

A cross on the south end of the stone door-sill of the brick store building on the northwest corner of the streets on the south corner of the open triangle opposite Decamp's hotel.

DECKERTOWN. . . . . Eleva., 441.67 ft.

A cross cut on the stone water-table on the southeast corner of the brick building (with the north end stone and corners trimmed with the same) now used as a furniture store. It is 45 yards north of the Union House.

FRANKLIN FURNACE. . . . . . Eleva., 535.45 ft.

This bench-mark is the frog at the junction of the Sussex railroad with the New York, Susquehanna and Western railroad.

FRANKLIN FURNACE. . . . . . Eleva., 560.13 ft.

This bench-mark is on the stone water-table at the southwest corner (front corner towards the new furnace) of the company's brick store and office.

HAINESVILLE. . . . . Eleva., 639.29 ft.

A cross cut on the top of an imbedded rock, with rounded summit, on the east side of the road, 40 yards north of the corner of roads at which the church and school-house are situated.

HAINESVILLE. . . . . Eleva., 748.62 ft.

A cross cut on a white rock on the southwest corner of the junction of the roads, about 2 miles south of Montague, and 1⅓ miles north of Hainesville.

HIGH POINT. . . . . Eleva., 1800.21 ft.

This bench-mark is the highest point of the bed-rock on the summit of the mountain.

HIGH POINT. . . . . Eleva., 1804.30 ft.

This bench-mark is a cross cut on the top of a boulder on the summit of the mountain. This is the highest point in New Jersey.

LAFAYETTE. . . . . Eleva., 549.94 ft.

This bench-mark is on the summit of a limestone boulder, indicated by an arrow, at the east corner of the main cross-roads in the village.

LAFAYETTE. . . . . Eleva., 512.60 ft.

A cross cut on the southeast corner of the limestone on top of the south abutment on the east side of the Sussex railroad track where it crosses above the wagon road, just east of the cross-roads, about 1 mile north of the village.

MONTAGUE. . . . . Eleva., 520.82 ft.

A cross cut on the rough stone water-table near the bar-room door of the Brick House hotel.

NEWTON. . . . . Eleva., 601.24 ft.

A cross cut on the stone sill of the most northerly of three doors (baggage-room) in the east side of the Newton station of the Sussex railroad.

NEWTON. . . . . Eleva., 649.63 ft.

A cross cut on the east end of the stone sill of the north door to the clerk's and surrogate's offices.

NEWTON. . . . . Eleva., 648.68 ft.

A cross cut on the east end of the outside of the stone door-sill at the entrance of the Sussex county court-house.

NEWTON. . . . . Eleva., 678.46 ft.

A cross cut on the east end of the stone door-sill at the corner of the jamb of the central entrance of the Presbyterian church.

STANHOPE. . . . . Eleva., 871.13 ft.

A cross cut on the northwest corner of the cap-stone of turret supporting the cable at the southeast corner of the bridge over the Morris canal, at the outlet of the reservoir.

STANHOPE. . . . . Eleva., 864.15 ft.

A cross cut on the outside corner of the coping at the west end of the north wall of the Morris canal lock, at the outlet of the reservoir. This is also a canal bench-mark.

TUTTLE'S CORNER. . . . . Eleva., 756.87 ft.

This bench-mark is on the summit of a large boulder on the northwest corner of the roads meeting about three-quarters mile south of Tuttle's Corner.

WATERLOO. . . . . Eleva., 655.44 ft.

A cross cut on the southwest corner of the north abutment of the Sussex railroad bridge over the Musconetcong river, at the head of Waterloo pond.

WHITEHALL. . . . . Eleva., 777.05 ft.

This bench-mark is on the summit of the most westerly of two spurs of the gneiss rock at the northeast corner of the road from Stanhope to Andover and a road running northeast, at the north end of the Cranberry reservoir.

WHITEHALL. . . . . Eleva., 705.58 ft.

This bench-mark is on a small rounded summit, marked by an arrow, on top of the coping-stone, 2 inches back of the face of the wall, and directly over the center of the keystone of the east side of the stone arch carrying the Sussex railroad over the wagon road, just north of Whitehall and about 1 mile south of Andover.

UNION COUNTY.

ELIZABETH. . . . . Eleva., 36.44 ft.

A cross cut on the south end of the stone sill of the main front door of the First Presbyterian Church.

ELIZABETH. . . . . Eleva., 32.71 ft.

A cross cut on the south end of the stone sill of the main front door of the Union county court-house.

ELIZABETH. . . . . Eleva., 38.45 ft.

This bench-mark is on the pier supporting the North Elizabeth railroad station, situated between the east-bound freight and passenger tracks. The point is a cross at the north corner, on a projecting tier of masonry, about 1½ feet from the ground. It is also a railroad bench-mark, and is marked in red paint thus— B. M. ⊂⊃

LINDEN. . . . . Eleva., 25.80 ft.

This bench-mark is a cross on the southeast corner of the west wall of the Pennsylvania railroad bridge over Morse's creek, a quarter of a mile southwest of the station.

LINDEN. . . . . Eleva., 19.70 ft.

This bench-mark is on the north abutment of the Pennsylvania railroad bridge over the north branch of Morse's creek, about a mile and a half north of Linden. The point is marked by a cross on the southwest corner of the stone on which the northwest corner of the bridge rests.

RAHWAY. . . . . Eleva., 18.81 ft.

A cross cut on the stone foundation at the northwest corner of the Second Presbyterian Church. A niche in the buttress at this corner exposes the foundation for an area about 6 inches square; on this is the cross.

RAHWAY. . . . . Eleva., 20.47 ft.

This bench-mark is a cross cut on the northwest corner of the stone on the south abutment of the Perth Amboy branch railroad bridge

over the south branch of the Rahway river. The point is about 1 foot below the level of the track and 7 feet west of the center of the south-bound track.

WARREN COUNTY.

BELVIDERE. . . . . Eleva., 264.09 ft.

A cross cut on the east end of the door-sill of the stone water-tank at the junction of the Lehigh and Hudson River railroad with the Belvidere division of the Pennsylvania railroad.

BELVIDERE. . . . . Eleva., 285.01 ft.

This bench-mark is on the west end of the stone door-sill of the surrogate's office. It is the most westerly of the three doors in the front of the Warren county court-house.

BELVIDERE. . . . . Eleva., 288.88 ft.

A cross cut on the northeast corner of the stone sill of the middle door of the First Presbyterian Church, which stands on the west side of the city park.

BROADWAY. . . . . Eleva., 434.73 ft.

This bench-mark is on the southwest corner of a square-dressed stone, 2½ feet from the end of the wooden sill lying on it, at the south side of the floodgate of the Morris canal, just south of the road from Broadway to Montana.

BUTTZVILLE. . . . . Eleva., 383.00 ft.

This bench-mark is on the joint of the south rail of the Lehigh and Hudson River railroad, at the north end of the stone wagon bridge, 225 yards east of the station.

BUTTZVILLE. . . . . Eleva., 423.32 ft.

A cross cut on the outer edge of the coping-stone on the south side of the Delaware, Lackawanna and Western railroad track, and directly over the keystone of the center arch of the stone bridge over the Pequest river and the Lehigh and Hudson River railroad, just east of Buttzville.

BUTTZVILLE. . . . . Eleva., 364.44 ft.

A cross cut on the top of the main wall of the west abutment, at the angle of the wall on the north side of the track where the Lehigh and Hudson River railroad crosses over the wagon road, about one mile west of the station.

EASTON, PA. U. S. C. S. . . . . . Eleva., 214.401 ft.

This bench-mark is the bottom surface of a square cavity cut on top of a pier (north side of New Jersey Central railroad track) of bridge across the Lehigh river at Easton. It is on the pier at the west end of wide part of bridge.

U. S.
It is marked thus— B. □ M.
XIX.

EASTON, PA. U. S. C. S. . . . . . Eleva., 357.186 ft.

This is the bottom of a square cavity cut in foundation stone at west corner of the jail at Easton. The front of the jail is built of red sandstone and the foundation of blue limestone.

EASTON, PA. U. S. C. S. . . . . Eleva., 363.488 ft.

This bench-mark is the bottom surface of a square cavity cut on the sill of a blind window on east side of Easton court-house. This side of the court-house has two blind windows, but the one used is the one nearest to the front of the building.

U. S. C. & G. S.
H.
It is marked thus— B. □ M.
1881.

HACKETTSTOWN. . . . . Eleva., 594.81 ft.

This bench-mark is on the sandstone water-table at the northwest side, close to the brickwork, of the Centenary Collegiate Institute.

HACKETTSTOWN. . . . . Eleva., 573.18 ft.

An arrow-head cut on the corner toward the road, of the top of the northwest wing wall of the Delaware, Lackawanna and Western railroad bridge over the turnpike, just south of Warren furnace.

HUTCHINSON'S STATION. . . . . . Eleva., 239.44 ft.

This bench-mark is the bottom of a slot cut in the north end of a

long yellow stone at the north end of the main wall of the stone bridge over the wagon road.

LOPATCONG. . . . . Eleva., 218.95 ft.

A cross cut on the summit of the most westerly stone in the coping of the north wall of the upper Morris canal lock.

MARTIN'S CREEK STATION. . . . . Eleva., 226.85 ft.

A cross cut on a red stone on the south end of the wall on the east side of the railroad track, and the south side of the wagon road, at the crossing near the north end of the station.

NEW VILLAGE. . . . . Eleva., 435.36 ft.

A cross cut on the rounded summit of the coping-stone on the west side of the south wall of the Morris canal lock, west of the village. The summit is 1.5 feet from the end of the wall, and about 3 yards from the tail-gates.

OXFORD FURNACE. . . . . . . Eleva., 479.77 ft.

A cross cut on the east end of the stone sill of the front door of the Oxford Iron and Nail Co.'s brick store, on the north corner of streets, just south of the railroad station.

OXFORD FURNACE. . . . . . . Eleva., 501.84 ft.

A cross cut on the east end of the stone door-sill of the front door of the Second Presbyterian Church.

PHILLIPSBURG. . . . . Eleva., 195.56 ft.

A cross cut on the northwest corner of the stone water-table under the column on the east side of the north entrance of the Pennsylvania railroad station, at the east end of the covered bridge over the Delaware river.

NEAR PHILLIPSBURG. U. S. C. S. . . Eleva., 262.986 ft.

This bench-mark is the bottom surface (center) of a square cavity cut in coping-stone at east end of north parapet of stone bridge (New Jersey Central railroad) over the Morris canal, about $1\frac{1}{2}$ miles east of Phillipsburg.

It is marked thus— B. ▭ M.
1881.

PORT COLDEN. . . . . Eleva., 570.16 ft.

This bench-mark is on the southeast corner of the masonry, at the gates of the flume, at the head of plane No. 6, west, Morris canal.

PORT MURRAY. . . . . Eleva., 630.99 ft.

This bench-mark is on the north corner of masonry of the gates at the head of the flume of the Morris canal plane No. 5, west.

PORT WARREN. . . . . Eleva., 334.39 ft.

A cross cut on the southeast corner of the bottom step of a series forming the end of the foundation wall at the southeast corner of the wheel-house of the Morris canal plane No. 9, west.

ROXBURY STATION. . . . . . . Eleva., 245.47 ft.

This bench-mark is on a cross on the northeast corner of the south abutment of the bridge over the wagon road at the north side of the Pennsylvania railroad station.

SAXTON FALLS. . . . . Eleva., 642.86 ft.

A cross cut on the corner of a stone in which the west tail-gate is anchored, close to the south side of the quoin, Morris canal, lock No. 4.

SAXTON FALLS. . . . . Eleva., 637.69 ft.

A cross on the coping of the west lock wall, just back of the middle of a groove for temporary repair dam, just above the chamber for the head-gate of the Morris canal guard lock.

STEWARTSVILLE. . . . . . . Eleva., 405.83 ft.

A cross cut on the foundation at the east corner of the wheel-house at the Morris canal plane No. 8, west.

STEWARTSVILLE. . . . . . . Eleva., 374.25 ft.

A cross cut on the northwest corner of the square-dressed stone on which the bed-plate of the truss rests, at the north end of the east abutment of the Morris and Essex railroad bridge over the Morris canal, east of the station. This stone is on a level with the bottom of the sills of the wooden bridge, and the corner is 12.7 feet from the sill.

WASHINGTON. . . . . Eleva., 462.01 ft.

This bench-mark is on the corner of a stone under the iron column at the northeast corner of the Beatty building, at the southwest corner of Belvidere and Washington avenues.

WASHINGTON. . . . . Eleva., 485.52 ft.

This bench-mark is on the west end of the brownstone door-sill, close to the corner of the brickwork, of the main (middle) entrance of the Presbyterian church.

WASHINGTON. . . . . Eleva., 467.54 ft.

This bench-mark is on the stone water-table of the Windsor Hotel, a brick building facing on Washington avenue. The point is on the rear corner of a wing, with three windows, extending back from the main building on Belvidere avenue.

WASHINGTON. . . . . Eleva., 508.08 ft.

This bench-mark is on the northwest corner of the north end, on top of the wall supporting the wooden flume at the top of Morris canal plane No. 7, west. The point is also a canal bench-mark, and is marked with red paint.

WASHINGTON. . . . . Eleva., 463.05 ft.

A cross on the southeast corner of the highest of three stone steps at the entrance of the First National Bank, on the northwest corner of Belvidere and Washington avenues.

ELEVATIONS OF PROMINENT POINTS IN NEW JERSEY, REFERRED TO MEAN SEA LEVEL.

The following list of elevations includes the latest and best determinations. In case of difference between these elevations and those shown on the map, these are to be preferred, as they have been adjusted to the Sandy Hook datum. These elevations are not so carefully determined as those in the list of bench-marks preceding, and those should always be used when great accuracy is required, but the following are sufficiently accurate for all ordinary purposes. At the railroad stations it has been customary to note the elevation at the

rail joint nearest the center of the station. At railroad crossings, a joint was usually taken also.

This list of elevations will be found convenient for reference, and will be especially useful to those who may not have access to the topographical atlas. It gives the highest point in each county and some well-known point in each town and village.

Atlantic County.

Atsion. Rail at crossing just west of station	47.4
Bakersville. Nail in door-sill of Central M. E. Church	27.0
Bargaintown. Stone at northeast corner of west abutment of bridge over pond,	8.8
Buena Vista. East rail at station	104.7
Cedar Lake. West rail at crossing by station	84.0
Da Costa. North rail at crossing by station, C. & A. R. R.	84.3
Doughty's station. North rail, C. & A. R. R.	29.9
Downstown. Bench-mark on button-ball tree, just east of store	115.3
English Creek. Bench-mark on willow, in front of store	9.6
English Creek station. South rail	60.4
Estelville. Bench-mark on oak, northwest corner, by M. E. church	23.6
Frankfort Avenue station. North rail at crossing, C. & A. R. R.	60.1
Germania station. North rail at crossing, C. & A. R. R.	59.4
Highest point in county, near Hammonton Coast Survey station, one mile northwest of Hammonton	152.
Landisville. North rail at station	113.1
Landisville. Rail at crossing of N. J. S. R. R. and W. J. R. R.	120.5
Leeds' Point. Bench-mark on wild cherry at southeast corner, just west of hotel,	54.0
Mays Landing pond.	13.
Murphy's station. North rail at crossing, C. & A. R. R.	114.5
Parkdale station. North rail at crossing	59.8
Pleasantville. Rail of P. & A. C. R. R. at shore road crossing	25.2
Pomona station. North rail at crossing, C. & A. R. R.	66.2
Port Republic. Projecting stone at southwest wing wall of draw-bridge	7.1
Richland. Rail at crossing northwest of station	99.4
Richland Coast Survey station	109.
Smith's Landing. Bench-mark on large ailanthus tree in front of house, just south of corner	34.1
Weekstown. East end of wooden door-sill of school-house	20.5
Weymouth. Bench-mark on button-ball tree at road forks, southwest of paper mill	44.4
Weymouth pond	37.

Bergen County.

Alpine. Bench-mark on oak, northeast corner of cross-roads on top of Palisades mountain	441.2
Arcola. Cross on stone door-step of store	49.7
Bergen Fields. Rail at crossing north of station	69.5
Camp Gaw. North rail at station	380.8

Bergen County—Continued.

Cherry Hill. Rail at crossing by station	8.3
Corona. Rail at station	6.8
Cresskill. Rail at station	40.9
Etna. Rail at station	46.0
Fort Lee. Lowest step, main entrance of Madonna R. C. Church.	314.2
Franklin lake	414.
Hackensack river at State line	45.
Highest point in county, Ramapo mountain, near State line	1106.
Highest point of the Palisades	545.
Hillsdale. Frog at station	57.3
Kingsland. Rail at crossing near station	28.2
Leonia. West rail at crossing near station	5.8
Lodi. Rail at Main street crossing	24.8
Maywood. North rail at crossing	68.8
Midland Park. Rail at station	202.9
Montvale. Bench-mark on oak, opposite the Grove House	180.5
Neuvy. Rail at station	38.1
New Milford. Rail at crossing by station	16.8
Norwood. Rail at station	36.0
Oakland. South rail at station	274.3
Oradell. Rail at station	21.0
Park Ridge. West rail at station	150.4
Paskack. West rail at crossing south of station	106.3
Ramapo river. At Oakland	207.
Ramapo river. At Suffern	272.
River Edge. Rail at crossing by station.	16.2
River Vale. South edge of mill-stone in south door of school-house	70.1
Rochelle Park. South rail at crossing by station	46.1
Rotten pond, in Ramapo mountain	534.
Rutherford. Top of monument near flag-staff, in grass plat behind station	47.3
Saddle River. West corner of sill, main door of stone church	269.1
Schraalenburg. Rail at crossing north of station	16.8
State line monuments.	
1st	200.3
2d	29.4
3d	109.0
4th	108.4
5th	78.8
6th	160.
7th	272.2
8th	227.6
9th	393.6
10th	372.9
11th	302.4
12th	417.9
13th	573.3
14th	517.3

Bergen County—Continued.

15th	287.4
16th	608.5
17th	765.6
Westwood. Southwest corner of large stone slab at entrance of Van Emburg & Bogert's store	76.4
Woodridge. Rail at crossing by station	10.7
Wortendyke. Sill of left entrance to silk mill	258.5
Wyckoff. Northeast corner of door-sill of Reformed church	356.2

Burlington County.

Apple-Pie hill	209.
Arney's Mount. Highest point in county	230.
Batsto. Bench-mark on large buttonwood, opposite mill	11.1
Bear Swamp hill	165.
Beverly. South rail at crossing west of station	30.1
Brown's Mills station. North rail at crossing	71.3
Buddtown. Ring-bolt, center of east arch of iron bridge over Stop-the-Jade run	48.0
Bustleton. Bench-mark on oak at corner by church	83.5
Columbus. A cross cut on curb opposite hotel	83.2
Cookstown. Bench-mark on maple diagonally opposite hotel	83.6
Crosswicks. Step at entrance to basement of Episcopal church	80.12
Crowleytown. On red sandstone under northwest corner of school-house	13.3
East Moorestown station. North rail at crossing	70.1
Edgewater Park. North rail at crossing east of station	30.1
Evesboro. Bench-mark on maple at northwest corner of cross-roads	94.3
Four-Mile hill	141.
Georgetown. Bench-mark on maple at cross-roads	91.9
Green Bank. Bench-mark on rock at forks of roads just south of blacksmith shop	25.6
Hainesport. Bench-mark on maple north of railroad and west of road, near station	30.9
Hanover station. North rail at crossing	92.9
Harris station. South rail at crossing, 300 yards east of	98.3
Harrisville. Top of pipe used as guard, east corner of paper mill	18.6
Hartford. Bench-mark on cherry tree, in front of station	44.9
Huckleberry hill	141.
Indian Mills. Bench-mark on oak at cross-roads in front of church	75.6
Jacksonville. On stone at northeast corner of road to Jobstown	70.6
Jacobstown. Northeast corner of stepping-stone in front of D. L. Platt's store	179.2
Jacobstown. Hill 1 mile northeast of	198.
Jemima Mount	99.
Jobstown. Rail at crossing of Mount Holly turnpike	74.2
Kinkora. North rail in front of station	10.2
Lewistown. Rail of P. & H. R. R., just west of cross-roads	85.5
Lewistown. Hill on road to Brown's Mills, 2 miles southeast of	175.
Lumberton. On mile-post (2 miles to Mount Holly)	23.3

Burlington County—Continued.

Lower Bank. Bench-mark on oak at north end of bridge over river........ 5.1
Masonville. Bench-mark on maple, in front of post-office........ 44.1
Maple Shade station. North rail at crossing........ 40.5
Marlton. Rail at crossing, 300 yards west of station........ 87.9
Medford. Water-table, northwest corner of bank........ 65.7
Mount Holly Coast Survey station. Top of the mount........ 183.
Mount Laurel. Bench-mark on maple, northeast corner of cross-roads........ 89.1
Mount Laurel........ 173.
New Gretna. Bench-mark on oak at east end of hotel........ 9.8
New Lisbon. Door-sill of school-house........ 50.6
Palmyra. South rail at crossing by station........ 20.5
Pointville. Bench-mark on maple at northeast corner of road, opposite hotel, 143.5
Rancocas. On marble stepping-stone in front of store at southwest corner of Main street and road to Centerton........ 63.1
Recklesstown. Bench-mark on buttonwood at meeting of four roads........ 91.8
Retreat. Hill 2 miles southeast of........ 131.
Riverside. South rail at crossing by station........ 17.1
Riverton. South rail at crossing by station........ 20.5
Shamong. North rail at crossing by station........ 91.1
Smithville. Bench-mark on oak east side of road, 40 yards south of station... 50.8
Stevens' station. South rail at crossing........ 24.2
Sykesville. Large stepping-stone in front of Newbold's house........ 191.9
Tabernacle. Cross-roads........ 101.
Taylor's Mount........ 140.
Vincentown. Lowest step of bank........ 29.4
Wading River. Most westerly bolt in northwest wing wall of bridge........ 7.3
Washington. Bench-mark on oak at corner of roads to Quaker Bridge and Hampton Gate........ 55.9
Wood Lane station. West rail at crossing........ 56.7
Woodmansie. North rail at crossing by station........ 159.9
Wrightstown. Cross on stepping-stone opposite hotel........ 135.9

Camden County.

Ancora. Bench-mark on large tree south side of railroad at crossing........ 95.3
Ashland. North rail at crossing by station........ 72.1
Atco. Bolt in top of hitching-post at south corner of Woodland's store........ 155.5
Atco. Hill northeast of station........ 178.
Berlin. West rail at Haddonfield road........ 155.4
Berlin. Coast survey station........ 211.
Blackwoodtown. Bench-mark on willow at cross-roads........ 74.8
Blue Anchor. Bench-mark on large oak in south forks of roads........ 152.1
Chew's Landing. Bench-mark on cedar near church........ 27.2
Clementon. North rail at crossing south of station........ 61.3
Collingswood. South rail of north track at crossing........ 25.2
Cuthbert's. South rail of north track at crossing........ 35.4
Dudley. North rail at crossing by station........ 54.0

Camden County—Continued.

Ellisburgh. On curbstone at northwest corner of cross-roads	58.7
Elm. Rail at crossing by station	98.2
Gibbsborough. Corner of stone wall at southwest corner	99.9
Glenwood. North rail at crossing	49.7
Great Egg Harbor river, at New Brooklyn	104.
Haddonfield. North rail at crossing, one-third mile northwest of station	30.3
Haddonfield. Hill 1 mile south of	140.
Highest point in county, 2½ miles northeast of Berlin	214.
Mount Ephraim. Cross on guard-stone, southwest corner of cross-roads	62.7
Parkdale. Rail at station	59.8
Pensauken station. South rail at crossing	70.0
Pine hill, near Clementon	202.
Sicklerville. Bench-mark on tree, southeast corner of cross-roads	137.7
Spring Mills. Nail in root of tree by post-office	77.4
Summit of C. & A. R. R.	174.
Trout Run station. North rail at	130.0
Waterford. South rail at crossing, one-quarter mile south of station	116.2
Wilton. South rail at station	164.4

Cape May County.

Beesley's Point. Bench-mark on Mulberry tree, north end of shore road	9.1
Bennett's station. West rail at	18.9
Burleigh. South rail of Anglesea R. R., at shore road crossing	16.7
Cold Spring. North end of north door-sill of Presbyterian church	20.7
Goshen. Bench-mark on tree in front of store at corner	14.6
Highest point in county, 2 miles east of Woodbine	50.
Mount Pleasant. North rail at crossing	33.9
North Dennisville. On stone in front of J. Holmes' house	15.9
Ocean View. South rail at crossing	18.8
Palermo. Bench-mark on oak opposite church	32.0
Rio Grande. Bench-mark on walnut in southwest corner	21.3
Sea Isle Junction. Rail at station	16.0
South Seaville. Rail at station	23.0
Surface of swamp at divide between Dennis and Cedar Swamp creeks	12.
Swaintown. East rail at crossing	18.8
Townsend's Inlet. Top of stone fence-post, northeast corner of M. E. church-yard	25.7
Tuckahoe. On large stone in northwest corner of road to Marshallville	17.5
Woodbine. Rail in front of station	43.5

Cumberland County.

Bacon's Neck station. North rail at crossing	16.5
Belle Plain. South rail at crossing	47.6
Bridgeton. Pond on Cohansey above	19.
Carlsburg. East rail at station	103.3
Cedar Grove pond	50.

Cumberland County—Continued.

Cedarville. West rail at crossing	53.4
Cumberland pond	30.
Deerfield Street. Bench-mark on maple at west side of road-forks	111.6
Dividing Creek. Bench-mark on maple in front of Dr. Judson's	13.0
Fairton. Rail at station	31.2
Finley station. East rail at crossing	109.7
Gouldtown. Bench-mark on maple in front of house just east of cross-roads	82.4
Greenwich. Bench-mark on large elm at east end of station	15.4
Highest point in county, 2 miles northeast of Deerfield	146.
Hopewell station. South rail at crossing	52.8
Husted station. West rail at	98.7
Jericho. Bench-mark on buttonwood, southeast corner near pond	31.0
Main Avenue station. Rail at crossing	99.6
Manumuskin station. West rail at crossing	17.4
Millville pond	26.
Newport. Bench-mark on mulberry tree, north side of road at hotel	8.0
North Vineland. Rail at crossing by station	97.0
Port Elizabeth. Highest guard-stone, southwest corner, opposite school-house,	12.8
Port Norris. Rail at station	8.2
Roadstown. Cross on stone, southwest corner of cross-roads	115.5
Rosenhayn station. Rail at crossing	106.7
Sheppard's station. North rail at crossing	13.4
Shiloh. Bench-mark on maple by T. F. Davis' store	116.1
South Vineland. East rail at crossing	93.5
Summit of Bridgeton and Millville turnpike	124.
Wheat Road station. South rail at crossing	99.6
Willow Grove. Bench-mark on tree, east corner of forks of roads	72.7
Woodruff. North rail at station	92.6

Essex County.

Bloomfield. Morris canal, above lock	119.8
Bloomfield. Morris canal, above plane No. 11	173.7
Caldwell. Sill of east door of Presbyterian church	411.0
Cedar Grove. Cross on stone, northeast corner, 100 yards north of store	270.0
Clinton. Stone step at south door of school-house	172.0
Franklin. Boulder by picket fence at northwest corner	234.8
Highest point in county, Second mountain, back of Caldwell penitentiary	691.
Livingston. Cement at base of flag-staff	315.3
Long Hill	473.
Millburn. Rail at crossing just east of station	151.4
Montclair. Rail at station, D., L. & W. R. R	240.9
Newark. Morris canal, at upper end of plane	100.4
Newark. Morris canal above lock, at Lock street	109.5
Northfield. On corner of step at west side of church door	265.3
Nutley. West rail in front of station	98.5
Orange. Rail at D., L. & W. station	187.4

Essex County—Continued.

Orange reservoir	329.
Pine Brook. Cross on stone under southwest end of porch of Frank Class' hotel	173.6
Pleasantdale. Large boulder at north corner of cross-roads	423.5
Roseland. Guard-stone, corner of grave-yard back of church	369.3
Short Hills. Rail at station	207.6
South Orange. Rail at station	141.8
Upper Montclair. West rail at crossing south of station	341.7
Verona. East corner of top step leading to cellar of store	356.2
Verona. Summit of First mountain, east of	665.

Gloucester County.

Almonesson. Bench-mark on maple tree, 30 yards northwest of cross-roads	48.2
Asbury station. East rail at crossing	55.2
Barnsboro. Bench-mark on maple near hotel pump	151.4
Barnsboro hill	152.
Bridgeport. Cross on guard-stone at southwest corner of Main street and road to Swedesboro	22.8
Clarksboro. North rail at crossing by station	54.0
Clayton. Rail at crossing just south of station	126.1
Cross Keys. Bench-mark on willow at	150.4
Evans' Mills. Bench-mark on maple opposite blacksmith shop, southwest corner of cross-roads	110.2
Fairview hill	142.
Five Points. Bench-mark on chestnut, 25 yards west of Rulon's hall	153.0
Forest Grove. North rail at crossing just north of	106.2
Franklinville. Rail at crossing	107.1
Green Tree. Hill at	155.
Glassboro. Rail of Bridgeton branch, at crossing south of station	146.3
Glassboro. Chestnut ridge	171.
Hardingville. Bench-mark on maple in front of Siloam M. E. Church	146.1
Harrisonville. Cross on guard-stone, northeast corner opposite Wriggins' store,	85.3
Highest point in county, 1 mile southeast of Cross Keys	177.
Hurffville. On horse-block in front of Mr. Hurff's house	78.4
Iona. Bench-mark on maple, northwest corner of roads, just east of station	112.7
Jefferson. Large stone at corner	147.5
Jefferson. Hill just east of	166.
Lippincott hill. South of Battentown	143.
Malaga. Rail at crossing near station	106.1
Mantua. On stone across ditch opposite toll-gate	31.2
Mickleton station. North rail at crossing	55.2
Mount Royal station. North rail at crossing	34.1
Mullica Hill. Cross on flagstone step of town hall, close to iron post	96.9
Mullica Hill road station. West rail of crossing	43.1
Newfield. Rail at crossing just north of station	115.7
Ogden station. West rail at crossing	13.8

Gloucester County—Continued.

Parkdale station. East rail at crossing	37.2
Paulsboro. Rail at crossing east of station	9.9
Pitman Grove. Rail at crossing by station	135.3
Porchtown. Bench-mark on hickory at corner just east of pond	88.2
Repaupo. Bench-mark on maple, northeast corner of cross-roads	20.6
Salina. Cross on northeast end of long stone in front of gate of house on northeast corner of cross-roads	66.3
Sewell station. Rail at crossing	19.8
Tatem's station. East rail at crossing	56.8
Thorofare. South rail at crossing by station	19.8
Tomlin station. East rail at crossing	42.9
Turnersville. Bench-mark on tree at cross-roads by toll-gate	59.3
Unionville. Rail at station	145.1
Wenonah. Rail of west track at main crossing	59.3
Westville station. East rail of north-bound track at crossing	9.1
Williamstown. West rail at crossing north of station	157.1
Williamstown. Highest point in	164.
Wolfert station. North rail at crossing	49.5

Hudson County.

Arlington. Rail at station	62.0
Bergen Point. Corner of Avenue S and Third street	37.
Guttenberg. Summit of hill. Highest point in county	263.
Homestead station. Rail of N. J. N. R. R., at crossing	4.9
Secaucus. Stone, southwest corner of roads to Clarendon and Snake Hill	41.4
Snake hill	203.
Stevens' Castle hill	100.
Tyler Park. Rail of N. J. N. R. R., at crossing south of station	5.8
Union. Curb at southeast corner of Bergen Line avenue and Fulton street	174.5
Weehawken. Hill just west of West Shore terminus	183.

Hunterdon County.

Anthony. Top of sharp rock on southeast, opposite Beatty's store	815.5
Baptistown. Brownstone stepping-stone in front of house just south of hotel	513.73
Califon. Rail at station	484.0
Centerville. Top of guard-stone, northeast corner of cross-roads	103.8
Cherryville. Bench-mark on maple at cross-roads	670.8
Clinton. Water-table, southeast corner of "Clinton National Bank"	196.1
Clover Hill. Cross on stone at southwest corner of cross-roads	186.0
Cokesbury. Highest point of stone bridge at	604.0
Copper Hill. East rail in front of station	161.9
Croton. Cross on stone 6 yards from guide-post	508.3
Everittstown. Summit of stone wall at north end of bridge, opposite wheelwright shop	262.1
Fair Mount. Highest point of stone step at north corner of store	672.5

Hunterdon County—Continued.

Frenchtown. Projecting window-sill of bank, 3.6 feet above pavement	131.5
Frenchtown. Delaware river at	101.
Goat hill	497.
Glen Gardner. Guard-stone, north corner of cross-roads	412.8
Gravel hill	865.
Hamden. North abutment at southeast corner of bridge over South Branch	164.9
Hamden. South Branch below dam	156.
High Bridge. Rail at station	329.4
Highest point in county, summit of county line between the Musconetcong and South Branch of the Raritan	1073.
Holland station. Delaware river just below	113.
Junction. Frog at junction of D., L. & W. R. R. and N. J. C. R. R	508.4
Kingwood. Northeast corner of stepping-stone in front of Presbyterian church	523.5
Lebanon. Rail at station	293.1
Little York. Crow's-foot on stone in forks of roads	355.7
Locktown. Corner, 100 yards north of store	477.
Milford. Rail at crossing near station	135.6
Milford. Delaware river at	108.
Mountainville. *On stone at southwest* corner of bridge	410.0
Mountainville. Hill just east of	957.
Musconetcong. Delaware river at mouth of Musconetcong river	129.
New Germantown. Pointed stone at stoop of store at northeast corner of cross-roads	260.6
New Hampton. Sill of door in end of mill	357.4
Oak Dale. Bench-mark on large oak at entrance to lane, north of railroad, just west of Bowne station	165.1
Oak Grove. On stone at center of cross-roads	525.8
Pattenburg. *Rail in front* of station	457.1
Pattenburg. Hill over Musconetcong tunnel, L. V. R. R	943.
Pickles mountain	839.
Pittstown. Bench-mark on rock, east side of *road alongside* of mill race	374.8
Pleasant Run. Arrow pointing to summit of guard-stone on northeast corner,	149.2
Point Pleasant. Delaware river at	69.
Readington. Northeast corner of southwest wall of bridge over Holland's branch	103.3
Reaville. Cross on stone marked 1876, *in front* of hotel	186.6
Rosemont. Stone in front of north door of M. E. church	321.6
Round mountain	508.
Sand Brook. Cross on southeast abutment of bridge on Flemington *road*	309.5
Sergeantsville. Cross on horse-block, *southwest* corner of cross-roads	344.7
Stanton. Lowest step of post-office	364.7
Stockton. Top of stepping-stone in front of hotel	83.3
Stockton. Delaware river at	52.
Three Bridges. North rail of S. Br. R. R., at crossing	107.2
Three Bridges. North Branch at	87.
Tumble. Delaware river, 1½ miles above	91.

Hunterdon County—Continued.

Valley. Whitewashed guard-stone, southeast corner of barn opposite hotel	425.5
Van Syckle's. Guard-stone at northwest corner of cross-roads	298.2
White Hall. Large rock at west end of store stoop	967.1
White House Station. West rail of south-bound track at station	176.3

Mercer County.

Asylum station. East rail at crossing	58.9
Divide between Stony brook and Assanpink creek	60.
Dutch Neck. Road at corner by church	99.
Ewingville. Arrow on stone opposite school-house	183.3
Hamilton Square. Water-table of brick store on corner	190.6
Harbourtown. Top of corner-stone, northwest corner of cross-roads	290.5
Highest point in county, summit of hill east of Moore's station	473.
Hightstown. Cross on stone, southwest corner in front of Railroad Hotel	84.9
Hopewell. Cross on flagstone opposite school-house	183.3
Lawrence Station. West rail at	62.4
Lawrenceville. Arrow on stone at northeast corner, northeast of church	123.2
Lawrenceville. Hill northwest of	192.
Marshall's corner. Hill south	460.
Moore's station. Stone at gate-post, by willow, at entrance to lane near station	56.6
Moore's station. Delaware river at	29.
Mount Canoe	442.
Mount Rose. Bolt in top of post near southwest corner of cross-roads	310.3
Mount Rose Coast Survey station	415.
Pennington. Main cross-roads	210.
Port Mercer. Stony brook at	53.
Princeton. Summit of ground at	227.
Princeton Junction. Rail at crossing southwest of station	87.5
Robbinsville. Rail at crossing	121.8
Scudder Falls station. West rail at railroad crossing	58.9
Titusville. South rail at railroad crossing near station	60.2
Trenton. Delaware and Raritan canal, below lock No. 2	8.7
Trenton. Delaware and Raritan canal, above lock No. 2	18.4
Trenton. Delaware and Raritan canal, above lock No. 3	30.7
Trenton. Delaware and Raritan canal, above lock No. 4	42.4
Trenton. Delaware and Raritan canal, above lock by prison	50.9
Trenton. Delaware and Raritan canal, above State street lock	56.3
Washington's Crossing. East rail at railroad crossing	59.3
Washington's Crossing. Delaware river at	24.
Wilburtha. West rail at railroad crossing	59.0
Wilburtha. Delaware river at	15.
Windsor. Bench-mark on maple at cross-roads	104.2
Yardville. Cross on northwest corner of foundation of store at cross-roads	59.8

Middlesex County.

Browntown. Hill 1½ miles east of	208.
Cranbury. Granite block under most northerly wooden pillar of the white church	102.4
Cranbury station. East rail at railroad crossing just south of	122.1
Dayton station. North rail at railroad crossing	104.5
Dean's station. East rail of east track at railroad crossing	103.2
Dunellen. Rail at station	54.9
Franklin Park. Large flat stone in front of church	132.5
Helmetta. North rail at crossing by station	42.9
Highest point in county, summit of the Sand hills, northwest of Monmouth Junction	293.
Hoffman station. North rail at railroad crossing	81.3
Iselin. East rail of main track at railroad crossing	56.3
Menlo Park. West rail of main track at railroad crossing northeast of station,	78.4
Milltown. On water-table at southwest corner of M. E. church	49.3
Morgan station. East rail of south-bound track at railroad crossing	9.8
New Brooklyn. Rail at railroad crossing near station	80.7
New Market. Stone at corner opposite hotel	64.6
Old Bridge. West rail at railroad crossing near station	15.5
Plainsboro. Road monument, center of cross-roads	91.20
Poplar hill, east of Metuchen	233.
Prospect Plains. Stepping-stone in front of Railroad Hotel	126.1
Sayreville. South end of flagstone sill, entrance of Sayreville Hall	29.5
South River. Cross on flat corner-stone, southeast corner, near Voorhees' hotel,	10.37
Spotswood. Rail at crossing near station	28.7
Stelton. Mile-stone on west side of New Brunswick road, just southwest of cross-roads	113.2
Tracey's station. North rail at railroad crossing	84.8

Monmouth County.

Allaire station. Joint of south rail at railroad crossing	52.6
Allentown. Bench-mark on tree in front of Union Hotel	82.2
Allenwood. South rail at main railroad crossing	64.8
Beacon Hill	373.
Black's Mills. Pond	113.
Chapel Hill	211.
Clarksburg. Arrow on stone at corner of road to Hightstown	231.5
Cliffwood station. West rail of north-bound track at crossing	61.0
Colt's Neck. Bench-mark on locust at corner by tavern	73.6
Cream Ridge. East rail at crossing by station	115.7
Davis. East rail at crossing by station	120.7
Eatontown. Rail at crossing of turnpike	31.8
Ellisdale. On stone at southeast corner opposite store	93.4
Fair Haven. Bench-mark on maple, northeast corner of cross-roads	27.0
Hamilton. On stone at southwest corner of Old church	102.0
Hazlet. South rail of east-bound track at railroad crossing	70.7

Monmouth County—Continued.

Highest point in county, Crawford's hill	391.0
Highlands of Navesink. Highest point	260.
Holmdel. Cross on southwest corner of stone step at west entrance to church	101.0
Hornerstown. East rail at railroad crossing north of station	84.5
Howell. South rail at railroad crossing	124.7
Imlaystown. On flagstone of bridge guard	105.7
Lower Squankum. Bench-mark on locust at corner near post-office	42.8
Manalapan. Bench-mark on willow at south corner of cross-roads	150.2
Marlboro. Bench-mark on tree at northeast corner of cross-roads just west of	169.9
Middletown. Bench-mark on tree at corner	41.9
Morganville. Rail at station	120.0
Navesink. Cross on curb at corner by W. Swan's store	60.7
New Bedford. Bench-mark on poplar in cross-roads by hotel	52.9
New Monmouth. Bench-mark on large stepping-stone in church-yard	40.4
Oceanic. Most easterly cross-roads	13.
Perrineville. Stone at southwest corner, foot of locust tree	183.2
Pine hill	364.
Red Valley. Long imbedded stone at corner	147.0
Robertsville. Bench-mark on willow, southwest corner of cross-roads	131.5
Scobeyville. Arrow on stone, northwest corner of roads	74.9
Shrewsbury. Rail at railroad station	48.3
Southard. Forks of road at store	120.0
Tennent. North rail at railroad crossing	89.3
Throckmorton hill. Two and one-half miles south of Colt's Neck	308.
Tinton Falls. Cross on stone step of residence on southwest corner of cross-roads	44.7
Turkey. On corner-stone supporting stringer of bridge at northwest corner, foot of mill-pond	86.8
Vanderburg. Bench-mark on large maple at corner	86.6

Morris County.

Afton. Door-sill of brick school-house	195.5
Bald hill	964.
Bartley. West rail at crossing by railroad station	635.3
Boonton. Morris canal, above lock east of	398.9
Boonton. Morris canal, above plane	480.7
Boonton. Morris canal, above upper lock	489.6
Boonton. Morris canal, above lock No. 8, east	504.5
Brookside. Top of stone, east end of north parapet of bridge over Dismal brook	405.5
Brook Valley. Brook in front of store	633.
Budd's lake	933.
Chatham. Rail at railroad station	233.9
Chester. Stone water-table of hotel	860.3
Convent station. Rail at railroad crossing	381.3
Denmark pond	818.

Morris County—Continued.

Denville. Morris canal, above lock No. 7, east 511.8
Dixon's pond .... 560.
Dover. Morris canal, above lock No. 6, east 581.2
Drakesville. Rail at station 797.3
Drakesville. Morris canal, above the planes 863.5
Drakesville. Morris canal, above plane No. 4, east 725.4
Durham pond .... 880.
Flanders. Stone step at small white house opposite Nichols' store 727.9
German Valley. South end of stone at east side of sink, opposite mill 545.0
Green pond .... 1045.
Green Village. Bench-mark on tree, southeast corner 253.2
Hanover: Corner near church .... 213.
Hanover Neck. Cross on stone at east corner 196.6
Hibernia. Guard-stone, northwest corner of Richards, Beach & Co.'s store 551.2
Highest point in county, summit of Bowling Green mountain .... 1391.
Hook mountain .... 456.
Ironia. West rail of Chester Branch railroad, just north of station 705.2
Lake Hopatcong. Surface of water when full 927.7
Lake Hopatcong. Morris canal, below outlet lock 913.0
Lincoln Park. Morris canal, below lock 174.9
Lincoln Park. Morris canal, above lock 181.7
Lincoln Park. Morris canal, above plane No. 10, east 237.9
Littleton. Stepping-stone in front of white house on southwest corner of roads, 366.3
Long Hill. Guard-stone at northeast corner 245.1
McCainsville. Rail of High Bridge branch at crossing by railroad station 725.1
Madison. Rail at railroad station 247.8
Mendham. Bench-mark on elm in front of First Presbyterian Church 649.1
Middle Valley. Rock under east gate-post at north corner 510.2
Millington. Arrow on coping-stone, southeast wing wall of bridge over river, 224.8
Middle Forge pond .... 708.
Milton. Southeast corner of stone under southeast corner of platform of store opposite hotel 822.9
Mine Hill. Guard-stone by steps of J. Bones' hotel 863.8
Montville. Morris canal, above planes 388.0
Mooseback pond .... 810.
Morris Plains. Rail at railroad station 405.7
Mount Fern .... 1003.
Mount Freedom. Wooden door-sill of Presbyterian church 944.4
Mount Hope. Conglomerate boulder in front of store (at end of railing) 828.9
Mount Olive. U. S. Coast Survey station .... 1150.
Mount Paul .... 806.
Mount Tabor. Rail at railroad station 532.6
Naughright. Highest point of coping of south parapet of bridge over river 569.0
New Vernon. Stone door-step of school-house 345.9
Parker. Bench-mark on second cherry tree south of southeast corner of cross-roads at school-house 902.0
Parsippany. Water-table, northeast corner of brick church 331.4

Morris County—Continued.

Passaic river, at Horse Neck bridge	162.
Passaic river, at Pine Brook bridge	162.6
Passaic river, at Swinefield bridge	164.
Passaic river, at Lower Chatham bridge	167.
Passaic river, north of New Providence	203.
Passaic river, at Millington bridge	214.
Petersburgh. South corner of stone door-step of mill	770.1
Petersburgh pond	772.0
Pequannock. Rail at railroad crossing	180.6
Pleasant Grove. Rock in middle of road in front of store	940.9
Pompton Plains. Rail at railroad crossing	193.2
Pompton river, at Pompton Plains	169.
Pompton station. Rail of N. Y. & G. L. R. R. at crossing near station	223.6
Port Oram. Morris canal at	665.2
Rockaway. Morris canal, above plane	563.1
Schooley's Mountain. Highest step of entrance to residence opposite Belmont Hall	1015.7
Shongum pond	698.
Stanhope. Morris canal, below plane	786.9
Stanhope. Morris canal, below lock 1 mile west of	776.1
Splitrock pond	815.
Stickle pond	783.
Stirling. Rail at crossing	227.5
Suckasunny. Platform under northwest column of portico of Presbyterian church	717.7
Summit of Copperas mountain	1243.
Summit of Green pond mountain	1300.
Troy Hills. Cross on large stone under elm tree	241.8
Whippany. Arrow on flat stone at north corner near hotel	205.4

Ocean County.

Bamber. Rail in front of railroad station	97.6
Bayville. Bench-mark on large oak in front of M. E. church	40.2
Bennett's Mills. Bench-mark on apple tree at cross-roads, one-eighth mile north of	93.5
Burrsville. Bench-mark on willow by store	29.3
Cassville. Bench-mark on buttonwood by store	124.3
Cedar Creek. Bench-mark on large oak, east side of main shore road, opposite mile-post	12.8
Collier's Mill. Stone at northeast corner of cross-roads	143.5
Forked River. Round stone in sidewalk just south of Presbyterian church	16.9
Forked River mountains	182.
Highest point in county, 2 miles west of Cassville	226.
Jackson's Mills. Pond at	90.
Lakewood. East rail at crossing just north of railroad station	53.7
Manahawken. Bench-mark on oak near E. Pridmore's store	27.1

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Ocean County—Continued.

Manchester. East rail at crossing just north of railroad station	65.1
Mayetta. East rail at railroad crossing	19.4
New Egypt. Rail at railroad station	73.6
Osborneville. Bench-mark on oak by Benj. Fisher's store	13.9
Prospertown. Big stone at northwest corner of cross-roads	105.8
Silverton. Bench-mark on oak at southwest corner of cross-roads	15.3
Staffordsville. East rail at railroad station	29.1
Van Hiseville. Bench-mark on locust at cross-roads	103.7
West Creek. East rail at crossing north of railroad station	23.6
West Point Pleasant. Bench-mark on hickory, at place where five roads meet,	16.2
Wheatland. South rail at most easterly street crossing	153.1

Passaic County.

Athenia. Rail at Erie station	134.0
Bloomingdale. Stone horse-block in front of Union Hotel	295.6
Bloomingdale. Pequannock river at	284.
Buckabear pond	992.
Charlotteburgh. North rail at station	718.5
Charlotteburgh pond	697.
Cedar pond	1113.
Clifton. Rail at Erie station	66.3
Cooper. Extreme west end of stone of dam, outlet of lake	624.0
Dunker pond	1010.
Echo lake. Top of boulder, 4 feet from corner of fence of Brown's hotel	985.8
Greenwood lake	618.
Hewitt. Bench-mark on oak at road corner, south of furnace	413.1
Highest point in county, summit of Bearfort mountain	1490.
Little Falls. Passaic river, above dam	158.
Little Falls. Passaic river, below falls	118.
Macopin lake	890.
Midvale. Step of bar-room door of Tice's hotel	253.4
Mud pond	337.
Negro pond	610.
Newfoundland. South rail at railroad crossing east of station	774.7
Hank's pond	1030.
High mountain, north of Paterson	879.
Oak Ridge. Rail at railroad station	856.3
Passaic. Rail at main railroad station, N. Y., L. E. & W. R. R	57.4
Pompton. Sill of Reformed church	208.0
Pompton lake	202.
Ringwood. Deck of bridge over Ringwood creek	339.
Sheppard's pond	634.
Singac. Rail at crossing near station	169.6
Smith's Mills. South rail at crossing	440.2
State line mile-stones.	
19th.	777.6
20th.	760.

Passaic County—Continued.

24th	781.8
25th	863.8
26th	627.8
27th	1369.
28th	1280.
Tice's pond	470.
Upper Macopin. Large rock under east end of road bridge, 30 yards south of store	1066.5
Wanaque. Rail at crossing by railroad station	238.5
Wanaque river, below dam at Wanaque	212.
West Milford. Large conglomerate rock, southwest corner of fence, north of church	704.8
Winbeam mountain	1023.

Salem County.

Acton station. South rail at railroad crossing	18.1
Aldine. Cross on door-sill of M. E. church	130.2
Alloway. Bench-mark on buttonwood, south side of hotel	38.5
Alloway pond	13.
Alloway station. South rail at railroad crossing	24.9
Auburn. At meeting of three roads	76.
Big Mannington hill	127.
Burden's hill	138.
Canton. Bench-mark on maple, southeast corner of cross-roads	23.6
Centerton. Bench-mark on willow opposite hotel	80.3
Cohansey. Bench-mark on maple, southwest corner of cross-roads	108.3
Daretown pond	93.
Fenwick station. East rail at railroad crossing	62.9
Hancock's Bridge. Cross on west end of south pier of bridge over creek	5.3
Harmersville. Bench-mark on maple, east side of cross-roads	18.6
Highest point in county, 2 miles northeast of Whig Lane	166.
Lower Penn's Neck. Highest point on	19.
Monroeville station. Rail at railroad crossing	135.5
Newkirk station. North rail at railroad crossing	128.3
Oakland station. South rail at railroad crossing	56.5
Palatine station. West rail at railroad crossing	109.1
Paulding station. South rail at railroad crossing	112.1
Pedricktown. Guard-stone at southeast corner of cross-roads	14.0
Penton station. South rail at crossing	20.9
Penns Grove. South rail at Main street crossing	6.0
Perkintown station. South rail	24.8
Pennsville. Corner by Moore & Wheaton's store	9.
Pittsgrove. Bench-mark on tree, northwest corner near school-house	135.6
Point Airy	151.
Quinton. Cross on curb in front of Hires & Co.'s store	8.8
Sharptown. Bench-mark on maple in front of old hotel	22.3
Shirley. Cross-roads	144.

Salem County—Continued.

Whig Lane. Bench-mark on maple, northeast corner of cross-roads 143.2
Woodstown. Hill 2 miles southeast of... 149.
Yorktown. Bench-mark on cedar, south of railroad and 100 yards west of railroad station.. 111.2

Somerset County.

Basking Ridge. Stone water-table, southwest corner of Presbyterian church.. 338.5
Bedminster. Stone step of post-office.. 177.0
Bedminster. North branch at.. 130.
Belle Mead. North rail of north track, crossing north of railroad station..... 99.8
Bernardsville. Rail at railroad station... 368.2
Blackwell's Mills. Cross on boulder, southeast corner of roads on east side of river... 44.9
Blawenburgh. On slate slab in front of store...................................... 157.5
Bloomington. Delaware and Raritan canal, below lock............................ 25.1
Flagtown. South rail of South Branch railroad, at crossing..................... 123.8
Griggstown. Delaware and Raritan canal, below lock.............................. 40.9
Harlingen. Cross on stone inscribed with names of building committee, at west side of steps of Reformed church... 94.8
Highest point in county, summit of Mine mountain................................. 857.
Kingston. Delaware and Raritan canal, below lock................................. 48.8
Lamington. Stone at southwest corner of picket fence, just west of church... 146.2
Liberty Corner. Stone in wall in front of hotel, 2.7 feet from largest tree...... 245.3
Martinsville. Cross on horse-block in front of house on northwest corner...... 315.7
Middlebush. South rail at crossing near station................................... 105.1
Millstone. Cross on guard-stone at northwest corner of roads, opposite hotel.. 45.4
Millstone river, at Millstone.. 26.
Montgomery. Cross on small culvert at northeast corner of cross-roads......... 120.1
Mount Horeb.. 594.
Mountain 2½ miles northwest of Mount Horeb....................................... 653.
Neshanic Station. (South Branch railroad.) South rail at station............... 86.6
Peapack. Top of coping at southwest corner of bridge by mill.................. 242.0
Pluckamin. Top of stone, southeast corner near yard fence 183.8
Pluckamin. North branch of Raritan, at bridge north of.......................... 105.
Roycefield. North rail of South Branch railroad, at crossing by station........ 102.4
South Branch. Coping, end of northeast wing wall of bridge over river....... 62.5
South Branch. River at... 54.
Summit of Sourland mountain .... 563.
Stoutsburgh West rail at railroad station... 177.3
Warrenville. Bench-mark on cedar, just north of school-house 383.3
Weston. Delaware and Raritan canal, below ten-mile lock........................ 32.5
Woodfern station. North rail at railroad crossing. 83.3

Sussex County.

Augusta. East rail at crossing... 498.5
Allamuchy mountains, summit of...1229.
Bear ponds... 977.

Sussex County—Continued.

Beemerville. Cross on old foundation of wheelwright shop	755.2
Bevans. Stone sill of main entrance to hotel	499.0
Canistear, at corner	1061.
Catfish pond	440.
Cranberry reservoir	771.
Creamery station. East rail at crossing, L. & H. R. R.	531.0
Culver's gap, summit of road in	915.
Culver's pond	848.
Davis' pond	581.
Decker pond	806.
Dingman's ferry. Delaware river at	356.
Flatbrookville. Delaware river at Decker's ferry	319.
Franklin Furnace pond	530.
Fredon. Bench-mark on walnut 30 yards northeast of corner	653.8
Glenwood. Bench-mark on maple near school-house	724.4
Hamburgh. East rail at crossing by railroad station	421.9
Hamburgh. Wallkill river at	402.
Hamburgh mountains, summit of	1469.
Hewitt's pond, near Andover	573.
Highest point in county, High Point, Kittatinny mountain	1804.
Highest point of the Highlands in New Jersey, 3 miles south of Vernon	1496.
Hopewell, pond at	1060.
Howell's pond, Pinkneyville	579.
Hunt's pond	675.
Huntsville. Bench-mark on elm at northeast corner near river	582.6
Iliff's pond	577.
Kays. Rail at railroad station	512.5
Lake Marcia, near High Point	1570.
Libertyville. Cross on stone at northeast corner of cross-roads	742.5
Lincoln. Large flat rock opposite hotel	633.3
Long pond, near Culver's gap	861.
Long pond, near Andover	576.
Mashipacong pond, on Kittatinny mountain	1124.
McAfee. West rail at railroad crossing	434.2
Monroe. West rail of L. & H. R. R. at crossing near station	544.2
Morris pond, near Sparta	929.
Mount Salem. State line monument at road north of	872.0
Mud pond, Hamburgh mountain	1244.
Mulford's station. East rail of L. & H. R. R. at crossing	595.3
Ogdensburgh. Rail at station	664.2
Ogdensburgh. Wallkill, 1 mile above	567.
Panther pond, south of Andover	766.
Papakating crossing. West rail of N. Y., S. & W. R. R.	395.9
Plumbsock. Pyramid-shaped stone, corner of fence just south of store	660.4
Port Jervis. Delaware river at mouth of the Neversink river	409.
Quarryville. East rail at railroad station	556.9
Quick pond, foot of Kittatinny mountain	943.

Sussex County—Continued.

Round pond, Kittatinny mountain	1359.
Sand pond, west of Coleville	1300.
Sand pond, south of McAfee	1244.
Smith's Ferry, Delaware river	324.
Sparta. Top of stone in sub-foundation at southeast corner of Presbyterian church	713.7
Stag pond	820.
Stanhope reservoir	859.
State line mile-stones.	
29th	1109.0
30th	1001.2
31st	777.2
32d	429.4
33d	510.7
34th	435.9
35th	391.5
36th	822.3
37th	871.7
38th	390.1
39th	398.4
40th	508.0
41st	575.9
42d	757.6
43d	703.
44th	915.8
45th	1022.5
47th	872.1
48th	555.2
Stickle pond	587.
Stillwater. Arrow on south end of step leading to Presbyterian church	442.8
Stockholm. Guard-stone, northeast corner of J. M. Lewis' store	982.5
Stockholm, summit of N. Y., S. & W. R. R. west of	1029.
Sucker pond	911.
Summit of Pimple hills	1088.
Summit of Pochuck mountain	1176.
Summit of Port Jervis turnpike on Blue mountain	1391.
Swartswood. Cross on stone opposite corner to McDonald's store	538.3
Swartswood lake, surface of water	480.
Tranquility station. East rail at crossing	568.0
Turtle pond	573.
Vernon. Bolt in guard-stone, corner of fence, east of Denton's store	561.6
Wallpack Centre. Arrow on conglomerate rock, west side of cross-roads	452.8
Wallpack Centre. Delaware river, 2 miles above Buck bar	329.
Washington, or Hunt's Mills. Cross on stone in triangle of roads	621.8
Wawayanda. On irregular gneiss rock, southwest corner of bridge over race, on road to Greenwood lake	1118.0
Wawayanda lake	1150.

Sussex County—Continued.

White lake	572.
White's pond	575.
Wright's pond	743.

Union County.

Berkeley Heights. Rail at crossing by railroad station	230.6
Cranford. Rail in front of station	72.7
Highest point in county, mountain north of Feltville	553.
Lyons Farms. Rock at east side of road, 4 feet from fence, near school-house	73.5
Murray Hill. Stream at road, just north of railroad	225.
New Providence. High guard-stone in front of hotel	217.3
Plainfield. Center of door-sill, main entrance Second Presbyterian church	106.8
Sayre Coast Survey station. Benedict's hill, northeast of Cranford	180.
Scotch Plains. Bench-mark on elm, northeast corner of bridge by mill	151.5
Springfield. Top of mile-stone, M. and E. turnpike	100.0
Summit. Rail at station	387.0
Union. Door sill of church	103.8
Washington Rock, near Plainfield, top of rock	507.
Westfield. Rail at station	127.8

Warren County.

Allamuchy. Corner of wall at west side of gate in front of white house	636.7
Allamuchy pond	775.
Anderson. Sill of front door of store opposite hotel	451.9
Asbury. Crow's-foot on flat rock at junction of roads north of mill	343.3
Asbury. Musconetcong river, below dam	311.
Bald Pate. Upper Pohatcong mountains	1192.
Beatyestown. Top of flat stone across lower end of drain opposite mill	485.6
Beatyestown. Musconetcong river	461.
Belvidere. Delaware river, head of rapids, 1½ miles south of	221.
Belvidere. Delaware river, below rapids, 2 miles south of	213.
Belvidere. Delaware river at mouth of Pequest creek	229.
Blairstown. South rail at crossing near railroad station	351.3
Blairstown. Paulin's Kill at	334.
Broadway level of Morris canal	433.4
Brotzmanville. Delaware river at Walker's ferry	296.
Calno. Bench-mark on elm at corner, just north of Mill brook	359.7
Calno. Delaware river, 1½ miles above Depew island	306.
Catfish pond	1179.
Carpentersville. East rail at station	175.6
Cedar lake	381.
Changewater. First stone in first course above ground at up-stream corner of south abutment of railroad bridge	376.6
Changewater. Musconetcong river	361.
Columbia. East rail at railroad crossing	307.9

Warren County—Continued.

Columbia. Delaware river at mouth of Paulin's Kill	265.
Columbia. Delaware river, 1½ miles above	277.
Danville. North end of door-sill of Presbyterian church	524.7
Delaware. Top of stone slab in front of gate of Presbyterian church	288.4
Delaware. River at Meyer's ferry	252.
Dunnfield. Rail at crossing west of station	314.0
Glover's pond	569.
Green's pond	399.
Hainesburg. Rail at crossing	307.2
Hardwick church. Guard-stone at north corner of grave-yard	877.3
Harmony. Summit of road between Upper and Lower Harmony	568.
Hazen. Rock at west side of flag-staff	380.5
Highest point in county, Kittatinny mountain, southeast of Sunfish pond	1602.
Hope. Guard-stone, 5 feet from east end of north wing wall of bridge over Beaver brook	414.5
Hughesville. Musconetcong river, just above	195.
Jacksonburgh. Cross on stone at corner	389.
Jenny Jump mountains. Highest point	1130.
Johnsonburgh. Southwest corner of stone door-step of hotel	573.8
Kalarama. Rail at crossing	370.
Karrsville. Stone door-sill of school-house	570.2
Knowlton. Cross on flagstone, entrance to basement of post-office	714.1
Lopatcong. Morris canal, foot of plane No. 10, west	216.6
Lopatcong. Morris canal, above plane No. 10, west	261.8
Marble mountain	770.
Marksborough. Corner of flange at bottom of cast-iron pillar of brick store	505.7
Martin's Creek station. Delaware river	186.7
Millbrook. Red stone by fence at east corner of cross-roads	652.7
Montana. Top of monument at U. S. C. S. station	1240.0
Mount Hermon. Cross on boulder at southeast corner	492.8
Mount Mohepinoke	1140.
Paulina. Arrow on lowest stone step, outside of gate, 100 yards west of corner,	349.0
Petersburgh. Bench-mark on elm, 37 yards northeast of cross-roads	707.2
Pohatcong mountain. Summit	898.
Polkville. Cross on stone near northeast corner of cross-roads	585.8
Port Colden. Morris canal, above lock	516.9
Port Colden. Morris canal, above plane No. 6, west	567.1
Port Murray. Morris canal, above plane No. 5, west	630.0
Port Warren. Morris canal, above plane No. 9, west	361.2
Riegelsville. On southeast wing wall of bridge over the Musconetcong	150.2
Sand pond, near Warren and Sussex county line	973.
Saxton's Falls. Morris canal, below lock	630.8
Saxton's Falls. Morris canal, below lock No. 4, west	632.1
Saxton's Falls. Morris canal, above lock No. 4, west	639.4
Shoemaker's Ferry. Delaware river at	300.
Shuster's pond	433.
Silver lake	419.

Warren County—Continued.

Stewartsville. Morris canal, above plane No. 8, west	423.3
Springtown. Pohatcong creek at bridge	192.
Sunfish pond	1375.
Townsbury. Lowest step in wall in front of house on south side of road between the bridge and corner of road to Buttzville	492.0
Townsbury. Pequest creek	483.
Uniontown. Cross on stone at forks of roads	376.0
Vienna. At corner of road to Petersburgh	536.
Walnut Valley. At cross-roads	345.
Warrenville. On rock opposite opening of road to Saxton Falls	859.9
Warrington. Rail at crossing	298.5
Washington. Morris canal, above plane No. 7, west	506.8
Water Gap. Delaware river opposite Water Gap House.	287.
Water Gap. Mountain on New Jersey side	1456.
White pond	449.

MAGNETIC SURVEY OF NEW JERSEY.

Anyone who has studied the isogonic chart for 1885, prepared by Mr. Chas. A. Schott, and published in the U. S. Coast and Geodetic Survey report for 1882, must have noticed that the more numerous the stations are, the more irregular are the isogonic curves. It had been noticed during the progress of the topographic survey of the State that the distribution of magnetic declination was much more irregular than has been generally supposed, and that even when local attraction was eliminated, variations of one or two degrees prevailed over quite extended areas. It was believed that a large number of observations taken within a short period of time, distributed over the State and not aiming at extreme accuracy, would be more serviceable in gaining a fuller knowledge of distribution than would very refined observations at a few stations. Consequently in October, 1887, two parties were placed in the field, equipped with good surveying transits, the needles of which were six inches in length and had been put in perfect order and carefully compared with each other and with a standard needle. One instrument was furnished with a Saegmuller solar attachment and the other was supplemented by a Gurley solar compass.

Having reached a locality where observations were desired, a meridian would be determined by observation on a circumpolar star, either Polaris or 51 Cephei, and from this a traverse would be run out over an area of two or three square miles and the declination carefully observed at each station, readings being occasionally taken with the solar compass.

The readings of the solar compass were thus checked, and so at the next locality it could be used alone and two localities could be occupied in one day, or in case the stars were obscured the work could proceed without loss of time, as the solar apparatus would be again checked at the first favorable opportunity.

In this way observations were obtained at 121 localities within a period of six weeks by two working parties. These observations

have been supplemented by 37 other observations made by the Topographer in charge, and a few other observers, within a few years, all being reduced to the epoch 1888.0. These 158 stations within the State and a few in neighboring States, taken from Mr. Schott's collections, have been utilized in preparing the isogonic chart facing page 324. In drawing the curves no attempt has been made to satisfy all of the observations, but only such as pointed indisputably to a disturbance covering a considerable extent of country and not purely local. It should be noted that the declinations given in the list following and utilized in the chart, are the mean of the declinations observed at several stations about the given locality, and that in making up these means, extreme results which showed evidence of purely local attraction were thrown out.

No attempt will here be made to explain the disturbances shown by the isogonic chart; some of the peculiarities of distribution observed may be pointed out, but theories as to their causes would be premature. A much larger number of observations would be necessary to this end.

In Southern New Jersey it may be noted that in the vicinity of Philadelphia and Mount Holly the increase of declination going northward is at about the rate of one degree in 4 miles, but elsewhere it is only at the rate of one degree in from 8 to 12 miles.

There seems to be a general deflection of the needle westward, amounting to about half a degree, about Trenton, N. J., Philadelphia, Morristown and Westchester, Pa., from which it recovers again at Lambertville and Doylestown.

There is an outcrop of Archæan rock on this area of west deflection, and it is as we approach this outcrop from the sand and clay regions that the more rapid increase of west declination above noted occurs. Generally, over Southern New Jersey the distribution is very uniform.

On the Red Sandstone plain the only disturbances are in the vicinity of the trap ridges, and here too we find a more rapid increase of west declination as we approach the Archæan Highlands. The disturbances about some of the trap ridges are marked. The declination at Tappan, near the New York line, is 7° 57′, while on top of Palisades mountain, two miles east, it is 9° 02′, and passing over the crest we find along the bank of the Hudson 8° 10′. At Hackensack it is 7° 49′, and a very uniform increase occurs in going east to the crest of the

Palisades at Linwood, where it is 9° 03′. Passing down to the bank of the Hudson it falls back again to 7° 57′. At Weehawken also the declination at the top of the ridge is $1\frac{1}{2}$° greater than in the valley west, and about $\frac{1}{2}$° greater than at the eastern foot of the Palisades. This tendency of the needle toward a perpendicular to the crest line of the trap ridges is noticeable at other points also. At High mountain, north of Paterson, it amounts to 45′, at the ridge east of Pompton to $1\frac{1}{2}$°, at Plainfield to 40′, at Martinsville to 30′, and at Goat Hill, near Lambertville, to 15′ or less. A series of stations across the Watchung mountains between Orange and Livingston gave no evidence whatever of such a tendency, and the same is true of a line across Rocky Hill between Princeton and Blawenburgh. Purely local attraction was observed, however, at all of these points on the trap. The effect of Palisades mountain was so continuous and well verified, that it was thought best to exhibit it in the isogonic chart; but at other points it was not shown, being treated as ordinary local attraction.

The greatest disturbance of the isogonic curves occurs in and about the Archæan Highlands. Local attraction due to magnetic ore deposits is very common here, making observations of the general distribution difficult. In general it may be said that the needle swings toward the axis of the Archæan mountain masses, which increases declination on the southeast slopes and decreases it on the northwest. The increase in declination in passing from the Red Sandstone up on the Highlands is about one degree. This tendency of the needle toward the mountain is not so noticeable in the case of Musconetcong and Schooley's mountains. About Bartley, in the German valley, the needle seems to be deflected about two degrees westward, and a line across from the ridge at Chester shows a rapid increase in declination until the foot of Schooley's mountain is reached, but on reaching the top of the mountain there is a decrease at once of more than two degrees. The declination in the valley at Greenwood lake and Newfoundland is from 1° to $1\frac{3}{4}$° less than it is on the mountains either side.

Through the eastern side of Kittatinny valley the needle is deflected eastward from the normal position. This deflection amounts to $\frac{3}{4}$° at Phillipsburgh, $1\frac{1}{2}$° at Belvidere and $1\frac{3}{4}$° at Vernon. Pochuck mountain causes a marked disturbance, amounting to about 2° at a maximum. Once out of the influence of the Highlands no disturb-

ances are noted on the west side of Kittatinny valley and on the mountain.

Enough has been observed to show that a close relationship exists between geological structure and magnetic distribution, that the principal irregularities in distribution occur in the vicinity of outcrops of Archæan or gneissic rocks, that the traps may cause equally great disturbances, although as their extent is less in New Jersey than that of the Archæan rocks, these disturbances are less noticeable, and that disturbances due to either kind of rock are not confined to the actual outcrop, but seem to be felt while the rocks are still below the surface. This last suggests at once the query—may not detailed magnetic surveys be made useful in the study of stratigraphical geology, when the relationship between geological structure and the magnetic forces comes to be better understood? At all events the knowledge of the existence of these irregularities in magnetic distribution, carries with it a useful lesson to the land surveyor.

COLLECTION OF MAGNETIC DECLINATIONS.

At the beginning of the study of this subject, inquiries as to observed declinations and change of bearing in old lines were sent out to most of the surveyors of the State. The results were meager, although all applied to showed interest and a disposition to aid in making such a collection. The survey is indebted to many of these gentlemen whose names are mentioned in the remarks after the information which they contributed. Mr. A. H. Konkle, of Newton, deserves special mention, as he was at considerable pains to procure the results sent, going into the field for that purpose. Where authority is not given the results were obtained from the magnetic survey made in 1887.

The Coast Survey collections have been largely drawn upon and every available source besides. Naturally the publication of this collection will bring to light much more material, as did the early collections by Mr. Schott, but it is doubtful if much more is needed than is here given for the use of surveyors, for the great uncertainties introduced by the irregularities of distribution which have been shown, make surveying with the compass in Northern New Jersey little better than guess work, while where these irregularities do not occur, the decennial series of computed declinations for New York

and Philadelphia will be found to apply very closely. While the effort is made to make this paper as useful as possible to the surveyors of the State, it must be remembered that its primary object is to record the irregularities of magnetic distribution brought out by a more than usually detailed survey, and to pave the way for an explanation of their causes.

Atlantic County.

ATLANTIC CITY.

Date.	Declination West.	
1860.6.	4° 54′.	United States Coast Survey Report, 1881.
1885.	(6° 48′.)	Schott's computation, Report, 1881.
1887.8.	6° 22′.	About the light-house. Several stations.

HAMMONTON.

1885.9.	5° 53′.	One mile northwest. Topographic Survey. (See Winslow, Camden county.)

MAYS LANDING.

1875.	5° 22′.	Mean of 13 trials by West Jersey Association, court-house meridian *(corrected for local attraction).*
1887.8.	(5° 38′.)	South end of court-house meridian (local attraction).
1887.8.	5° 55′.	North end of court-house meridian.
1887.8.	5° 52′.	Average about the village.

Bergen County.

DARLINGTON.

1879.6.	9° 40′.	On brow of mountain just west. Topographic Survey.

ENGLEWOOD.

1839.	5° 36′.	J. H. Serviss, re-survey of old road at Fort Lee.
1877.6.	7° 53′.	J. H. Serviss, observer.
1885.4.	8° 27′.	J. H. Serviss, observer.
1887.8.	8° 29′.	Near Nordhoff station.

FAIRLAWN.

1887.8.	8° 06′.	Vicinity of railroad station.

HACKENSACK.

1887.8.	7° 49′.	From Maywood to the West Shore railroad.

LINWOOD.

1887.8.	9° 03′.	Average for top of Palisade mountain, only slight variation.
1887.8.	7° 57′.	At eastern base of Palisade mountain. There is a steady increase of declination from Hackensack to Linwood, at top of the Palisades, then a fall of over a degree down the eastern foot.

Date.	Declination West.	
		MAHWAH.
1887.8.	8° 40′.	West of the Ramapo river, at base and on top of mountain.
1887.8.	8° 23′.	Vicinity of village.
		PALISADES, N. Y.
1874.6.	9° 15′.	Prof. E. A. Bowser, Boundary Survey.
1887.8.	9° 02′.	Average on top of trap ridge. Not much local attraction on top, but 2½° observed at one point on the slope.
		RAMAPO, N. Y.
1883.6.	9° 20′.	Top of High Torn. A. A. Titsworth.
		SLOATSBURGH, N. Y.
1874.6.	7° 42′.	Prof. E. A. Bowser, Boundary Survey.
		TAPPAN, N. Y.
1887.8.	7° 57′.	On sandstone west of foot of Palisades.
		TEANECK.
1887.8.	8° 09′.	Average on top of ridge.

Burlington County.

		BASS RIVER.
1885.6.	6° 30′.	H. S. Haines.
		BORDENTOWN.
1846.4.	4° 26′.	At White Hill, United States Coast Survey Report, 1882.
1885.0.	7° 9′.	At White Hill, Schott's computation, United States Coast Survey Report, 1882.
1885.8.	7° 03′.	In the town. Topographic Survey.
		BRISTOL, PA.
1846.5.	4° 28′.	United States Coast Survey Report, 1882.
1885.	7° 11′.	Schott's computation, United States Coast Survey Report, 1882.
		BROWN'S MILLS.
1885.8.	6° 53′.	Topographic Survey.
		COLUMBUS.
1885.8.	7° 15′.	At Bishop's barn, 2 miles east. Topographic Survey.
		ELLISDALE.
1885.8.	6° 45′.	At Stony Hill, near county line.
		LITTLE EGG HARBOR LIGHT.
1846.9.	4° 28′.	On Tucker's island, United States Coast Survey Report, 1882.
1885.	7° 09′.	Schott's computation, United States Coast Survey Report, 1882.
		MOUNT HOLLY.
		Observations by West Jersey Associations, at meridian, in the court-house yard.

Date.	Declination West.	
1866.7.	5° 36′.	Mean of 10 observations with different instruments.
1870.6.	6° 00′.	Mean of 15 observations with different instruments.
1873.6.	6° 10′.	Mean of 10 observations with different instruments.
1875.0.	6° 12′.	Mean of 16 observations with different instruments.
1877.6.	6° 32′.	Mean of 9 observations with different instruments.
1879.6.	6° 42′.	Mean of 9 observations with different instruments.
1881.6.	6° 50′.	Mean of 12 observations with different instruments.
1882.6.	6° 53′.	Mean of 11 observations with different instruments.
1885.6.	6° 57′.	Mean of 16 observations with different instruments.
		N. B.—It seems that local attraction exists at the south end of the county meridian to the amount of not less than +23′. Hence, while the above are of interest as showing westward movement, they do not give absolute values correctly.
1887.9.	6° 51′.	Observed on same point with instrument used in magnetic survey.
1887.9.	6° 28′.	Mean about village on top of mount and northward.

SHAMONG STATION.

1885.9.	6° 13′.	On Apple-pie hill. Topographic Survey.
1887.9.	6° 36′.	Vicinity of village.

SMITHVILLE.

1885.8.	6° 32′.	Topographic Survey.

TUCKERTON.

1885.6.	6° 57′.	H. S. Haines.
1887.9.	6° 52′.	Vicinity of village.

Camden County.

BERLIN.

1884.6.	5° 46′.	At Coast Survey station, 2 miles northeast of village. A. A. Titsworth.
1885.9.	5° 35′.	At Coast Survey station. Topographic Survey.

CAMDEN.

1887.8.	6° 10′.	Vicinity of Liberty Park.

HADDONFIELD.

1885.9.	6° 24′.	Topographic Survey.
1887.8.	6° 10′.	Southwest side of village.

WATERFORD.

1885.9.	5° 49′.	At village. Topographic Survey.

WINSLOW.

1887.8.	5° 57′.	Vicinity of Winslow Junction.

PHILADELPHIA, PA., FROM SCHOTT'S TABLES.

1701.	8° 30′.	Scull, Sill. Journal, Vol. 23, 1833.
1710.	8° 30′.	Th. Whitney, Sill. Journal, Vol. 34, 1838.

Date.	Declination West.	
1750.	5° 45′.	Kalm's Travels, reference as above.
1793.	1° 30′.	Th. Whitney, reference as above. Also Brooks, Sill. Journal, Vol. 23, 1833.
1802.	1° 30′.	Howell, reference as above.
1804.	2° 00′.	By several men of science, reference as above.
1804.	2° 10′.	Th. Whitney, Sill. Journal, Vol. 34, 1838.
1813.	2° 25′.	D. McClure, reference as above.
1813.	2° 27′.	Whitney, Sill. Journal, Vol. 23, 1833.
1837.	3° 52′.	W. R. Johnson, Sill. Journal, Vol. 34, 1838.
1840.5.	3° 37′.	Dr. A. D. Bache, Girard College. Magnetic Survey of Pennsylvania.
1841.7.	3° 54′.	Reference as above.
1846.4.	3° 51′.	Dr. J. Locke, Girard College.
1855.7.	4° 32′.	C. A. Schott, Girard College, United States Coast Survey.
1862.6.	5° 00′.	C. A. Schott, Girard College, United States Coast Survey.
1872.8.	5° 28′.	A. H. Scott, Girard College, United States Coast Survey.
1877.8.	6° 02′.	J. B. Baylor, Girard College, United States Coast Survey.
1884.7.	6° 22′.	Edwin Smith, Girard College, United States Coast Survey.

Cape May County.

CAPE MAY CITY.

1846.5.	3° 05′.	United States Coast Survey Report, 1881, at light-house.
1849.7.	3° 05′.	N. C. Price.
1850.7.	3° 11′.	N. C. Price.
1855.6.	3° 45′.	United States Coast Survey Report, 1881, at light house.
1857.7.	3° 30′.	N. C. Price.
1874.5.	4° 38′.	United States Coast Survey Report, 1881, at light-house.
1881.	5° 06′.	N. C. Price.
1885.0.	5° 23′.	United States Coast Survey Report, 1882, Schott's computation.
1887.8.	5° 11′.	Average of several stations between Cape May City and light-house.

OCEAN VIEW.

1887.8.	5° 40′.	Vicinity of railroad station.

TOWN BANK.

1846.5.	2° 59′.	United States Coast Survey Report, 1881.
1885.0.	5° 30′.	United States Coast Survey Report, 1882, Schott's computation.

Cumberland County.

BRIDGETON.

1846.5.	2° 59′.	United States Coast Survey Report, 1881, "Hawkins," just west of Bowentown station.
1885.0.	5° 30′.	United States Coast Survey Report, 1882, "Hawkins," Schott's computation.
1872.6.	4° 31′.	Mean of 17 trials, West Jersey Association, county meridian.
1884.9.	5° 18′.	Mean of 9 trials, West Jersey Association, county meridian.

Date.	Declination West.	
1887.8.	5° 15′.	On same county meridian used above.
1887.8.	5° 19′.	Mean of several stations about town.

EGG ISLAND LIGHT-HOUSE.

1846.5.	3° 03′.	United States Coast Survey Report, 1881.
1885.0.	5° 34′.	Schott's computation, United States Coast Survey Report of 1882.

GREENWICH.

1846.5.	3° 14′.	United States Coast Survey Report, 1881, at Pine mountain, 2 miles north.
1885.	5° 45′.	United States Coast Survey Report, 1882, at Pine mountain, Schott's computation.

PORT NORRIS.

1846.5.	3° 04′.	United States Coast Survey Report, 1881.
1885.0.	5° 35′.	United States Coast Survey Report, 1882, Schott's computation.
1887.8.	5° 24′.	Average of several stations.
1883.5.	5° 05′.	At Maurice river light, 3 miles south.

Essex County.

COOK'S BRIDGE.

1887.9.	8° 02′.	Both sides of river. N. B.—It is noticeable that there is little variation on a line from Orange to Hanover. The trap ridges appear to exert no general effect on the needle, only local.

LIVINGSTON.

1887.9.	8° 10′.	No effect observed from Riker hill.

ORANGE.

1887.9.	8° 05′.	Vicinity of Orange and Llewellyn Park up to brow of mountain.
1887.9.	8° 00′.	Crest of First mountain and valley west along Mt. Pleasant turnpike. Local attraction observed, amounting to 2½°, on top of mountain.
1887–9.	8° 05′.	Crest of Second mountain, Mt. Pleasant turnpike. Local attraction, amounting to 1½°, observed on west slope.

NEWARK.

1846.4.	5° 35′.	United States Coast Survey Report, 1881.
1847.	5° 45′.	Reported by P. Witzel.
1878.	7° 40′.	Observed by P. Witzel.
1887.8.	7° 49′.	At Harrison.

Gloucester County.

CLARKSBORO.

1870.1.	5° 48′ (?).	Wm. Haines.

CLAYTON.

1885.9.	5° 46′.	Topographic Survey.

Date.	Declination West.	
		NEWFIELD.
1887.8.	5° 45′.	South of the village.
		WOODBURY.
1846.5.	3° 45′.	United States Coast Survey Station Chew, 2 miles southwest of village.
1865.0.	4° 48′.	Wm. Haines, at court-house.
1867.6.	4° 49′.	Mean of 23 trials, West Jersey Association, at court-house.
1870.0.	4° 46′.	Wm. Haines, at court-house.
1874.6.	5° 11′.	Mean of 15 trials, West Jersey Association, at court-house.
1883.6.	6° 01′.	Mean of 4 trials, West Jersey Association, at court-house.
1887.8.	6° 02′.	Mean of several stations northwest of village.

Hudson County.

		JERSEY CITY.
1841.	5° 52′.	W. C. Wetmore, U. S. N. See Winfield's Land Titles. At court-house.
1841.1.	6° 06′.	Douglas' map of city.
1871.4.	7° 55′.	Delos E. Culver. Winfield's Land Titles.
		HARRISON.
1887.8.	7° 49′.	Top and east side of ridge. At west foot of ridge a value of 7° 35′ was observed.
		SECAUCUS.
1887.8.	8° 45′.	Along Paterson plank road.
		WEST HOBOKEN.
1840.7.	5° 53′.	United States Coast Survey, just west of monastery.
1887.8.	9° 22′.	Average of top of ridge north of monastery. Much local attraction exists hereabouts, due partly to natural, partly to artificial causes.
1887.8.	8° 55′.	Along base of Palisades from Weehawken to Guttenberg. 9° 32′ was noted here at one station.
		NEW YORK, N. Y., FROM SCHOTT'S TABLES.
1684.	8° 45′.	Philip Welles, Surveyor-General. Report of the New York Commissioners on the Connecticut Boundary, made in April, 1857. Sen. Doc. 165, p. 155.
1691.	8° 45′.	On Staten Island. Geological Survey of New York, 1858, E. Duxbury's patent.
1714.8.	8° 45′.	John Beatty, Deputy Surveyor, on map of Livingston's Manor. O'Callaghan's Doc. History of New York, iii., 414.
1723.	7° 20′.	G. Burnett. Prof. E. Loomis' collection, Sill. Journal, Vol. 34, 1838.
1724.	7° 20′.	Cadwallader Colden. Report of Commissioners on the Connecticut Boundary, 1857.

Date.	Declination West.	
1750.	6° 22′.	Mr. Alexander. Prof. E. Loomis' collection, Sill. Journal, Vol. 34, 1838.
1755.	5° 00′.	Mr. Evans, as above.
1789.	4° 20′.	Mr. Evans, as above.
1824.	4° 40′.	Blunt's map, as above.
1834.	4° 50′.	Capt. Owen, as above.
1837.	5° 40′.	Prof. J. Renwick, Columbia College, as above.
1840.5.	5° 01′.	At Howard, Staten Island. United States Coast Survey.
1840.6.	5° 53′.	At Bergen Neck station. United States Coast Survey. West Hoboken.
1841.	6° 06′.	Douglas' map of New Jersey.
1844.6.	6° 13′.	United States Coast Survey at Columbia College.
1845.7.	6° 25′.	United States Coast Survey at Columbia College.
1846.3.	5° 10′.	United States Coast Survey at Bloomingdale Asylum.
1855.6.	6° 40′.	United States Coast Survey at Governor's Island.
1855.6.	7° 02′.	United States Coast Survey at Bedloe's Island.
1855.6.	6° 28′.	United States Coast Survey at receiving reservoir, Central Park.
1874.6.	7° 23′.	Report of Chief of Engineers, U. S. A. Chart of Way Reef, Hell Gate, 1875.
1885.8.	9° 00′.	J. B. Baylor, United States Coast Survey in Riverside Park. [Not used on account of local deflection. Sch.]

Hunterdon County.

CUSHETUNK OR PICKLES MOUNTAIN.

1883.8.	7° 29′.	Topographic Survey at Geodetic station (Pickles).

FLEMINGTON.

1887.9.	7° 14′.	Vicinity of town.

FRENCHTOWN.

1887.9.	7° 05′.	At town above and below bluff.
1887.9.	7° 15′.	From one to two miles northeast.

GLEN GARDNER.

1887.8.	6° 59′.	One mile northeast of village, local attraction amounting to 10° observed hereabouts.

HIGH BRIDGE.

1887.8.	8° 18′.	One mile northwest of village.

LAMBERTVILLE.

1887.9.	6° 55′.	Vicinity of town.
1887.9.	7° 11′.	Crossing trap ridge from one to three miles southeast of town; local attraction of 45′ observed, with a slight tendency to throw the needle away from axis of ridge.

LEBANON.

1887.8.	7° 52′.	Vicinity of Potterstown and Lebanon.
1887.8.	7° 45′.	On mountain 1 to 2 miles southeast of Cokesbury. No general effect is observable in approaching and mounting Fox hill.

Date.	Declination West.	
		PATTENBURG.
1887.8.	6° 53′.	Vicinity of village. Musconetcong mountain attracts the needle about here and Valley station, up both slopes.
		POTTERSVILLE.
1883.8.	7° 46′.	On hill 1 mile southwest.
		VALLEY STATION, CENTRAL RAILROAD OF NEW JERSEY.
1887.8.	7° 04′.	Half a mile north of station, in valley.
1887.8.	6° 28′.	At foot of Musconetcong mountain.
1887.8.	6° 42′.	Crest of Musconetcong mountain. Varies from 5° 17′ to 7° 57′ (local attraction).

Mercer County.

		HAMILTON SQUARE.
1885.8.	6° 58′.	Topographic Survey.
		HIGHTSTOWN.
1887.8.	7° 18′.	South and west of village.
		PRINCETON.
1810.5.	7° 00′.	Silliman's Journal, 1838. (This seems erroneous.)
1852.6.	5° 32′.	At Mt. Rose, 3½ miles northwest of village. United States Coast Survey.
1887.9.	7° 09′.	About the village.
1887.9.	7° 21′.	Crest of trap ridge north-northwest of village. Local attraction amounting to 30′ observed.
		TRENTON.
1887.8.	7° 13′.	East of city, extending to Pond run.

Middlesex County.

		JAMESBURG AND VICINITY.
1761.	4° 33′.	Henry M. Thomas. Bearings of old lines.
1795.	3° 11′.	Henry M. Thomas. Bearings of old lines.
1799.	2° 43′.	Henry M. Thomas. Bearings of old lines.
1815.	3° 12′.	Henry M. Thomas. Bearings of old lines.
1826.	3° 50′.	Henry M. Thomas. Bearings of old lines.
1829.	3° 52′.	Henry M. Thomas. Bearings of old lines.
1887.	7° 25′.	
		NEW BRUNSWICK.
1800.	2° 24′.	Bearings of old lines, taken by Geo. Hill.
1804.	2° 30′.	Bearings of old lines, taken by Jas. M. Cobb.
1811.	3° 19′.	Bearings of old lines.
1814.6.	3° 07′.	Bearings of old lines, taken by Geo. Hill.
1815.9.	3° 13′.	Bearings of old lines, taken by Geo. Hill.

Date.	Declination West.	
1830.5.	3° 34′ (?).	Bearings of old lines, taken by Geo. Hill.
1836.6.	4° 40′.	Bearings of old lines, taken by Geo. Hill.
1838.5.	4° 45′.	Bearings of old lines, taken by Geo. Hill.
1846.0.	5° 23′ (?).	Bearings of old lines, taken by Geo. Hill.
1848.6.	5° 10′.	Bearings of old lines, taken by Geo. Hill.
1850.8.	5° 23′.	Bearings of old lines, taken by Geo. Hill.
1863.0.	6° 09′.	Old deed; reported by Geo. Hill.
1864.	6° 10′.	Prof. Geo. H. Cook, at county meridian.
1866.	6° 00′ (?).	T. N. Doughty.
1870.	6° 24′.	Bearings of old lines.
1880.	7° 15′.	Prof. E. A. Bowser.
1884.	7° 30′.	Jas. M. Cobb.
1886.	7° 30′.	Geo. Hill.
1887.	7° 32′.	Geo. Hill.
1887.8.	7° 34′.	Observed at Rutgers College, and at several stations northward.

PERTH AMBOY.

1830.0.	4° 10′.	H. S. Haines. Change in bearing of old line at South Amboy.
1885.5.	7° 43′.	G. H. Blakeley.

Monmouth County.

FREEHOLD.

1887.9.	7° 15′.	North side of town.

IMLAYSTOWN.

1765.8.	4° 45′.	John Lawrence, at his house.

MORGANVILLE.

1887.9.	7° 35′.	At village and at Beacon Hill station. This hill of gravel, etc., has no effect whatever on the needle.

MOUNT MITCHELL—NAVESINK PARK.

1840.8.	5° 29′.	United States Coast Survey.
1844.0.	5° 39′.	United States Coast Survey.

RED BANK.

1887.9.	7° 23′.	South and east of town.

SANDY HOOK.

1686.0.	9° 00′.	Geo. Keith. Records of Proprietors of East Jersey.
1842.7.	5° 32′.	United States Coast Survey.
1844.1.	5° 51′.	United States Coast Survey.
1855.6.	6° 11′.	United States Coast Survey.
1873.9.	7° 09′.	United States Coast Survey.
1879.5.	7° 32′.	United States Coast Survey.
1885.8.	7° 53′.	United States Coast Survey.

SEABRIGHT.

1884.7.	7° 12′.	G. H. Blakeley.

Date.	Declination West.	
		SEA GIRT.
1884.9.	6° 59′.	G. H. Blakeley.
1887.9.	7° 09′.	Extending $1\frac{1}{2}$ miles inland.

Morris County.

		BARTLEY.
1887.8.	4° 08′.	On Schooley's mountain slope, three-quarters mile west of store.
1887.8.	9° 48′.	West side of the valley.
1887.8.	9° 03′.	East side of the valley.
1887.8.	8° 29′.	Top of ridge east of valley, road from Chester to Flanders.
		BUDD'S LAKE.
1880.0.	6° 42′.	One mile east, at top of mountain.
		BOONTON.
1887.9.	8° 05′.	Southeast of town in valley.
1887.9.	8° 27′.	Top of hill north of town.
		CHESTER.
1880.0.	7° 03′.	On Seward's hill, near cross-roads.
1887.8.	7° 56′.	At the cross-roads. There seems to be a constant and rapid increase from here across the valley to the base of Schooley's mountain, amounting to nearly 2° in 3 miles, then a decrease in climbing the mountain.
		DOVER.
1887.8.	8° 58′.	At the town.
1887.8.	8° 20′.	On gravel terrace, 1 mile west.
		GILLETTE.
1887.9.	7° 53′.	One-half mile east of station.
1887.9.	7° 54′.	In Great swamp, one-half mile north of Long hill.
1887.9.	9° 34′.	Crest of Long hill, 1 mile northeast of Gillette railroad station.
		HANOVER.
1887.9.	8° 01′.	Average of 4 stations east and west of river.
		LAKE HOPATCONG.
1884.8.	8° 26′.	Bertrand island. G. H. Blakeley.
1884.8.	8° 15′.	Shippenport. G. H. Blakeley.
1887.8.	7° 49′.	Across head of lake south and west of Hurdtown.
1887.8.	8° 34′.	Head of Henderson cove, east foot of mountain.
		MORRISTOWN.
1887.9.	8° 12′.	On mountain just west of borough limits.
1887.9.	9° 00′.	On drift at eastern borough limits, north of the Whippany.
1887.9.	8° 33′.	South of Horse hill.

Date.	Declination West.	
		NEWFOUNDLAND.
1887.8.	7° 57′.	Crest of Green Pond mountain, 1 mile southwest.
1887.8.	7° 31′.	West base of Green Pond mountain.
1887.8.	7° 58′.	At Oak Ridge village.
1887.8.	9° 41′.	On mountain 1 mile south of Holland school-house. Change in bearings of lines surveyed about 1800 from 4° to 4¼°. Horace Chamberlain.
		POMPTON.
1887.8.	10° 47′.	Top of trap ridge southeast of steel works.
1887.8.	9° 16′.	Village and 2 miles west in mountain south of Bloomingdale. Local attraction amounting to 20′, but no marked difference between mountain and valley.
		SCHOOLEY'S MOUNTAIN.
1887.8.	6° 25′.	One mile northeast of the mineral spring.

Ocean County.

		BARNEGAT LIGHT.
1860.6.	5° 24′.	United States Coast Survey, Report of 1881.
1880.	6° 57′.	A. P. Irons.
1885.	7° 18′.	Schott's computation. United States Coast Survey Report, 1881.
		BARNEGAT VILLAGE.
1887.9.	6° 52′.	At village.
		FORKED RIVER.
1876.5.	6° 03′.	Moore. See United States Coast Survey Report, 1882.
1885.0.	6° 47′.	Schott's computation, Report, 1882.
		HARVEY CEDARS—LONG BEACH.
1860.6.	5° 18′.	United States Coast Survey Report, 1881.
1885.0.	7° 13′.	Schott's computation. United States Coast Survey Report, 1881.
		NEW EGYPT.
1887.9.	6° 56′.	North of village.
		SEASIDE PARK.
1880.	7° 14′.	A. P. Irons, at Capt. J. Reed's house, south of village.
1887.9.	6° 56′.	At the village.
		WEST CREEK
1745.	5° 25′.	Dennis. John Lawrence's notes. NOTE.—The true bearing of Lawrence's line from here to Collier's Mills, 30 miles, is N. 14° 42′ W. Lawrence ran on a magnetic course of N. 9° 19′ W., which shows a declination amounting to 5° 23′, and verifies the above observation conclusively. C. C. V.
		WHITINGS.
1887.9.	7° 09′.	About the village.

Passaic County.

BEARFORT MOUNTAIN.

Date.	Declination West.	
1882.6.	8° 00′.	At United States Coast Survey station. Topographic Survey.

GREENWOOD LAKE.

1887.8.	7° 40′.	At extreme south end of lake.
1887.8.	8° 03′.	Foot of Bearfort mountain. Warwick turnpike.
1887.8.	8° 34′.	Central ridge of Bearfort, just south of turnpike. A gradual increase going west.

HIGH MOUNTAIN.

1883.6.	9° 03′.	Trap ridge north of Paterson. A. A. Titsworth.

PATERSON.

1868.7.	6° 37′.	A. A. Fonda; reported by J. T. Hilton, C.E.
1869.1.	6° 37′.	Theo. Ryerson; reported by J. T. Hilton, C.E.
1887.8.	7° 51′.	North of Hawthorne station.
1887.8.	8° 06′.	At Fairlawn station.

POMPTON.

1887.8.	9° 16′.	In valley at village.

STATE LINE.

1874.6.	7° 14′.	At Longhouse creek.
1874.6.	6° 02′.	On Bearfort mountain.

Salem County.

CHURCH'S LANDING.

1846.4.	5° 49′ (?).	United States Coast Survey Report, 1881.
1885.0.	8° 32′ (?).	United States Coast Survey Report, 1882, Schott's computation.

DELAWARE CITY, DEL.

1842.5.	3° 30′.	Barnett; Philadelphia, Trans. Roy. Soc., 1874.
1846.5.	3° 17′.	At Fort Delaware; United States Coast Survey Report, 1881.
1885.0.	5° 48′.	United States Coast Survey Report, 1882; Schott's computation for Fort Delaware.

SALEM.

1887.8.	5° 42′.	North side of town.

WILMINGTON, DEL.

1846.4.	2° 31′.	United States Coast Survey Report, 1881.
1875.5.	3° 44′.	United States Coast Survey Report, 1881.
1885.	4° 25′.	United States Coast Survey Report, 1882, Schott's computation.

Somerset County.

BLAWENBURGH.

1887.9.	7° 36′.	In vicinity to beyond Skillman's.

Date.	Declination West.	
		MIDDLEBUSH.
1884.9.	7° 13′.	G. H. Blakeley.
		SOMERVILLE.
		Observations reported by Joshua Doughty, Jr.
1864 (?).	5° 30′.	C. W. Van Nuys, observer.
1864.9.	6° 00′.	W. W Drake, observer.
1865.3.	6° 15′.	Ab'm Stryker, observer.
1865.4.	5° 40′.	H. Cook, observer.
1865.6.	5° 49′.	Isaac P. Lindley, observer.
1865.9.	5° 55′.	Jacob Wyckoff, observer.
1865.9.	5° 50′.	Peter N. Van Nuys, observer.
1866.5.	6° 15′.	D. Annin, observer.
1867.3.	6° 00′.	S. Gano, observer.
1867.5.	5° 50′.	Jacob Wyckoff, observer.
1867.8.	6° 00′.	S. Gano, observer.
1867.9.	5° 50′.	Peter N. Van Nuys, observer.
1868.3.	5° 58′.	S. Gano, observer.
1869.3.	6° 00′.	Joseph Thompson, observer.
1869.5.	6° 00′.	Joshua Doughty, Jr., observer.
1870.1.	6° 00′.	Joshua Doughty, Jr., observer.
1873.4.	6° 27′.	N. McConaughy, observer.
1887.8.	7° 19′.	From 1 to 3 miles north of town.
		From the above the following series has been deduced:
1864.	5° 47′.	
1865.	5° 50′.	
1866.	5° 53′.	
1867.	5° 55′.	
1868.	5° 58′.	
1869.	6° 00′.	
1870.	6° 03′.	
1875.	6° 25′.	
1880.	6° 46′.	
1887.	7° 19′.	
1887.9.	7° 15′.	Foot of First mountain, north of town.
1887.9.	6° 42′.	Crest of mountain above. A value of 5° 56′ observed on face of mountain.
1887.9.	8° 32′.	In Washington Valley, 1 mile west of Martinsville. A value of 5° 31′ observed on north slope of First mountain.
1887.9.	7° 05′.	On crest of Second mountain, southwest of Mt. Horeb church.
1887.9.	7° 35′.	Just north of Mt. Horeb church. An apparent tendency of both trap ridges to repel the needle.

Sussex County.

		ANDOVER.
1881.7.	6° 25′.	Hill just west of village. Topographic Survey. Mr. A. H. Konkle says that lines in Sussex and northern Warren counties run between 1790 and 1815 require a correction of from 4° 15′ to 4° 20′.

Date.	Declination West.	
		CARPENTER'S POINT.
1873.6.	7° 05′.	United States Coast Survey, at Tri-State rock.
1874.6.	7° 01′.	Prof. E. A. Bowser, at same place.
1884.8.	7° 51′.	Topographic Survey.
1887.8.	7° 50′.	At Tri-State rock and on east side of river.
1839.1.	4° 40′.	Two and a half miles south of here a line bore in 1839.1, N. 44° 30′ W., and in 1887.8, N. 41° 35′ W. Another line bore in 1839.1, S. 45° 30′ W., and in 1887.8, S. 48° 50′ W.
		CULVER'S GAP.
1887.8.	7° 19′.	On turnpike, one-half mile west.
1887.8.	7° 29′.	Crest of mountain, south of gap.
1887.8.	7° 26′.	Summit of turnpike, 1 mile east of mountain.
		DECKERTOWN.
1887.8.	7° 29′.	Irregular variations of 10′ within a mile. This is the value at three stations within a radius of half a mile of the center of the village.
		DINGMAN'S, PA.
1884.8.	6° 13′.	Topographic Survey.
		FRANKLIN FURNACE.
1887.8.	6° 36′ to 7° 47′.	Brow of mountain near Two Bridges.
1887.8.	7° 38′.	At village. Local attraction amounting to 1 degree observed.
		HAMBURG.
1882.8.	7° 04′.	One mile south of village, west side of Wallkill. Topographic Survey.
		HIGH POINT.
1887.8.	7° 50′.	Top and west slope of mountain.
		LAYTON.
1887.8.	7° 11′.	On Pompey ridge, east of its crest line.
1887.8.	7° 25′.	In valley at village, 1 mile east of above.
		LIBERTY CORNER, N. Y.
1874.6.	6° 45′.	Prof. E. A. Bowser. Boundary Survey.
		MILFORD, PA., AND MONTAGUE, N. J.
1884.8.	6° 56′.	Topographic Survey.
1887.8.	7° 06′.	Near the bridge, both sides of the river.
1887.8.	7° 21′.	At the "Brick House," Montague.
		MONROE CORNER.
1887.8.	7° 03′.	Just east of cross-roads.
		MOUNT SALEM.
1887.8.	7° 39′.	From 1 mile southwest of the village westward to the foot of Kittatinny mountain a slight increase is observed.

Date.	Declination West.	
		NEAR WAWAYANDA MINES.
1874.6.	5° 09′.	Prof. E. A. Bowser. Boundary Survey.
		NEWTON.
1881.8.	7° 01′.	A. H. Konkle, observer.
1883.4.	7° 02′.	A. H. Konkle, observer.
1884.9.	7° 05′.	A. H. Konkle, observer.
1885.4.	7° 11′.	A. H. Konkle, observer.
1886.0.	7° 08′.	A. H. Konkle, observer.
1886.3.	7° 08′.	A. H. Konkle, observer.
1887.0.	7° 17′.	A. H. Konkle, observer.
1887.4.	7° 17′.	A. H. Konkle, observer.
1887.9.	7° 17′.	A. H. Konkle, observer.
1887.8.	7° 21′.	Just south of village.
		UNIONVILLE, N. Y.
1874.6.	6° 03′.	Prof. E. A. Bowser. Boundary Survey.
		VERNON.
1887.8.	2° 52′.	Brow of Wawayanda mountain, above village. Local attraction.
1887.8.	6° 15′.	Between village and railroad.
1887.8.	6° 41′.	West side of valley, one-quarter mile from meadow.
1887.8.	7° 08′.	Eastern foot of Pochuck mountain.
1887.8.	9° 08′.	Summit of Pochuck mountain, east of head of Decker pond. Both mountains seem to attract the needle here. The value, 6° 41′, is probably least influenced by this attraction.
		WARWICK MOUNTAIN.
1874.6.	3° 12′.	Prof. E. A. Bowser. Boundary Survey.

Union County.

		PLAINFIELD.
1887.9.	7° 40′.	South and west of town.
1887.9.	8° 18′.	Crest of First mountain, south of Stony Brook gap.
1887.9.	7° 42′.	Crest of Second mountain, road to Union village. Local attraction of 1° 40′ observed. The only effect of the trap ridges here is apparently local and irregular.

Warren County.

		ALLAMUCHY.
1887.8.	9° 00′.	On slope of mountain, road to Waterloo.
1887.8.	8° 18′.	At west side of village.
1887.8.	7° 45′.	In valley, 2 miles northwest. There appears to be a steady increase going toward the mountain.
		BELVIDERE.
1887.8.	5° 32′.	There is a steady decrease going southeast, which amounts to 50′ at a point on the mountain 1 mile east of Oxford church.

Date.	Declination ′ West.	
		BETHLEHEM, PA., SCHOTT'S TABLES.
1757.	6° 30′.	R. W. Walker, from bearings of old lines.
1784.	2° 53′.	Reference as above.
1799.	1° 52′.	Reference as above.
1841.5.	3° 26′.	Prof. A. D. Bache, at Easton, Pa.
1851.	3° 50′.	R. W. Walker, from bearings of old lines.
1874.5.	5° 20′.	Dr. T. C. Hilgard, near Lehigh University.
1878.2.	5° 37′.	R. W. Walker, from bearings of old lines.
1881.2.	5° 52′.	Prof. C. L. Doolittle, Lehigh University.
1882.7.	6° 05′.	R. W. Walker, deduced from 80 observations by students.
1884.0.	6° 06′.	R. W. Walker.
		BLAIRSTOWN.
1887.8.	7° 25′.	Average of both sides of valley of the Paulin's Kill.
		EASTON, PA.
1841.6.	3° 38′.	United States Coast Survey, Report of 1882.
1885.0.	6° 37′.	Schott's computation, Report of 1882.
		HACKETTSTOWN.
1887.8.	6° 25′.	Top of Schooley's mountain, 1 mile northeast of the mineral spring. Local attraction amounting to 3¼ degrees observed. Declination equals 3° 08′ at brow of mountain west of this point.
1887.8.	6° 50′.	On knoll south of village. West of the limestone quarries 8° 27′ was observed.
1887.8.	7° 02′.	Top of mountain just west of village.
		HARDWICK TOWNSHIP.
1866.1.	6° 03′.	Observed by A. H. Konkle at a point 2⅝ miles northwest of Marksboro, and 3 miles northeast of Blairstown.
1868.2.	6° 10′.	
1870.1.	6° 18′.	
1881.8.	6° 58′.	
1886.3.	7° 11′.	
		JENNY JUMP MOUNTAIN.
1881.8.	4° 45′.	Near south end of mountain on crest.
		PHILLIPSBURG.
1887.8.	6° 10′.	At several stations north and east.
		WARRENVILLE.
1881.7.	6° 00′.	Hill just west of village.
		WATER GAP.
1887.8.	6° 36′.	At Water Gap House, Pa.
1887.8.	7° 05′.	At Portland, Pa.
		There is a uniform increase in passing down the river through the Water Gap from Water Gap railroad station to Portland.

MAGNETIC DIPS AND INTENSITIES.

In Appendix No. 6, United States Coast and Geodetic Survey Report for 1885, will be found a complete collection and discussion of magnetic dips and intensities for the United States, by Chas. A. Schott, Assistant. Although this paper has to do principally with declination and its distribution, the collection of dips for New Jersey may prove useful to some in this connection.

Magnetic Dips and Horizontal and Total Magnetic Intensities in New Jersey.

STATION.	Year.	Dip.	Horizontal force.	Total force.	Reduced to 1885.		
					Dip.	Horizontal force.	Total force.
Cape May Light-house	1846.5	71° 25′.8	4.255	13.36			
Cape May Light-house	1855.6	71° 34′.4	4.182	13.23	70°.99	4.304	13.21
Cape May Light-house	1874.5	71° 28′.5	4.283	13.48			
Town Bank	1846.5	71° 23′.6	4.269	13.38	70°.88	4.334	13.23
Egg Island Light-house	1846.5	71° 45′.1	4.206	13.43	71°.24	4.271	13.28
Port Norris	1846.5	71° 39′.6	4.211	13.38	71°.15	4.276	13.24
Atlantic City	1860.6	71° 47′.0	4.205	13.45	71°.18	4.288	13.29
Pine Mount (near Greenwich)	1846.5	71° 41′.4	4.237	13.49	71°.18	4.296	13.32
Long Beach	1860.6	71° 58′.5	4.156	13.43	71°.37	4.240	13.27
Tuckerton	1846.9	72° 12′.8	4.063	13.30	71°.69	4.129	13.14
Church Landing, Salem county	1846.4	71° 22′.0	4.311	13.49	70°.86	4.377	13.35
Barnegat Light-house	1860.7	72° 05′.3	4.108	13.36	71°.49	4.191	13.20
Chew, near Mantua	1846.5	72° 14′.4	4.105	13.46	71°.73	4.171	13.31
White Hill	1846.4	72° 06′.2	4.147	13.50	71°.59	4.213	13.34
Trenton	1841.3	71° 59′.0	4.196	13.56	71°.46	4.242	13.34
Princeton College	1839.7	72° 47′.1	4.041	13.55			
Princeton, behind College	1842.8	72° 43′.5	4.010	13.50			
Princeton, near College	1843.5	72° 38′.3	4.222	....			
Princeton, near College	1844.0	72° 39′.5	....	....	72°.17	4.110	13.42
Princeton, near College	1844.4	72° 40′.2	4.016	13.48			
Princeton, Potts' woods	1844.4	72° 41′.4 72° 41′.2	4.017 3.999	13.50 13.44			
Princeton, on Rocky Hill (trap)	1844.4	72° 35′.0	4.049	13.53			
Mount Rose (trap)	1852.6	72° 42′.5	4.130	13.90	72°.16	4.211	13.75

Magnetic Dips and Horizontal and Total Magnetic Intensities in New Jersey—Continued.

STATION.	Year.	Dip.	Horizontal force.	Total force.	Reduced to 1885. Dip.	Reduced to 1885. Horizontal force.	Reduced to 1885. Total force.
Sandy Hook	1844.6	72° 37′.9	4.077	13.66	71°.93	4.081	13.16
Sandy Hook	1855.6	72° 52′.0	3.917	13.30			
Sandy Hook	1873.9	72° 29′.6	4.040	13.43			
Sandy Hook	1879.6	72° 08′.3	4.078	13.30			
New Brunswick	1844.4	72° 43′.2	4.008	13.50	72°.21	4.066	13.31
Snake Hill	1844.3	72° 45′.4	....	....	72°.25	....	....
Newark	1841.3	72° 48′.5	3.999	13.54	72°.31	4.037	13.29
Newark, Washington Place	18443	72° 50′.2	3.972	13.46			
Newark, on the neck	1844.3	72° 46′.3	3.986	13.46			
Newark	1846.4	72° 52′.2	3.964	13.46			
Fort Lee	1844.3	72° 41′.0	....	....	72°.17	....	....
Paterson	1844.3	72° 17′.0 to 75° 00′.0	....	....	....	....	....

SECULAR CHANGE OF MAGNETIC DECLINATION.

Mr. Charles A. Schott gives, in Appendix No. 12, Report of United States Coast and Geodetic Survey for 1886, a collection of declinations and a discussion of the secular change for the United States, which leaves little to be desired for the use of the surveyor. This work has been largely drawn upon for the following material necessary to make the results of the Magnetic Survey as useful as possible to the New Jersey surveyor. Matter of local interest has been extracted and to it has been added the information derived from the Magnetic Survey.

TABLE OF DECENNIAL VALUES OF THE MAGNETIC DECLINATION.

The values given below will be found useful when old lines have to be retraced. The amount of declination varies often two or three degrees within two miles or less, but the change of declination, from year to year, will be found to be practically the same over quite large

areas. The values at New York, N. Y., Bethlehem, Hatborough and Philadelphia, Pa., were carefully computed by Mr. Chas. A. Schott, and are given in Appendix No. 12, Report of the United States Coast and Geodetic Survey for 1886. The series for New Brunswick, N. J., was obtained graphically by reducing all of the observations available in the vicinity to that locality, and constructing an average curve with due attention to curves for New York and Philadelphia. It is recommended that where a surveyor has no other knowledge to guide him in taking out the change in declination between any two States, he shall use the New York series for the counties of Passaic, Bergen, Hudson, Essex and Union; the New Brunswick series for the counties of Sussex, Warren, Morris, Hunterdon, Somerset, Middlesex, Mercer and Monmouth, and the Philadelphia series for the remaining counties in Southern New Jersey. If he has accumulated data from long practice in resurveying old lines in one locality, however, he will be able to choose for himself the series which is best adapted to his vicinity.

Table of Decennial Values.

Year.	New York, N. Y.	New Brunswick, N. J.	Bethlehem, Pa.	Hatborough, Pa.	Philadelphia, Pa.	Cape Henlopen, Del.
1600	*5° 00′	....	....	....	....	*3° 00′
1610	6° 00′	....	....	....	....	4° 00′
1620	6° 30′	....	....	....	....	4° 30′
1630	7° 00′	....	....	....	....	5° 00′
1640	7° 30′	....	....	....	....	5° 30′
1650	8° 00′	....	....	....	....	6° 00′
1660	8° 30′	....	....	....	....	6° 30′
1670	8° 54′	....	....	....	....	6° 36′
1680	9° 06′	....	....	8° 18′	....	6° 30′
1690	9° 00′	....	....	8° 12′	....	6° 24′
1700	8° 42′	....	....	7° 54′	8° 12′	6° 00′
1710	8° 12′	....	....	7° 30′	7° 48′	5° 30′
1720	7° 42′	....	....	7° 00′	7° 24′	4° 54′

*Results for the seventeenth century are very doubtful.

Table of Decennial Values—Continued.

YEAR.	New York, N. Y.	New Brunswick, N. J.	Bethlehem, Pa.	Hatborough, Pa.	Philadelphia, Pa.	Cape Henlopen, Del.
1730	7° 18′	....	....	6° 24′	6° 48′	4° 12′
1740	6° 42′	....	....	5° 42′	6° 12′	3° 30′
1750	6° 00′	....	6° 06′	4° 48′	5° 18′	2° 48′
1760	5° 18′	....	5° 18′	3° 54′	4° 24′	2° 12′
1770	4° 42′	....	4° 30′	3° 06′	3° 36′	1° 36′
1780	4° 24′	....	3° 42′	2° 24′	2° 48′	1° 12′
1790	4° 24′	....	3° 06′	2° 00′	2° 18′	0° 54′
1800	4° 18′	2° 24′	2° 36′	1° 48′	2° 06′	0° 48′
1810	4° 24′	2° 52′	2° 18′	2° 00′	2° 09′	0° 54′
1820	4° 31′	3° 32′	2° 18′	2° 30′	2° 26′	1° 06′
1830	4° 55′	4° 12′	2° 30′	3° 00′	2° 55′	1° 30′
1840	5° 36′	4° 52′	2° 54′	3° 42′	3° 28′	2° 02′
1850	6° 21′	5° 18′	3° 27′	4° 21′	4° 04′	2° 39′
1860	6° 58′	5° 46′	4° 41′	5° 00′	4° 44′	3° 20′
1870	7° 28′	6° 30′	5° 00′	5° 42′	5° 26′	4° 02′
1880	7° 55′	7° 15′	5° 51′	6° 42′	6° 12′	4° 43′
1890	8° 24′	7° 40′	6° 40′	7° 36′	6° 58′	5° 20′
1895	8° 42′	....	7° 02′	7° 54′	7° 24′	5° 36′

SOLAR DIURNAL VARIATION.

This is the only other important change in magnetic declination, beside the secular change above considered, which is regular enough in character to be taken into account in observations. It consists of a swing of the needle through the 24 hours, averaging 8′ at Philadelphia, and varying from 10½′ in August to 6′ in November. It is generally so much within the limits of accuracy of ordinary sur-

veyors' instruments, and disturbances too irregular to be allowed for, but greater in amount than the daily range, occur so frequently that it may as well be neglected in ordinary surveying. In all observations for magnetic declination, however, it should be taken into account, and as it is to be hoped that these may be more frequently made in the future, the following table is appended. It is taken from a more extended one in the United States Coast Survey Report for 1875, p. 263. The + quantities are to be added to all west declinations and the — quantities subtracted, to reduce them to the mean value for 24 hours.

Corrections for Solar Diurnal Variation at Philadelphia, Pa.

	7 A. M.	9 A. M.	11 A. M.	1 P. M.	3 P. M.	5 P. M.
January	+1′.2	+2′.5	+0′.3	—3′.4	—2′.5	—0′.9
February	+1′.9	+2′.5	+0′.2	—3′.0	—2′.4	—1′.2
March	+2′.9	+3′.4	+0′.6	—3′.9	—3′.2	—1′.6
April	+3′.5	+3′.4	+1′.1	—5′.1	—4′.3	—1′.8
May	+4′.7	+3′.2	+1′.9	—5′.1	—3′.9	—1′.2
June	+5′.0	+3′.8	+1′.7	—5′.0	—3′.8	—1′.6
July	+5′.4	+4′.0	+1′.5	—5′.3	—4′.5	—2′.0
August	+5′.7	+3′.7	+2′.9	—6′.3	—3′.8	—0′.9
September	+4′.5	+2′.8	+3′.2	—5′.5	—3′.0	—0′.8
October	+1′.7	+1′.9	+0′.8	—3′.2	—2′.2	—0′.3
November	+1′.7	+1′.5	+1′.1	—2′.8	—1′.9	—0′.6
December	+1′.0	+1′.6	+0′.3	—3′.0	—2′.3	—0′.6

The other periodic variations are the *annual*, amounting to $1\frac{1}{2}$ minutes of arc, and the *lunar diurnal*, with a range of 27 seconds, and two maxima and two minima in each lunar day.

MAGNETIC DISTURBANCES AND STORMS.

These occur irregularly and are beyond the power of prediction. They are an important source of error in compass surveys, as the following table shows. It gives the observed disturbances in a bi-hourly

series at Philadelphia in the years 1840 to 1845, furnishing a good indication of the relative frequency and magnitude of such disturbances. It is taken from Appendix No. 12, United States Coast and Geodetic Survey Report for 1886:

Deviations from Normal Direction.	Number of Disturbances.
3′.6 to 10′.8	2,189
10′.8 to 18′.1	147
18′.1 to 25′.3	18
25′.3 to 32′.6	3
Beyond.	0

Mr. Wm. J. Young, of Philadelphia, observed with a fourteen-inch needle a variation of 1° 10′ in position within one hour during an active aurora. January 3d, 1870, Mr. William Haines observed during a time of brilliant auroral display a change of 2° 10′ in the position of the needle between 5:30 and 7:25 A. M., at Clarksboro, N. J.*

IMPERFECTIONS OF NEEDLE INSTRUMENTS.

The disturbances noted above and the irregular distribution of declination introduce unavoidable and unforeseen elements of error with even the most perfect instruments; but it may be well to call attention here to the differences which exist between different needle instruments, and even well-constructed ones. In faulty instruments, malformation or dullness of pivot, or bad centering, causes errors. In good instruments they may arise from loss of polarity of the needle, or from lack of coincidence between the line joining the two points of the needle and its magnetic axis. Even when this has been guarded against in construction, the position of the magnetic axis may afterward change. A gentleman largely engaged in the manufacture and repair of surveying instruments has, at my request, made some trials, and sent me the results. From three new compasses of the best construction he obtained the following:

	First Trial.	Second Trial.
No. 1	15° 8′.	15° 8′.
No. 2	15° 12′.	15° 14′.
No. 3	15° 15′.	15° 16′.†

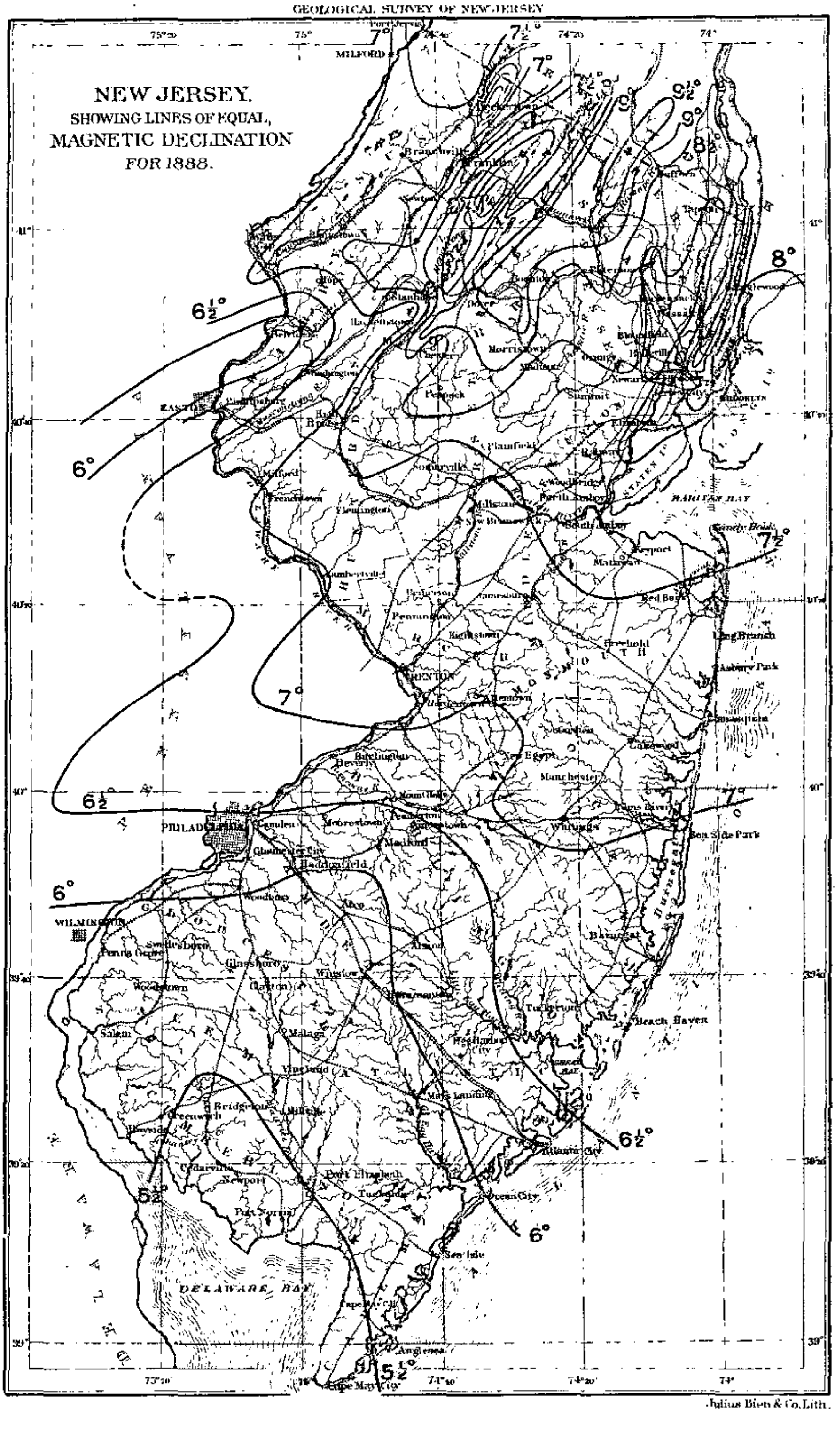
* Proceedings of the Surveyors' Association of West New Jersey, p. 61.

† Report to the Board of Freeholders of Middlesex county upon true meridian lines. Geo. H. Cook, 1864.

An analysis of 181 readings taken by the members of the West Jersey Association on their various instruments, shows that 122 of the readings are within 5′ of the adopted means which have been assumed to be correct. The remaining 59 readings are out more than 5′, and range up to 21′, and one reading is out 34′. Variations of 10′ are observed in the readings of a single instrument in several cases, and a departure from the mean, amounting to 5′, is not necessarily an indication of instrumental defects.

An examination of several instruments, made as a preliminary to the magnetic survey of New Jersey, showed in one case an error of $1\frac{1}{4}°$ in a needle with a tapering north point and thick south end, the pivot being at a point about one-third of the way from the south to the north end. In another case a symmetrically-tapered, nicely-balanced needle, four inches in length, showed an error of 25′. Another six-inch needle showed an error of 10′. These are rather exceptional cases, but as they are instruments of different makers, in good order, and carefully compared, they point out the danger of error from this source.

In conclusion, it may be said that the data given above are sufficient to enable compass surveys to be made with all the accuracy of which the method is capable. While the compass must still be used in retracing old lines, the teaching of the irregularities of magnetic declination shown by the isogonic chart and list of declinations, of the notes on magnetic disturbances, and those on instrumental defects, is clearly that no new surveys should be recorded by reference to the magnetic needle alone. The time has come when its use for this purpose should be discontinued throughout the greater part of the State.



Julius Bien & Co. Lith.

CLIMATE OF NEW JERSEY.

BY JOHN C. SMOCK.

INTRODUCTION.

Climate has been defined to be the sum total of the meteorological phenomena which characterize the average condition of the atmosphere on any part of the earth's surface. What we call the weather is a single phase in the succession of phenomena, and hence climate may be said to consist of the weather changes which are observed from year to year in any given period of time.* The chief elements or factors of climate are temperature, humidity, rainfall, winds and pressure of the atmosphere. It is the province of climatology to exhibit the different phases of these meteorological phenomena, and to ascertain the causes of these differences. Practically, all of them may be traced either directly or indirectly to the sun, as the source of energy and activity, and hence the origin of what are termed solar climates. But the variations in all the climatic elements on the same parallels of latitude point to disturbing or modifying forces or conditions. The principal factors in thus modifying the phenomena of climate are four, viz.: 1. Proximity and relation to water areas; 2. Prevailing winds; 3. Height above the ocean; 4. Shape and nature of the earth's surface and its covering.

In general, there are two types of climate, the continental and the oceanic or insular. On account of the varied surface, with its interlocking forms of land and water, there are many gradations from the one type to the other, and no sharp lines of demarcation are possible, or classification of all the kinds of climate, which result, in part, from these relations of sea and land. The climate of New Jersey partakes of the continental type, and is marked by extreme features, but softened in some degree by the nearness to the ocean. Omitting the consideration of the factors of climate and their modifications due to

* Hand-book of Climatology, by Dr. Julius Hann, page 1, Stuttgart, 1883.

varying conditions, in so far as these refer to the earth's surface in general, the climate of New Jersey is here discussed under the following heads, viz.:

I. *Temperature.*
II. *Winds.*
III. *Weight or Pressure of the Atmosphere.*
IV. *Atmospheric Precipitation.*
V. *Sanitary Relations.*
VI. *Permanency of Climate.*

TEMPERATURE.

The situation of New Jersey on the Atlantic slope of the continent, between the ocean and the higher ranges of the Appalachian chain, gives it a climate of continental type, greatly modified by its proximity to the ocean, and by its configuration of surface. The constant play of these disturbing elements in the climate produce variety within comparatively narrow limits. And the State, although small, exhibits diversities, which correspond somewhat with its varied surface features. The elevation of the northern part, and the nearness of the southern portion to the sea, tend to heighten the influence due to difference of latitude only. The nature of the soil and the forests of the southern interior counteract the effect due to proximity to the ocean, and still further modify the climate in that part of the State. To properly estimate the influence of these factors is the difficult problem of the student of climatology. The meteorological statistics of places within and near the borders of the State are too incomplete, and, in some cases, faulty, to exhibit the results of their inter-action at every locality, or even in the well-marked natural divisions of the State.

Following the divisions of the older geographers, there are: the alluvial and *southern;* the secondary, hilly and *middle;* and the mountainous and *northern.* A more natural and correct subdivision, based upon the geological and topographic features, would be: 1. Kittatinny Valley; 2. Highlands; 3. Red Sandstone Plain; 4. Southern Interior; 5. Atlantic Coast, or Seashore Belt. Inasmuch as the data are too scanty to separate the first and second, there remain four divisions, or natural climatic provinces:

I. Highlands and Kittatinny Valley.
II. Red Sandstone Plain.
III. Southern Interior.
IV. Seashore, or Atlantic Coast Belt.

A further subdivision will follow the accumulation of records of careful observations at many stations, and the true climatic provinces of the State will be made out. It will be understood at the outset that while these divisions have definite characteristics, it is not possible to define sharply their boundary lines, or to indicate where the one ceases and the other begins, since they shade by insensible graduations into one another.

For the location and limits of these divisions reference must be had to the geological maps of the State.

Their boundaries, extent, elevation and general surface features, which modify the general character of our climate, together with local peculiarities induced by their varying intensity, are described under their respective heads.

Table of Mean Temperature for the several Climatic Divisions of the State. Degrees—Fahrenheit.

DIVISIONS.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.
I. Kittatinny Valley and Highlands	25.5	27.1	34.6	46.6	56.5	65.1	69.6	67.5	60.2	48.8	39.0	29.1
II. Red Sandstone Plain	28.5	29.9	36.8	48.5	59.6	68.8	74.1	71.3	63.9	52.5	41.6	31.3
III. Southern Interior	30.8	32.7	39.1	50.2	61.5	71.3	76.1	73.2	66.1	54.5	42.9	33.5
IV. Atlantic Coast Belt	32.2	33.3	38.0	46.7	57.5	67.1	73.1	72.2	67.2	57.1	45.1	36.2

	Year.	SEASONS.				MARCH OF THE SEASONS.			
		Spring.	Summer.	Autumn.	Winter.	Winter to Spring.	Spring to Summer.	Summer to Autumn.	Autumn to Winter.
I. Kittatinny Valley and Highlands	47.4	45.9	67.4	49.3	27.2	18.7	21.5	-18.1	-22.1
II. Red Sandstone Plain	50.6	48.3	71.4	52.7	29.9	18.4	23.1	-18.7	-22.8
III. Southern Interior	52.6	50.3	73.5	54.5	32.3	18.0	23.2	-19.0	-22.2
IV. Atlantic Coast Belt	52.1	47.4	70.8	56.5	33.9	13.5	23.4	-14.3	-22.6

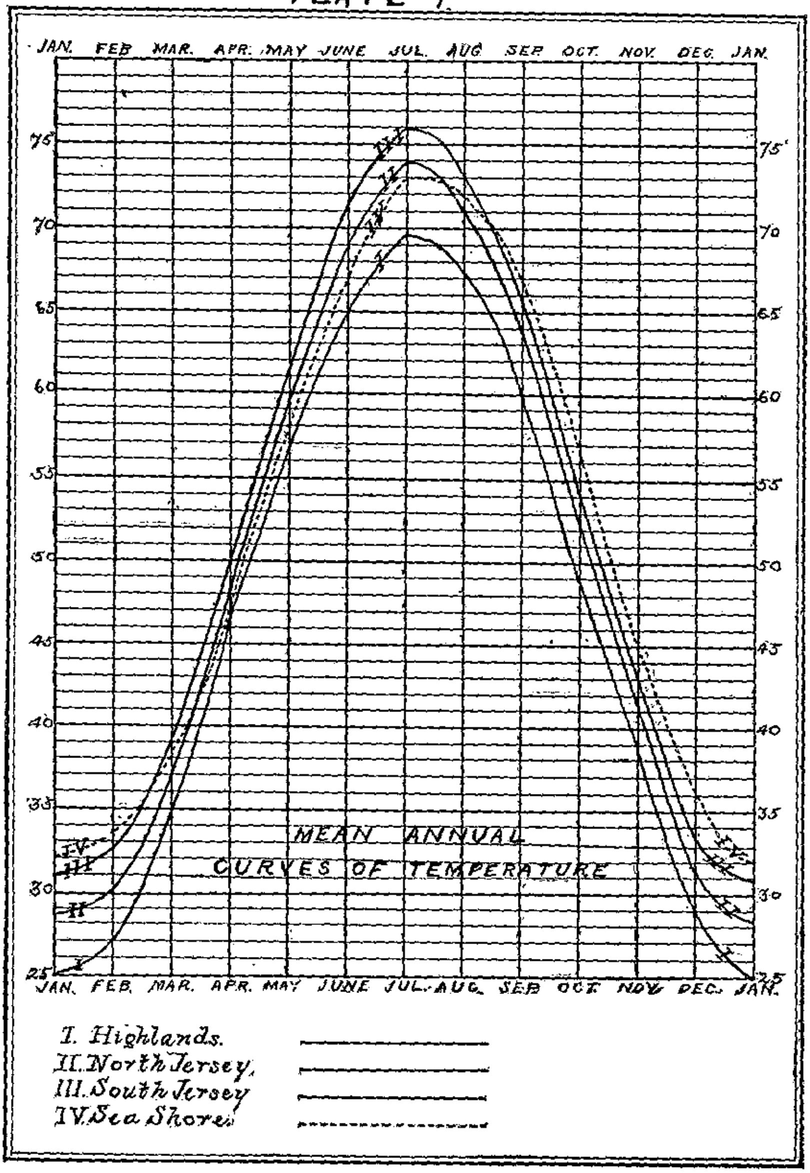
Introductory to these descriptions of the several provinces, and in order to convenience of reference, we give at the outset a table of mean temperatures for each month, season, and the year, in each of these four divisions of the State. They are obtained by taking the averages of the stations which are selected as representative of them. Thus, that of the *first* is the average of the mean daily temperature by months, as recorded at Goshen and Port Jervis, in Orange county, N. Y., and Dover, Morris county. The same method is used to get that for the seasons and the year. The figures of the table give the degrees and tenths, according to the Fahrenheit scale.

This table exhibits the gradual increase in the mean temperature of the months, of the seasons, and of the year, as we go from north towards the south, or from the Atlantic coast west-southwest. This difference between the Kittatinny valley and the southern interior amounts to nearly *one month* in the early spring, *i. e.* the temperature of February in the latter is nearly as high as that of March in the former. The differences of the seasons in the several provinces are not so great as in individual months. In general, it may be said that there is a difference of nearly one month in the spring, and a half month in the late autumn or at the beginning of the winter. The mean annual temperature ranges from 47°.41 in the north to 52°.6 at the southwest, a difference of about 5°, corresponding to 3° of latitude, or slightly more than the difference between the extreme north and south ends of the State.* New Jersey stands at the eastern end and near the south limit of the populous belt of our country, lying between the annual means of 45° and 55° of heat, and comprising the New England States, the Middle Atlantic States and the northern half of the great Mississippi valley.

A graphical representation of the table is given in Plate 1. The figures at the side express the mean temperature in degrees. These are connected by horizontal lines. The months are represented by vertical lines. The several divisions are represented by curved lines, and where these latter cross the monthly lines we have the temperature for months. The curves show the rapid increase of heat in the spring, particularly in April and May, in all parts of the State. The more gradual rise to the July maximum, and the varying rate of decline to August, are plainly shown. October and November bring

*The latitude of Carpenter's Point is 41° 21′ 22.63″. That of Cape May lighthouse is 38° 55′ 50″, a difference of 2° 25′ 32″, equivalent to 167.4 miles.

PLATE I.


JAN. FEB MAR. APR. MAY JUNE JUL. AUG SEP OCT. NOV. DEC. JAN.
75
70
65
60
55
50
45
40
35
30
25
MEAN ANNUAL
CURVES OF TEMPERATURE
I. Highlands.
II. North Jersey.
III. South Jersey
IV. Sea Shore.

the curves nearer together, as the heat decreases. The greatest divergence appears in the winter months.

The difference in mean temperature in the spring months has a marked effect upon vegetation, and the flowering of fruit trees is about three weeks earlier in the extreme southern part of the State than on the Highlands. The small fruits also come earlier, and are marketed before the picking begins in the central and northern counties. Early vegetables are produced in the southern part of the State as early as in Virginia. Melons, sweet potatoes and other semi-tropical products, which thrive so well in the central and southern counties, are scarcely attempted in the extreme north. There appears to be a difference of a week or so between Lambertville and the immediate Delaware River valley, and places in the interior and eastern side of the State, on the same parallels of latitude, in the earlier blossoming of certain plants and fruit trees.* But further observations are needed to indicate the extent of these differences of locality within our borders. The floras of the northern and southern counties differ widely, but how much is due to the nature of the soil and to proximity to the ocean water, and what is strictly owing to differences in heat, cannot be determined as yet with accuracy.

Following the isothermal lines of our State westward they diverge widely. The lines for the summers on our coast correspond with those for Northern and Central New York, and the region of the Great Lakes, while those of the southern interior correspond with the valley of the Ohio and Southern Missouri. The isocheimal or winter lines of the coast and of the southern end of the State also bend southward, and follow the same general direction as the isotherals, or lines of equal heat, for the summer. They show a milder climate than that of the same belt of latitude west of the State, and beyond the Appalachians. This ameliorating influence is due to the proximity to the ocean; and the same cause acts in summer to lessen the heat, particularly on the seashore.

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* According to 13 years' observations at Perth Amboy (1819-1831), the mean date of blossoming of peach was April 21st, and of apple May 2d. Thirteen years observed at Lambertville (1840-1855), gave the mean dates of April 14th for peach, and April 26th for apple.—*Blodgett's Climatology*, p. 507.

Observations for same years (1844-1857, inclusive,) at both places show similar differences of 0 to 13 days in blossoming of peach, cherry and apple.

I. HIGHLANDS AND KITTATINNY VALLEY.

This division of the State is peculiarly the mountainous one, and outside of it, to the south, there are no elevations of 900 feet above tide-level. It includes the Kittatinny or Blue mountain on the northwest, which rises to a maximum height of 1,800 feet near the New York State line. It comprises the Highland ridges and the included valleys. And, in short, it may be said to be that part of the great Appalachian chain which is comprised between New York and Pennsylvania, within the bounds of New Jersey. The Ringwood, Rockaway and Longwood valleys, the Succasunna plains, German valley, Musconetcong, Pohatcong and Pequest valleys are the principal depressions in the Highland plateau or table-land. Their general trend is northeast and southwest, conformable to that of the ridges. The crests of the mountains are from 300 to 600 feet above the valleys, and are remarkable for their uniform elevation. And the average height above the ocean is 900 to 1,200 feet on the southeast, and 1,000 to 1,400 feet on the northwest. Budd's lake, Lake Hopatcong and Wawayanda lake lie in rather shallow depressions in it. The whole district may be viewed as a table-land from 900 to 1,500 feet high.

The Kittatinny valley is a section of the great valley which, from Canada to Alabama, is known as a continuous valley, under various local names. It lies between the Highlands on the southeast and the Kittatinny mountain on the northwest. At the Wallkill, on the New York line, its height is only 383 feet; at Belvidere, on the Delaware river, it is only 235 feet above tide, but in some of the slate ridges it attains a height of about 1,000 feet.

The surface of the Highlands at the southwest, in Hunterdon and in parts of Warren and of Morris counties, is marked by its smooth and uniform slopes, and it is largely in farms and under cultivation, whereas to the northeast, in Sussex and in Passaic, and, in general, north of the line of the terminal moraine, the glacial effect has been such as to leave it much more uneven and rocky, and consequently unsuitable for easy cultivation. And probably 75 per cent. of its area there is still in forest. The drainage of that portion lying to the south of the drift line is rapid, and there are no large tracts of wet or swampy lands as are found north of it. For a description of the marked differences of surface features between these sections of

the Highlands, the reader is referred to the last annual report of the Geological Survey.

In the Kittatinny valley the surface is very generally cultivated, and three-fourths of the area is cleared and in farms.

The Kittatinny, or Blue mountain, remains an almost unbroken forest belt.

These diversities of surface, the differences in height above the ocean, the configuration or shape and the trend of the valleys and ridges, all tend to produce differences of climate, although so small as scarcely to be detected among our few and short series of observations. As stated in the introduction, other things being equal, the mean temperature decreases about 1° for every 300 feet of increase in height. Applying this rule, we should expect to find that of the Highlands about 2° below that of the Kittatinny and other valleys, which are included among the Highlands. And at the same rate of decrease the crest of the Kittatinny mountain would have a mean temperature of 3° or 4° below the valleys on either side. That it is more exposed to the wind and sensibly cooler, is well known and observed by the visitors to the Delaware Water Gap and to High Point.* But the range is so narrow that the warm currents of the day cannot be cooled very much in their rapid passage up its comparatively short slopes and over its crest. The westerly winds coming from off the more wooded and mountainous country to the north and west are probably less heated than the same currents are after their passage across the Kittatinny valley. The differences are no doubt greater, *as felt*, than instruments would record. The earlier snowfalls on the Blue mountain at the beginning of winter show that the average temperature is lower. And the snow-covered crest is a common phenomenon to the inhabitants of the valley when that is yet bare.

The valley of the Delaware, from Port Jervis to the Water Gap, experiences high summer temperatures, although we have no records excepting that of Port Jervis, N. Y., at the extreme northern end of the State. Its average monthly temperature for the summer months is as low as that of Goshen, N. Y., which is in the Kittatinny valley and on nearly the same parallel of latitude. It corresponds closely

* The same range, as it continues in New York State, and is known as Shawangunk mountain, is found to be somewhat cooler than the valley on the south. Observations at the noted summer resorts of Lakes Mohonk and Minnewaski, in Ulster county, show it.

with that of Dover, in Morris county. The winter appears to be 2° to 3° colder than at the latter place. Compared with Easton, Pa., and Phillipsburg, on the Delaware, the winter is colder and the summer months also. This valley is much visited in summer and autumn by tourists who seek comfort, pleasure and health in its attractive localities. The beautiful and wild scenery, and the fishing and hunting, for all of which it is noted, divert the attention so that the extremes which are sometimes reported are not felt seriously. The greater coolness of the nights, especially in the summer, as compared with that of our cities near the sea-board, enable one to endure the same extremes by day with much more comfort. As compared with Newark, the Port Jervis record shows that the winter is 4° to 5° colder in the monthly averages, while the summer is 3° to 4° cooler. The extreme range of temperature is greater, reaching 8° to 10°, due mainly to the lower minima in the winter.

No meteorological observations are known to have been kept on the Kittatinny or Blue mountain, excepting at the U. S. C. S. station, at Culver's Gap, in Sussex county, where tri-daily observations on temperature were made from August 19th to September 29th, 1881, by A. A. Titsworth, M.S. In that time a maximum of 102° was reached (the thermometer hanging in the shade in the open air) on the 7th of September. The minimum and the daily means differ but little from those recorded by Mr. Whitehead, at Newark. But no conclusions about mean temperature can be drawn from this record. The night and morning hours in still weather on this crest would probably give higher readings than the valleys on each side, in consequence of the colder and denser strata of air settling in these valleys, leaving the warmer air about the mountain tops.

In the Kittatinny valley and the Highlands we have records at the following localities:

Deckertown, Sussex county	7 months.
Newton, Sussex county	8 months.
Dodge Mine, Morris county	1 year, 6 months.
Dover, Morris county	5 years, 4 months.
Mount Olive, Morris county	4 months.
Phillipsburg, Warren county	5 years (in part).

The periods covered by these records are so short that it has seemed necessary to add to them that of Goshen, Orange county, N. Y., which is 11 years in length, and that of Easton, Pa., 7 years long. Goshen

is 12 miles from the State line, but the valley there has the same general features as in Sussex county, and hence it seems fair to assume that it is representative of the northern part of *our* Kittatinny valley. Easton is at the extreme southwest, separated by the river only from our territory. It may stand for the lower or southwest parts of our Musconetcong and Pohatcong valleys, as well as the Kittatinny valley. These two stations may represent that part of the great Kittatinny valley, which is within the limits of the State. The Goshen record shows that the winter minima fall 5° to 30° below zero; and the summer maxima reach 96° above zero. The Easton records have the extreme range from 14½° below to 102° above zero. The mean temperatures at Dodge Mine and at Dover have been compared with the Newark record, for the same periods, and then reduced so as to give more fairly comparable averages for the Highlands. As compared with Goshen, N. Y., the observations at the Dodge Mine run nearly alike in the winter months; the differences in autumn and summer are small; the spring months are colder at the latter place. Possibly the later melting of the winter's snows in that wooded, mountain district, retards the advance of heat in the spring. The record at Dover shows an average monthly temperature of 2°.4 above that at the Dodge Mine. It appears to represent a Highland valley; and, with Easton, Pa., these valleys are fairly represented. It is noticeable that these two stations agree closely in the averages for the colder months; whereas, during the warmer part of the year, the mean monthly temperature at Easton varies from 2° to 4° above that of Dover. The records are too short to afford data for the extreme ranges of temperature; and, in order to get a longer series from the Highlands, that of West Point, on the Hudson river, and near tide-level, has been inserted in the tables of temperature. Its wide range agrees with that of Goshen, in the same county—our Kittatinny Valley station. As compared with Newark, the Highlands have an average monthly temperature 2° to 6° lower, being greatest in autumn.

In general, the climate of the Highlands is not marked by excessive extremes of temperature. The spring opens a few days later than it does in the valleys and on the Red Sandstone plain, but it advances rapidly, so that May is nearly as warm, and vegetation on the first of June is quite as forward, as on the lower lands.* The summer is not

* On Schooley's mountain the spring is five to eight days later than it is in the Musconetcong valley, and the wheat and rye harvests are nearly as much later.—*Wm. W. Marsh, of Schooley's Mountain.*

marked by so great extremes of heat, and hence the hot weather is much more endurable. The attractiveness of Schooley's mountain, Budd's lake, Lake Hopatcong, Newfoundland and Chester, is no doubt greatly owing to the absence of excessively high temperature in midsummer. But more marked are the lower night temperatures, and all travelers and tourists going from our cities into the Highlands notice the cooler and more refreshing nights, and thereby experience the relief which comes from such a delightful change. In the winter the lowest temperatures are but little below those observed in Newark and the central part of the State, although the average minimum may run uniformly lower than in the latter. It is said by observers of the weather that the extremely low winter temperatures on the hills are often several degrees above what is recorded at such times in the adjacent valleys. This striking phenomenon has been particularly observed on Schooley's mountain, which has the deep German and Musconetcong valleys on its sides. Such phenomena accord with what has been observed elsewhere in mountainous countries, and they harmonize with the explanation given on a preceding page in reference to the Kittatinny mountain. The frosts come later in autumn on the hills and ridges of the Highlands than they do in the valleys. But the low and wet, swampy depressions among the hills, especially north of the terminal moraine, are not thus favored. In some of the wet localities in Sussex county frosts have been known to occur in August. This exemption from frost is more marked to the southwest, in Hunterdon and Warren counties and the southern part of Morris county. Generally there are no frosts which injure vegetation much before October, and in some years none are severe before the first of November. The most remarkable and striking difference between the Highlands and the Red Sandstone plain, to the south and east of them, is the earlier appearance of snow in the late autumn or at the beginning of winter. The same storm bringing rain to the latter, covers the higher mountain ranges with snow. This first coming of snow is often a fortnight earlier; and the sleighing season begins earlier and continues later than it does in the central or eastern parts of the State. Even between Schooley's mountain and Hackettstown there is often all the difference between good sleighing and roads bare of snow. From New Brunswick a like difference between the red shales of the Raritan valley, and the snow-covered Chester and Fox hills ranges in the northwestern horizon, is often observed. As the

weather grows colder this distinctive mark is obliterated by the winter storms, which sweep over the whole country and envelope all alike in snow.

In the winter the cold is not sensibly greater than in the lowlands, although the minima recorded at Goshen and Easton and West Point run several degrees below those of Newark, New Brunswick and Trenton. And this is true in the face of much longer periods at the latter places, giving opportunity for lower extremes. The West Point series, so much longer, appears to confirm the occurrence of low winter temperatures in the valleys. The northeast and southwest courses of these valleys in a measure protect them and permit the free movement of warm, southwest currents of air through them, far into the Highlands. The northwest sides of the valleys are sheltered, as it were, by the steep hills and mountains to the west of them. The southern slopes are more nearly exposed to the perpendicular action of the sun's rays, and thereby more quickly warmed than those to the north. The greater depth of the snow in the spring, on the northerly mountain slopes, shows the less active melting influence of the sun on that side of the hills generally.

The well-drained surface of the more southern part of the Highlands, and the more porous and drier gneissic soils must have some influence upon the humidity and the temperature of the air, and upon the general healthfulness of the country. Then, again, the greater proportion of cultivated area, as compared with forest, makes the surface drier and so affects, indirectly, the climate. To the north of the terminal moraine line there is much more wet and swampy land and a much greater area covered by forest. These unite in making the air more damp, and their effect is, as has been stated in the introduction, to lower the temperature slightly.

It is unfortunate that we have so few meteorological stations in this part of the State, since it would be of great interest and of public importance to show by figures the differences which are here indicated by general statements only. And not only to demonstrate these positions, but to exhibit the features of climate, which make the Highlands so attractive for tourists and for rural homes and retreats, and so comfortable and health-giving to both the natives and also to the invalids who seek strength and health on these hills.

II. RED SANDSTONE PLAIN.

Under this head is placed the middle (or more properly, the north central) division of the State, and which is coincident with the limits of the new Red Sandstone formation. The larger part of Passaic, Somerset, Morris, Hunterdon, Mercer, Middlesex, Union, Essex, Hudson and Bergen counties are in it. And it has a breadth of 15 to 30 miles, and stretches south-southwest and west-southwest, to the Delaware river. As compared with the deeply-furrowed and mountainous Highlands on its northwest border, it seems as it were, a great plain. But its surface is diversified by gently-swelling ridges and by jagged and steeply-sloping trap-rock hills and mountains. They divide it into subordinate valleys. The Upper Passaic valley is one of them thus shut in by trap-rock ranges. In the central part of Hunterdon county, between the South Branch and the Delaware, there is an elevated district or kind of table-land. The Round valley, near White House, is a small but notable example of another of these valleys. At present it is impossible to show any differences in temperature, or climate, which these natural divisions suggest.

The general slope of the plain is southward, from the border of the Highlands, where the height is 300 to 400 feet, to tide-level on southeast and east.

The trap-rock ridges rise 200 to 500 feet above the adjacent Red Sandstone country, culminating in High mountain, at 879 feet, and in the Watchung mountains, at 691 feet. The Palisade mountain range is 300 to 522 feet high. These mountains are nearly all still in forest, whereas the plain has scarcely any forests left, excepting in Bergen and Morris counties. In the absence of comparative records, it is not possible to show what the differences in temperature are between the Palisades and the low-lying country on the west. The valley of the Upper Passaic also ought to have a slightly different range in temperature and rainfall, as well as in other climatic elements. No doubt there are differences, corresponding to what is known to exist between the Highlands and its included valleys. A difference is noticed in the frosts and in the early winter snows which whiten the hills, when the plain to the east is still bare. Certain it is that the residents of Madison, Caldwell and Orange mountain believe that their rural homes are more comfortable during the hot weather than residences in Newark or New York. But the more open situa-

tions in the country, which allow a free circulation of the air, are an advantage which may offset mere temperature. The measurement of the total air movement, or the winds, would show a great difference in favor of these hills. The greater percentage of area in forest on the trap-rock ridges also exerts an ameliorating effect in the warmer months. The hot, southerly winds, striking the mountain tops and passing over woodland whose soil is not parched and dried up by long-continued drought and heat, are sensibly cooled.

The country to the west and southwest of the Watchung mountain ranges, and which is drained by the Raritan, is a low-lying plain, almost bare of timber, and it is, consequently, exposed to both the full sweep of the winds, and to the heating effect of the sun's rays. It is subject to the extreme temperatures of the summer, whilst the greater part of it is too far from the ocean to enjoy its equalizing influences. The records of New Brunswick and Trenton give high summer temperatures, not exceeded by any other records in our table. The remarkably large area almost entirely destitute of forest, and the quick-drying shale and sandstone soils, allow of an accumulation of heat in them. And it seems as if there was some connection between the soil and the lateness of the frosts in autumn, which keep off longer than they do in the Highlands and the Kittatinny valley. The mean difference in temperature due to this bared condition of the country can amount to 1°.3, as mentioned above.

West of the South Branch and north of Flemington there is a table-land 500 to 800 feet high, and occupying an area of nearly 150 square miles. The Delaware flows along its southwest border, or, more properly, it may be said to flow through it, as the elevated country continues westward into Pennsylvania, and the river has eroded a deep cañon-like valley through it from above Milford to Lambertville. Such an average height must reduce the mean temperature at least 1°, as compared with Lambertville and Trenton, or other localities in the lower surrounding country. But we possess no meteorological records from it.

The Red Sandstone plain has a well-drained and naturally dry soil, excepting in the Upper Passaic valley, where there are extensive tracts of wet meadows and swamps, and some smaller areas of wet lands in Union county. These are all north of the terminal moraine line. There is also more forest, in proportion to the whole surface, in the country to the north of the same line than in the central or

western parts. The trap-rock soils are all cold, and generally wet, even when cleared and cultivated. The effect of these variations in the soil, though slight, cannot be wholly ignored. They are capable of measurement in the Upper Passaic valley, and on the Watchung mountains, if not elsewhere.

The varying distances from the ocean also have their influence. The records of Bloomfield, Newark and South Orange, when compared month by month with New Brunswick, Somerville and New Germantown, show the more even temperatures at the former, amounting to a little over 1° for the autumn and winter, whereas in the spring and summer the variation is reduced to a minimum.

These disturbing or modifying elements in the several parts of this province or division of the State are not so marked in their results that we can do more than indicate a probable further subdivision, according to the well-marked natural lines mentioned above.

For the list of stations, with their elevation and length of observing period, as also names of the observers, reference must be had to the folded table of temperature. The greater number of stations and their long series, as compared with the scanty records of the Highlands, are noteworthy. But this is the densely-populated belt of the State, and there are living on it 650,000 inhabitants, or more than half of the people of our State. Its climate affects the majority of our population, and hence the importance of records from so many localities.

The mean temperature, by months and seasons, at the several stations, together with the maximum and minimum for the months and year, are given in Table of Temperature. And the mean temperature for the five principal stations, which represent fairly this part of the State, is given in the first table on page 327. The annual mean temperature is 50°.6, or about the average for the whole State. The figures from the several station records vary from one another to the extent of 2° in the averages for the months. Thus, New Germantown, near the northwest border, has the lowest temperature of these stations of longer records. And the difference is mainly in the autumn and winter months. Readington, with a shorter record, is marked by higher temperature than New Brunswick, but a further and longer term of observing may show less contrast between these places. The closer correspondence between Somerville and New Brunswick, seems to indicate that the record for Reading-

ton is abnormally high in its averages for the months. Comparing Lambertville, on the Delaware river, with Newark, both of which are long series, the monthly and seasonal averages agree quite closely. The only notable difference is in the autumn, which, at Newark, is nearly 2° warmer than the same season at Lambertville. The correspondence throughout all the monthly averages for Newark and Paterson, is remarkable, especially in view of the wide margin in the rainfall comparison of these cities. The long records at Morrisville, Pennsylvania, opposite Trenton, and at Fallsington, in Bucks county, also in Pennsylvania, are inserted in the long table on temperature. And they may be taken to represent the southwestern end of this division better than the Trenton observations. They indicate about a degree warmer average winter temperature than that of New Brunswick. And the more luxuriant growth of the common ivy at Trenton than at the latter city also proves a milder winter. The range of temperature for the year at these stations near the Delaware and at New Brunswick, is slightly greater than it is at Newark or at points on the waters of New York and Raritan bays.

The climate of this belt, so far as temperature is concerned, approaches nearest to what may be considered an average of the State. There is greater uniformity of surface than in that of the Highlands, and there is less forest in proportion to the whole area, than in any other division of the State. The range of temperature for the year is, however, larger than in the other climatic provinces, stretching from 22° below zero to 103° above, or 125° for the year. These figures are the results derived from long series of observations stretching over half a century, whilst in the other parts of the State we are confined to much shorter periods. The monthly variations also are wide, and ranges of 70° in a given month have been recorded. March generally affords the greatest extremes, owing to sudden warm periods of short duration, when the thermometer reaches an unusually high maximum. The winter months also have wide ranges, due to extremes in both directions from the mean temperature. While there are these high monthly ranges, the climate is not excessive. The winters are less severe than they are in the Highlands, and are not quite so long. And occasionally they are very mild, and the ground is unfrozen and the streams are free from ice, even in midwinter. The cold weather usually comes about the holidays, and is accompanied with the formation of thick ice and snow. A common phe-

nomenon is the "January thaw," which may be termed a period of a week or ten days of mild weather, when the frost disappears almost entirely from the ground and ice breaks up in the streams, giving rise to freshets. The examination of long-continued observations has so far failed to detect any regularity in the occurrence of such a warm spell. All that can be said of it is that it is not uncommon.

The coldest weather occurs most generally in January and the middle of the month, but to this rule there are many exceptions. In the winter of 1880–1881 the cold day was the last of December. The winter may be said to continue until the middle of March. The advance of the spring is generally slow until the latter part of April or first of May; but from that time onward it is rapid. Both the spring and autumn are shorter than our calendar seasons; and the more natural divisions of the year for all the central part of the State would be, winter until the vernal equinox, three and a half months; spring until June, two and a half months; summer until near the autumnal equinox, or to the middle of September, three and a half months; then autumn until first of December. The cold and hot seasons cover more than one-half of the year. A reference to the diagram, Plate 1, will illustrate this statement. The period free from frosts, or what may be termed the growing season, often continues quite into October, and sometimes to November. Frosts have been known earlier, as in such an exceptional year as that of 1816. But the three summer months are, practically, exempt from any frost.

The winter usually begins about the first of December, when the ground begins to freeze and ice is formed. In November there is a variable period of warm and smoky weather, which is known as "Indian Summer," apparently due to smoke from forest fires in the more wooded districts to the north and northwest. The subject of its occurrence has been studied elsewhere, and at Toronto, in Canada, a long series of observations appears to show that its occurrence is limited to the period of October 5th to November 23d, generally coming October 27th to November 2d, and lasting six and a half days. Here in this belt, as in the northern and also in the southern interior belts or provinces, the so-called "Indian Summer" is always anticipated, although the cold preceding it may have the semblance of early winter. Snow sufficient for sleighing, for a short period at least, occurs every winter. In this particular the belt marks a transition from the Highlands, where *sleighing snows* mark every winter, to the

southern interior, where there may pass a winter without sleighing. That of 1879 and '80 was remarkable for its slight depth of snow, and its generally warm weather. Reference to the historical notes and to chronological notes of the weather on succeeding pages will afford examples.

III. SOUTHERN INTERIOR.

In the northern half of the State the geological structure is the basis for our climatic divisions. In the southern part the nearness to the waters of the ocean on the east, and to the Delaware bay on the west and southwest, exerts a modifying influence; the elevations above ocean level are comparatively so inconsiderable that they may be disregarded altogether. The nature of the surface and the character and extent of the forest disturb but slightly the climate, as determined by latitude, by proximity to the sea and by prevailing winds.

Under this head all of the southern part of the State is included, except the narrow belt bordering the ocean and a part of Cape May, which make the fourth climatic province of this description. The limits on the north cannot be indicated or traced except in an approximate way. But the line may be said to follow the Raritan bay and river and then Lawrence's brook, and thence a southwest course to the Delaware near Trenton. Of course, it is understood that all of these divisions merge gradually into one another, and that no sharp lines of demarcation are possible.

The southern part of the State has an average height of 200 feet along the divide between the Atlantic ocean and the Delaware river. The surface slopes gently each way to these waters and to the Delaware bay at the southwest. There are no rocky outcrops nor any steep slopes, as in the northern part of the State. The surface is gently-rolling to hilly, and the elevations have no measurable effect upon the temperature, so far as our records show. In regard to the nature of the soil, it is in general comparatively sandy. And the pine-land belts have broad expanses of glistening white sand surface, on which there is a very scanty growth of pitch-pine (*P. rigida*), and scattering, scrubby oaks. They are parts of the so-called "pine barrens" of older writers. The general influence of soil and forests has been mentioned in the introduction and referred to in the descriptions of the Highlands and of the Red Sandstone plain. In this

province their influence is more marked than to the northward, on account of their striking peculiarities. And it is most evident in the temperature of localities. The conductive power of such soils and land surfaces is such that they become intensely heated by the sun's rays falling directly upon them, both more rapidly and to a greater depth than more clayey and grass-covered soils. In short, they are *warm soils*. They often become so hot in the heat of the day as to be almost unbearable to the touch of the bare foot or hand. The stratum of air in contact with so hot a surface is also heated, and in this way the lower atmosphere is raised to a higher temperature than it would be over a cold, wet soil, or over water. The influence of such a sandy soil is both heating and drying, and somewhat like that of a desert, making the days hot and the nights, owing to rapid radiation of the heat, cool, and producing a wide daily range. Hence, also, the occurrence of frosts late in the spring and early in the autumn also. The heat of the day forces vegetation forward early in the spring and then the cold of the night may bring frost to kill it.* While the influence of so sandy a surface is greatest in the pine-land belts, it is felt throughout this whole division to some extent. The observations at Atco and Vineland show something of the extremes of temperature, although the averages of the daily range would be more expressive of their extent. As it is, the range of temperature during the year varies from 98° to 116° at given localities, or to 121° for the whole of South Jersey. And a range of 84° within a month's time has occurred.

The mean temperature also runs high in the summer, particularly at Atco and Vineland. That of the winter is not correspondingly so much higher than like months or seasons in the northern part of the State.

The climate of this large division varies a little from north to south, being warmer at the southwest, and also from east to west, but these variations are confined within narrow limits. The observations at Freehold show in general a lower temperature for all the months than that of any of the other stations. It is possible that the difference is that corresponding to that of latitude alone. Along the Delaware river from Bordentown down, there is a very narrow

* A remarkable instance of late frost occurred in the beginning of summer, June 6th, 1878, which was felt in Ocean and Burlington counties severely. The tender oak leaves were killed and fell off and were succeeded by a second growth, giving to the forests a strangely unseasonable appearance.

strip of country which is influenced by the proximity of the river. The prevailing west and southwest winds, as they sweep across it, are no doubt slightly cooled by it, in the summer and autumn months, while later in the season the presence of such a body of water tends to raise the temperature. On account of its soil it is noted for its adaptation to the production of early vegetables and small fruits. And truck farmers say that within a short distance of the river the frosts are not so late in spring, and *keep off* later in the autumn than they do further from it. In general, the climate differs little from that of the Red Sandstone plain, described above. The seasons are all from one to three degrees warmer, with the greater difference in the winter, owing to the equalizing effect of the greater nearness to the ocean. There is less snow, on the average, and the ground is bared sooner by the more rapid melting. The winter of 1880–81 was, however, an exception, and the snowfall in Monmouth county was nearly twice the depth of that in the northern part of the State. For the details of localities the reader is referred to the table on temperature, which gives the mean maximum and minimum temperatures, monthly at the stations.

The following tables, from the records of Thomas J. Beans, at Moorestown, in Burlington county, and of Dr. John Ingram, at Vineland, in Cumberland county, showing the late and early frost dates and the periods between frosts, are here inserted as bearing upon these important phenomena of climate. The observations at Moorestown are from 1865 to 1887, inclusive; those of Dr. Ingram extend over fifteen years—from 1866 to end of 1880. They fairly represent the southern interior. The average length of the season at Moorestown is 179.6 days, or about six months. The Vineland table shows the severity of the winter also. And both indicate June, July, August and September as the warmer months, free from all frosts.

Table of Frosts.

By Thomas J. Beans, Observer, Moorestown, N. J.

YEAR.	Frosts Injuring Tender Vegetation. Latest in Spring. Date.	Earliest in Autumn. Date.	Length of Season. Days.
1865	April 14	October 14	186
1866	May 15	October 5	143
1867	May 14	October 25	174
1868	April 24	October 17	176
1869	April 15	October 21	189
1870	April 20	November 8	202
1871	April 18	October 21	186
1872	April 23	October 29	189
1873	April 13	October 26	196
1874	April 30	October 15	168
1875	April 25	October 13	171
1876	April 26	October 12	169
1877	April 15	November 4	203
1878	April 17	October 22	188
1879	May 10	October 29	164
1880	May 1	October 19	170
1881	April 27	October 6	162
1882	May 3	November 3	184
1883	April 30	October 17	180
1884	April 22	October 26	188
1885	May 12	October 23	164
1886	April 9	October 17	191
1887	April 21	October 16	178
Range	April 9	October 5	203
	May 15	November 8	143
Average length of season			179.6

Table of Frosts.

By Dr. J. Ingram, Observer, Vineland, N. J.

YEAR.	JAN. Days. Some Frost.	JAN. Days. All Frost.	FEB. Days. Some Frost.	FEB. Days. All Frost.	MAR. Days. Some Frost.	MAR. Days. All Frost.	APR. Days. Some Frost.	APR. Days. All Frost.	OCT. Days. Some Frost.	OCT. Days. All Frost.	NOV. Days. Some Frost.	NOV. Days. All Frost.	DEC. Days. Some Frost.	DEC. Days. All Frost.	YEAR. Some Frost.	YEAR. All Frost.
1866	21	5	20	4	15	...	3	...	1	...	10	...	23	13	93	22
1867	29	22	10	2	14	3	...	...	3	...	9	...	26	11	91	38
1868	26	13	28	17	14	4	5	...	4	...	10	...	26	11	113	45
1869	22	4	17	4	19	5	...	...	5	...	16	...	22	3	101	16
1870	12	2	23	4	16	3	...	...	1	...	7	...	18	7	77	16
1871	23	12	18	5	4	...	...	...	1	...	12	3	20	10	78	30
1872	24	11	25	5	22	5	...	...	2	...	13	2	27	12	113	35
1873	23	8	22	10	15	...	...	...	2	...	16	...	14	1	92	19
1874	16	6	21	8	13	1	4	...	2	...	15	1	21	3	92	19
1875	28	15	23	15	17	3	2	...	1	...	13	1	15	5	99	39
1876	17	5	16	5	17	2	1	...	3	...	7	...	30	17	91	29
1877	27	11	17	2	13	4	1	...	1	...	7	1	14	...	80	18
1878	21	10	17	3	5	...	...	...	1	...	8	...	23	11	75	24
1879	26	10	25	7	15	...	...	...	2	...	12	1	12	3	92	21
1880	12	...	17	3	12	...	5	...	6	...	21	7	27	16	100	26
Range	29	22	28	17	22	5	5	...	6	...	21	7	30	17	113	35
	12	5	10	2	4	0	0	...	1	...	7	0	12	0	75	16
Means	22	9	20	6	14	2	1.4	...	2	...	12	1	21	8	92	26

Note.—"Some Frost" means any degree of frost, and includes whole frosty period, recorded by days. "All Frost" indicates days when temperature throughout is below 32°, or freezing.

At the southwest, bordering the Delaware bay and the lower part of the Delaware river, there is a belt of low, alluvial necks and tidal meadows, whose proximity to these waters and whose more *clayey*, cultivated soil, mark it as almost a subdivision or subordinate part of this climatic province. In the absence of long records at well-located stations of observation, it is not possible to define the limits of this belt, or to prove the existence of any marked peculiarities in climate.

The results of a comparison of Greenwich and Newark for a like period are: 2°.7 warmer, spring; 2° warmer, summer; 2°.5 warmer, autumn, and 4° warmer, winter season. And in comparison with other places in South Jersey, the records show that at Greenwich the winter is from 1° to 2° warmer. Compared with Atlantic City, which is on the same parallel of latitude, Greenwich for the year is 2° warmer; the winter temperatures practically agree, both being made more even by the presence of bodies of water near them, but the summer at Greenwich is 5° warmer than at the seaside. As already remarked, there is about a month's difference between this part of the State and the extreme north end in the spring, and nearly as much in the autumn, making the season nearly two months longer.* The winter is not only mild, but is not accompanied by much snow. The account given in De Vries' Journal, in 1631, is true of some of the winters of the present time.†

IV. ATLANTIC COAST, OR SEASHORE BELT.

That part of the State which borders the ocean, and is near enough to be more directly exposed to the ameliorating influence of its waters, is here designated as the Atlantic Coast Belt. It is difficult to define its limits, as it merges into that of the southern interior on the west and northwest. The influence of the ocean's waters is felt very decidedly to a distance of four to eight miles from the line of beach or outer coast line, from Sandy Hook to Cape May. In Monmouth county it is thought to be four or five miles; in Ocean county it follows closely the line of clearings or settlements, not going beyond the

* The spring at Greenwich is about two weeks earlier, as shown in blossoming of the peach, the cherry and the apple, than it is at Perth Amboy, and 10 days in advance of Trenton.

† See Chronological Notes of Weather at end of this paper—year 1631.

line of woods or into the forest belt. It is here from four to seven miles wide. In Burlington, Atlantic and Cape May the breadth is five to eight miles. Open bays and tide-marshes, as along the Little Egg Harbor river and Great Egg Harbor, allow the winds of the ocean and the tidal waters to carry these influences further inland. In severe storms the salt spray is felt for several miles back from the shore.* The effect of the prevailing sea winds is not, however, noticed far from the shore in the pine districts. But the isolated and scattered trees of fields, and the woods on the beaches, all show it in their westerly and unsymmetrical growths. The western limit of the summer sea breezes is variable, depending on the season. They may be said to prevail during the summer season over a belt four to five miles wide. But in very dry seasons, and in the spring sometimes, the peculiarly moist and refreshing sea air is noticeable ten to twenty miles back from the water, and occasionally the sea wind sweeps across the State.† But its arrival at these more distant points is at a later hour in the day; and it is not a daily, but an exceptional phenomenon.

The records of observations by the United States Signal Office at Sandy Hook, Barnegat, Atlantic City and Cape May, with those of voluntary observers at Middletown, Long Branch, Squan Beach, Oceanic, Toms River, Peck's Beach and Ocean City, are the data for this seashore belt. And the mean seasonal temperatures, as derived from the longer series, are:

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*According to statement of Eli Collins, of Barnegat, a *dry storm*, September 3d, 1821, carried spray of salt water three miles inland, upsetting stacks, &c. It lasted from 9 A. M. to 3 P. M. For two hours it was cloudy and dark—a hurricane. It killed the leaves of the trees, and after they fell new buds and flowers were developed the same year. Trees were not, however, killed.—[*From notes taken by Prof. Cook, in 1856.*]

The same gale was felt with great violence on the Long Island coast, and in a recent published account of it, Col. B. Aycrigg, of Passaic, who was staying at Jerusalem, on the south side, says: "Its violence may be estimated from the fact that where I was staying, at two miles from the bay and six miles from the sea, the salt water was blown against the windows and left a crust of salt, which had the effect of ground glass, and the leaves on the southeast sides of the trees were killed, turned brown and dropped off."

†Mr. Thomas J. Beans, of Moorestown, Burlington county, writes: "Our house is on a gentle eminence, and in hot, close and quiet summer days I have been observing frequently that at about 4 P. M. a refreshing breeze from the southeast springs up and continues steadily until evening, producing a sensation so unlike that caused by winds from other quarters that I often find myself wondering if, under favoring conditions, our sea breezes almost cross the State."—*Letter to Dr. Cook, April 10th, 1888.*

Spring	47°.4
Summer	70°.8
Autumn	56°.5
Winter	33°.9
Year	52°.1

These figures show the milder winter, the warmer autumn and the cooler spring and summer than are observed in the same latitude in the southern interior or even the Red Sandstone plain. The diagram (Plate 1) exhibits these contrasts more clearly than the figures of the table. As compared with interior stations, the difference appears to reach the maximum in July. The highest temperature is usually in August, and the decline is then slower than at places further inland. The observations at Sandy Hook, Barnegat and Atlantic City agree closely in the average monthly temperatures, through the autumn and in the winter. Sandy Hook is colder, as would be expected, but after March its average is 1° to 2° warmer through the summer. The annual mean temperature is 52°.1, or a little less than that of the interior of South Jersey. The comparison between the seashore and the inland is well exhibited graphically by the curves in Plate 1. At the former, the mean temperature for the months from March to August, inclusive, is from 1° to 4° lower; whereas, from September to February, inclusive, it ranges from half a degree to two and a half degrees higher than at the interior stations. The equalizing effect of the water is thus seen in the more even temperature. The extremes of the year as brought out in these longer periods of observation, are 99° above and 10° below zero, or 109° as against 121° for the like range of the southern interior. The winds from the sea are warmer in winter and cooler in summer, than those blowing off shore. The sea breezes of the hot season spring up generally about noon, so that the maximum for the day is before noon, or at noon, just before the incoming of the cool, sea air. The influence of these sea winds is to temper the extreme heat, to reduce both the range and the mean temperature in the warmer months, and to give a more humid character to the air. During the cold weather the storms which bring snow in the interior are accompanied by rain along the coast. The snow disappears more quickly at these localities. Sleighing is possible for very brief periods only. At Atlantic City it is unknown some winters. These sea beaches, situated as they are, with the ocean on one side and the tidal waters on the other, have a climate partaking

slightly of the insular type. Barnegat station is separated from the mainland by the Barnegat bay, which is four miles wide. Atlantic City is at least five miles in a direct line from the nearest mainland. But the maximum and minimum temperatures at each of these places show that the range in the year may be nearly as much as it is in the interior of the State. The average daily variation is less. The average maximal and minimal curves also are unlike those representing places in the interior. Thus, comparing the temperatures day by day at Philadelphia and Atlantic City for 1886 and 1887, the following differences are notable: In the four colder months the highest daily readings differed on the average only 0°.5 to 3°. From April to June, inclusive, the average maximum at Atlantic City was from 6° to 12° lower than at Philadelphia, whereas for the same months the average minimum was only 1° to 4° lower. There are not such extremes of heat, and the average cold is little greater. For July to September, inclusive, the maximum is 2° to 6°, and the minimum 1° to 3° lower at Atlantic City. In October and November the differences are all less than 2°. The influence of the ocean appears to be to reduce or lower the maxima in the spring, summer and autumn more than it does the minima.

This moderating influence is, therefore, greater in summer than it is in the winter months. And what is true of Atlantic City applies generally to the seaside. The milder winter of our coast is, however, a well-known fact, although the records of observed winter temperatures, when thus compared, do not exhibit the differences which have been said to exist. That the Gulf Stream tends to raise the average temperature is evident from its nearness to our coast. The general influence of the Gulf Stream, as given by Chas. A. Schott, of the United States Coast Survey, in Smithsonian Contributions to Knowledge, No. 277, p. 105, may be thus summarized: "In the *winter* months the proximity of the Gulf Stream to the Atlantic sea-board has the effect of *elevating* the temperature in the vicinity of the ocean, the amount being 0° in Florida, about 4° in North Carolina, and about 8° or 10° in Massachusetts; in the summer months the effect is reversed, as shown by the isotherals curving southward; this is due to the cold current running southward, between the coast and the Gulf Stream, and the depression produced would be still greater, but for the circumstances of the prevalence of the *westerly* winds, which carry the heated air to seaward. The depressing effect, however, in amount, is

less than one-half that given for the opposite season." Of course this influence is not materially more ameliorating at one point than another, and it is a common factor in the climate of the whole coast belt. The delightfully warm weather of some of the late winter and early spring days, when the wind is from the southeast quarter, is due probably to the nearness of the Gulf Stream. On the contrary, the south winds, which blow over a long belt of the colder shore current, are chilling, especially on the beaches south of Barnegat.

There is a noteworthy difference in the winter season, between Cape May and the other coast stations. It is seen in the difference in the average daily minimum, which, at Barnegat and Atlantic City, is four to five degrees lower than it is at Cape May. The extreme temperatures at these places also run lower—from four to nine degrees. The more southern situation of Cape May has something to do with this higher average minimum of the winter. But the Delaware bay on the west explains a part of it. The winter winds from west and west-northwest points of the compass are tempered by the latter, and are not so cold as land winds generally. The position of Cape May is more *insular* than that of Atlantic City or Barnegat. The evenness of its temperature is quite remarkable for its latitude, and for our Middle Atlantic coast. In its slight daily range it compares favorably with more southern stations in our country. It is warmer in winter than Washington, and its mean daily range of temperature is four degrees less than that of Norfolk, Va. The Monthly Weather Review of the United States Signal Office, nearly every month, gives Cape May as having the least daily range of temperature among its Middle States stations. And the range is nearly as low as that of Cape Lookout, in North Carolina, and Key West, New Orleans and Galveston, in the Gulf States. The average, as there stated, for three years is, for Cape May, 19°; while that of Key West is 16°. These figures show that in the *daily* range of temperature Cape May compares favorably with our most southern localities. Of course the *monthly* range exceeds that of the more southern stations here mentioned. The changes are not generally sudden.

It is interesting here to observe that the isothermal line of 36°, the mean temperature, runs, according to the charts of the Smithsonian Institution, through West Virginia, North Carolina, Northern Georgia, Eastern Tennessee and Southern Missouri, near the parallels of 36° and 37° north latitude. The effect of so high a mean

temperature in the spring is to produce crops of vegetables and small fruits quite as early as Portsmouth and Norfolk, Virginia. And the season is generally about a month in advance of it in the northern part of the State. But in late springs the difference is not quite so much. The summer is warm enough and the season long enough to produce cotton. According to Blodgett's "Climatology of the United States," pp. 436–7, Huntsville, Alabama, represents one of the best cotton districts near the limit of its northern extension. Now, the mean temperature of Huntsville, in the winter, is, on the average, 7° higher than it is at Cape May, but the thermometer often falls to zero, and occasionally several degrees below zero, extremes unknown in Cape May. The following popular description of the climate of Cape May, by Dr. S. S. Marcy, appeared in the "Geology of the County of Cape May," Trenton, 1857, p. 89:

"Our winters embrace every variety of cold and temperate weather. Ice is rarely obtained in this neighborhood more than four inches thick, and frequently but three inches; often it is but a short time that it can be obtained of this thickness. It is cut from still water, in artificial ponds, which are only one or two feet deep. So great is the uncertainty of obtaining a supply of ice, that we commence filling our ice-houses with ice from two and a half to three inches thick; and every team within a distance of six miles is put in requisition for that purpose, with *retaining fee*, some weeks before the appearance of the ice.

"The lowest temperature observed here for the last 30 years was 2° above zero. This was on the 9th of January, 1856. On the 10th it was 4°, and for several days the thermometer was as low as 8° or 10°. This will long be remembered as the cold winter of 1855–6. In our winters generally, the thermometer does not fall below 14° to 18°, though it has been known as low as 8° above. Up to last winter the latter was thought to be the extreme of cold weather here.

"The mildness of our winters admits of large numbers of cattle being wintered on Seven, Five and Two-Mile beaches, without any provisions being made for them by their owners. In cold weather they find shelter in the thickets on the beach."

That the seaside is more comfortable in the extreme hot weather of our summers is attested by the throngs of thousands of visitors who seek comfort and relief from the heat at the many localities, long and justly famous for their attractiveness. From Sandy Hook to Cape May the whole length of beach will probably be all taken up very soon for summer homes and seaside resorts. The new places which

have sprung up since the Geological Survey's first maps appeared, form an almost continuous line from Sandy Hook to Point Pleasant. And the maps accompanying the annual reports indicate how rapid and extensive the changes are to suit the increasing patronage of our coast. The records of meteorological stations, like figures in so many places, cannot express all the peculiarities of climate, and they often fail to indicate the nicer and more delicate distinctions in the quality or tone of the atmosphere, which, especially at the seaside, impart to it its wondrous properties in building up the system. Thus, a high temperature, if not long continued, may not give great discomfort. The cool and pleasant afternoons and nights carry one over the heat of the forenoon. Again, the denser air, the presence of ozone, and the absence of impurities or poisonous exhalations, all tend to produce an effect which thermometers and rain-gauges do not measure.

As winter resorts, there are several places on and near the Atlantic coast which have acquired some notoriety, and Lakewood and Atlantic City have attracted many visitors, particularly in the months of February and March. But no part of this coast belt has a truly mild winter climate, such as that of the Bahamas and the West Indies, the southern part of California and Florida. It is not exempt

NOTE.—The milder climate of Cape May appears in the character of its flora. In reference to the existence of plants of a more southern range, Dr. N. L. Britton, of the Columbia College School of Mines, and author of "A Preliminary Catalogue of the Flora of New Jersey," gives the following points, viz.:

(1.) "All the southern counties of New Jersey have a somewhat southern flora, and it seems true that the further south we go the more pronounced does this become.

(2.) "Although Cape May county has never been botanically explored to the extent that discoveries already made should warrant, yet it has already yielded a number of species of more southern distribution, and, so far as known, is the northern limit of the following six: Œnothera humifusa, Nutt; Galium hispidulum, Michx; Diodia Virginica, L.; Conoclinum cœlestinum, DC.; Pleuchea bifrons, DC.; Paspalum Walterianum, Schultes. These are all the southern species of the New Jersey flora at present known to occur only on Cape May, but I have no doubt that further exploration will add others to this list.

"Besides these species the following have been found on Cape May, but also in one or two other localities in the southern part of the State: Kosteletzkya Virginica, Presl; Lobelia puberula, Michx; Smilax Walteri, Pursh; Fuirena squarrosa, Michx; Panicum viscidum, Ell.

(3.) "In addition to the above lists it may be stated that there are other species of a southern character which probably occur in greater abundance in Cape May county than in any other part of New Jersey."

The Euonymus Japonica, commonly known as the *Chinese Box*, is cultivated in gardens and door-yards at Cape May City as an ornamental shrub, and appears to thrive out of doors, although it is not hardy north. In the Southern States it is common.

from sudden changes of temperature and cold, freezing weather, although for short periods, generally. And it has its fair proportion of cloudy and wet days and chilly northeasterly winds, which are features of the climate of all of our Middle Atlantic slope. And so far as climate is influenced by the percentage of relative humidity, the records of the United States Signal Service show that it is more damp or moist than the more inland belts or localities.* The tonic nature of the pure air and much outdoor exercise has, probably, more effect than the slight differences in temperature, which instrumental observation detects. Still it must be stated that as yet our meteorological observatories cannot analyze, as it were, the air, and note the small fractional percentage of constituents which may be in the air, and of which the consumption in the course of a seaside visit is, in the aggregate, comparatively potent in its effect upon the human system. These unmeasurable or rarely-noted factors may enhance the influence of a slightly milder and more equable temperature in the winter. To persons coming from New England and New York, or from the colder northwest, these seashore places appear warm and pleasant, and the change for that class of visitors is both agreeably pleasant and beneficial. And even to the residents of our large cities, whose winter temperatures are not much lower and whose climates are not greatly different, the effect of out-of-door air at the seaside is tonic.

WINDS.

The prevailing winds in the State are from the west. In the warmer months they are more southwest or south of west; in the colder months, more north of west and northwest. The unequal pressure and the differences in temperature on land and sea give rise to more northern winds in the winter season, and southern currents in the summer. In the winter the areas of high pressure, or anticyclones, over the northwest, cause the air to flow south or southeast towards the ocean for longer periods than in the summer or warm weather, when the reverse conditions prevail, and the winds from the sea flow landwards and from south quarters.†

* The relative humidity on the coast is greater in summer and less in the winter months, or the reverse of what prevails in the interior, and hence, comparatively speaking, the winter in that belt is not more moist than it is in the interior.

† The winds in storms are referred to under the head of Atmospheric Precipitation.

The mean direction of the winds for each month, as deduced by Prof. Coffin, from observations at 40 different places in Delaware, Southeastern Pennsylvania and Southern New Jersey, is given in the following table:

January	N. 81° W.
February	N. 78° W.
March	N. 83° W.
April	S. 89° W.
May	S. 89° W.
June	S. 84° W.
July	S. 83° W.
August	S. 64° W.
September	N. 89° W.
October	N. 88° W.
November	N. 79° W.
December	N. 79° W.

Here, as generally, on the middle Atlantic coast, the change in the mean direction is slight, the wind being westerly in all months, and the difference but 38° between February, when the winds incline most to the north, and August, when the most southerly direction is reached.*

The mean direction of the winds in the four seasons in Southeast New York, Eastern Pennsylvania, and North and Central New Jersey, are given in Prof. Coffin's tables.

	Spring.	Summer.	Autumn.	Winter.
Southeastern New York	N. 80° W.	S. 43° W.	N. 77° W.	N. 60° W.
North and Central New Jersey	N. 55° W.	S. 69° W.	N. 69° W.	N. 58° W.
Eastern Pennsylvania	N. 68° W.	S. 75° W.	N. 72° W.	N. 55° W.

In this table Eastern Pennsylvania may be said to represent the western part of New Jersey.

The relative frequency of the winds blowing from the several quarters is exhibited by statistics of records at various stations in the State. From a large number of observations made at Easton, Pa., Newark, Lambertville and Burlington in 1854–9, the percentage has been found to be—

* "Discussion and Analysis of Prof. Coffin's Tables and Charts of the Winds of the Globe," by Dr. Alexander J. Woeikoff, Smithsonian Contributions to Knowledge, No. 268. Washington, 1876.

North	6.46	per cent.
North and east	14.17	"
East	3.29	"
East and south	9.72	"
South	6.20	"
South and west	20.57	"
West	13.77	"
West and north	25.82	"
	100.00	

Observations in different parts of the State show variations in the relative frequency and in the velocity also. And, in general, there is a gradual increase in the frequency or percentage of southerly winds, going from the Highlands or North Jersey to the south. At the seaside there are more frequent easterly winds. The sea breezes account for much of this excess.

The observations do not, however, show fully the relative prevalence of the west winds, unless we take into account the distance traveled by them. The mean velocity of the northwest winds exceeds that of the west, southwest, or winds from other quarters. Observations ought not to be limited to direction only, but should include velocity and measure the distance traveled, also.

In mountainous regions the winds are generally controlled in their directions by the courses of the valleys and of the mountain ranges. The prevailing winds take the valleys, and they are said to blow up or down them. In New Jersey our mountains are too low, and the valleys are not deep enough, to have much effect in diverting the course of the winds, excepting in some of the very narrow depressions and over very limited areas. The southeastern slopes of some of the Highland ranges are thus shielded from the cold and northwest winds of winter. But the aggregate area of such sheltered localities is small, compared with that of the whole Highlands.

The proximity of the ocean gives rise to another disturbing agency, which is due to the different heating capacities of land and water, and it appears in the

SEA BREEZES.

Along our coast there is a belt of varying breadth in which the general direction of the wind is interrupted, during the warmer part of the year, by the inflowing currents of sea air, which are known as sea breezes. They are periodic, coming daily, with rare exceptions.

They are caused by the unequal heating of the land and water surfaces. The air over the land is heated and expands, giving rise to ascending currents. To restore the average density and to maintain an equilibrium, the cooler air over the water flows toward the land, producing an *on-shore wind.* This movement begins usually near midday, or sometimes about 11 o'clock, gradually increasing in force, until it attains a maximum velocity about 2 o'clock in the afternoon. It then lessens (as the land cools more rapidly) and ceases about nightfall, when the land or *off-shore* wind takes its place. This daily recurrence of the sea breeze is the peculiar feature of our shore, which moderates the heat, and by its invigorating sea air makes the seaside so attractive both to the pleasure-seeker and the invalid. It affects the temperature, and hence the maximum for the day at the seaside is not about 2 to 3 o'clock, as in the interior, but about noon or just before its arrival. Occasionally there is a summer day when the land wind prevails and there is no sea breeze. They are known as hot days at the shore, and probably because of the contrast with the cooler days when the sea breeze prevails. The influence of the sea breeze upon average temperatures of the summer months, and in depressing the maximum at the coast stations, is evident in the lower means and maxima at them.

The extent or limit to which sea breezes are felt from the coast line, varies considerably, according to the direction of the shore line and the contour of the surface. There is a variation in the same season and in different seasons, according to the character of the same. Generally the distance is less than ten miles, and often not more than four or five miles.* Its regular recurrence is limited to the shorter distance, or to a narrow shore belt. Cleared land surfaces which are readily heated and where there are no obstructions in the form of timber belts, allow of a further indraught of the sea breeze. The absence of hills along our coast favors its progress. Long-continued hot weather, as in summer droughts, which allow an accumulation of heat in the surface soil and the lower air stratum, seems to widen the belt considerably, and for many days together the breeze is observed at places further inland, beyond its ordinary limit, coming, however, later in the afternoon than it does on the shore.

The height to which the sea breeze reaches has been determined very recently by balloon ascensions and observations made at Coney

* See page 348 for observations on sea breezes at greater distances from the ocean.

Island, N. Y., in August, 1879, and reported with notes by O. T. Sherman, in the "American Journal of Science," Vol. XIX., pp. 300–302. The surface breeze was found to cease at a height of about 650 feet, and at 700 feet a land current deflected the breeze towards the northwest. At 800, 900, 1,000, 1,100 and 1,200 feet, the observations, with one exception, indicated winds from the northwest quarter. Under 700 feet the prevailing directions were southerly, and from both the southeast and southwest quarters. The extension of observations of this kind to points on the New Jersey coast, would be interesting and add to our knowledge of this phenomenon.

The total movement of the air, or distance traveled, varies with the velocity and duration of the wind.

In the interior of the State the winds are not often high, nor do they blow steadily at a given rate for a long time. Everywhere our winds may be termed variable, shifting slightly from point to point, and varying in their velocity. In the summer they are more gentle than in the other seasons of the year. And short seasons of calms are not uncommon. The more violent and high winds come with thunder storms. The spring and winter are marked by more windy weather, and by a greater total movement of the air. Hurricanes are unknown, and there are very few records of what may be termed tornadoes. That of June 13th, 1835, at New Brunswick, was probably the most destructive one ever felt in the State since records of such phenomena have been made.* Generally, the damaging effects of high winds are confined to narrow limits, and rarely do more than throw down crops and partially decayed trees, or occasionally unroof a building. Destructive winds, such as are reported from the Southern and Western States, are here unknown.

On the shores of our Atlantic coast and Delaware bay divisions the winds blow more steadily, and the velocity is generally greater than it is inland, where the mountains and wood serve to retard the air movement. The more isolated high peaks or crests of the Highlands are, possibly, more exposed than the coast stations, but we have no records from them. Observations and measurements elsewhere indicate this to be a fact. But at Cape May the United States Signal Office Station records frequently give a greater total movement than that of any other of their stations in the country, excepting Mount Washing-

* Blodgett's Climatology of the United States, page 403.

ton and Pike's Peak. The total movement of the air at Cape May for one month (December, 1878,) has amounted to 16,567 miles, or an average of 22 miles per hour for every hour of that month. In the winter and spring months the totals are from 9,000 to 13,000 miles, whereas in the summer months they are under 10,000 miles, and rarely exceed 9,000. The autumn months give a wider range.

At Sandy Hook, 16,954 miles were measured in December, 1876, a slight excess over Cape May. Generally, the totals for Sandy Hook are a few hundreds or a thousand miles below those of Cape May. Philadelphia, Baltimore and New York rarely report more than 9,000 miles for any month. From the "Monthly Weather Review" it appears that Cape May is the most windy of all the United States Signal Office Stations, except Mount Washington and Pike's Peak. Its position between the ocean and the bay may explain this large total air movement.

High velocities also are frequently reported from these coast stations. Rates over 50 miles per hour are quite common. At Sandy Hook, December 9th, 1876, the rate of 84 miles was observed. At Cape May, 83 miles were recorded of a northwest wind in November, 1879; 72 miles of a west wind, December 9th, 1876, and 65 miles of a wind in September, 1876. The duration of high winds, having these velocities, is short. They are the peculiar features of severe storms which move northeastward along our coast, and generally belong to the clearing-up period of the storm as it is moving away.

No records of movements or velocities from the northern or central parts of the State are known, but it is not likely that any such figures as are given here would be measured, unless on mountain tops.

BAROMETRIC PRESSURE. WEIGHT OF THE ATMOSPHERE.

No attempt has been made to collect the records of barometric observations. The diurnal, annual and secular movements are so slight as not to be taken into account in this connection, and their discussion belongs to the department of physics rather than to a popular notice of climate. The variation between localities, due to differences of elevation, is according to a general law, and the amount of this variation does not exceed two inches in our State. The barometer falls as the height increases. The rate varies a little according to temperatures, but at ordinary summer heat, say 72°,

the fall is one-tenth of an inch for 95 feet rise; at 32°, a fall of a tenth corresponds to 87 feet; but, in round numbers, the difference is about one inch for 900 feet rise. Hence, on our highest ridges the difference would be about two inches, and throughout our Highlands the depression would range from 1 to 1.5 inches. In recording barometric observations, corrections are generally made so as to reduce them to a common datum, which is that of the ocean level.

The most important barometric observations are those made during the passage of low pressures or storm-centers across our territory. These areas of low pressure are accompanied in nearly all cases by either rain or snow. And very low depressions are marked by high winds, which blow *down* steep gradients towards the center of the cyclonic storm. In the colder months the low barometric pressures are marked by moisture and precipitation, and a rise in temperature. In the summer season they are associated with a lowering of the temperature and rainfall. The high barometric pressure is characterized by reverse conditions—in the summer by great heat, and in the winter by severe cold. These *anti-cyclones* appear to move more slowly and to be of great extent, and to continue longer than the low pressure or *cyclonic* conditions. The long and very warm summer *spells*, or periods of weather, and the cold waves of the winter, are coincident, nearly with high barometric pressure.

The differences between the mean barometric measurements in the several parts of the State, excepting as modified by altitude, which has been referred to above, are too inconsiderable to affect us sensibly, and scarcely enter into the subject of our climatology. Careful observations, and long continued, may prove the existence of differences, and they may be found to affect the human organism; and the study of the sanitary relations of climate must include them.

RELATIVE HUMIDITY.

Atmospheric air always contains some vapor of water or moisture, in addition to its oxygen, nitrogen and carbonic acid gas.

When fully saturated, each cubic foot of air, at 80° temperature, holds	10.81	grains of	vapor of	water.
One cubic foot, at 60°, holds	5.87	"	"	"
Difference	4.94	"	"	"

Therefore, when cooled from 80° to 60°, 4.94 grains will be thrown down or deposited in a liquid form as rain, or, if colder, as snow or hail. The height of the mercurial column, which is sustained by the vapor of water in the air, when saturated, at different temperatures, varies as follows:

At 32°	0.181 inch.
At 60°	0.518 "
At 80°	1.023 "
At 100°	1.918 "

The capacity is, therefore, about doubled for each rise of about 20°. Using the saturated condition or state as the standard of comparison (100), the relative quantity of moisture is expressed by percentage. The drier the air, the lower the percentage, and conversely. It is possible to make comparisons between localities, or between the different states of the air at any given place, expressing the differences in such terms of percentage. It is in such comparisons that the term *relative humidity* is employed. The instrument to measure the quantity of vapor of water is a hygrometer, and from its readings the relative humidity is calculated.

In consequence of the ever-varying rates at which the processes of evaporation and condensation go forward, the quantity of moisture in the air is subject to continual change. The extent of water surface, the elevation above ocean level, the direction of the prevailing winds, and the temperature, all combine to modify these processes and to increase or diminish the quantity of moisture. Oceanic and insular climates are generally moist or *humid*, whereas continental climates are dry. The mean relative humidity is greater on the seashore than inland.

The influence of great humidity upon vegetable growth, upon temperature and on the healthfulness of localities, is such that the determination is necessary to a full understanding of their climates. The luxuriance of tropical vegetation is generally associated with moist climates. The effect upon temperature is to make it more even, and moist climates are more equable. The moisture in the air, when it approaches saturation, tends like a screen to prevent excessive radiation at night, and to protect from the sun's rays during the day. The air itself is thereby warmed.

Although so important, the accurate determination of this element

is somewhat involved in uncertainty, since variations are found to be considerable within comparatively short distances.

The absence of records giving the relative humidity of the air at localities in the State, excepting the United States Signal Service stations, which are all on the coast, or near it, prevents any accurate comparison of the different districts of the State. In general, the relative humidity is greater at the seaside than inland, and in the southern than in the northern part of the State. The average percentage of humidity at the seaside localities, as reported by the United States Signal Office, is from 75 to 83 per cent., whereas at Philadelphia and New York the average for the year is only about 70 per cent. A notable difference in the seasons is that in the interior the four coldest months are the moist ones of the year, whereas on the coast the humidity is greatest in the summer, or from June to September, inclusive. And August has, generally, the highest percentage. The relatively drier spring and winter at the seaside is one reason for the apparently more pleasant and milder climate of Atlantic City, Cape May and other localities on the coast, in the winter, and which has attracted attention to them as winter resorts. The oppressiveness of the humid atmosphere is not as great at that season, as in a hot summer day, when the absolute amount of moisture in the air is much greater.

ATMOSPHERIC PRECIPITATION.

RAIN AND SNOW.

The average amount of rain and snow falling on any part of the earth's surface is determined by its situation, the prevailing winds, the configuration of its surface and the nature of the surface covering. And the amount of such precipitation is one of the measures of its climate. And, further, as it is distributed throughout the seasons and the year, and is in excess or is deficient, climates are, relatively, wet and rainy, or they are dry and parched. As factors of climate, the amount and the distribution of the rain and snow are the most important after that of temperature. They exercise a controlling influence in agriculture, and determine largely the kinds of crops and the modes of cultivation of the soil. They indicate the lines of internal navigation and of water-supply. And in their indirect influence upon the human system, the health and activities of the inhabitants are mightily affected.

The limits, areas and surface features of the climatic divisions of the State have been referred to under the head of Temperature. The direction and relative frequency of the winds also have been given. (*See* WINDS.)

The larger part of the annual precipitation is in the form of rain and snow, falling during the passage of cyclonic storms across the State. These storms, marked by low barometric pressure, move over the country in a general northeast course, entering from the Gulf of Mexico and passing northward and north-northeast to New England, the St. Lawrence region and Newfoundland. Others come from the northwest and west, going in a general east or east-northeast course to the ocean. Occasionally these low centers meet or coalesce, and the intensity and duration of the storm are then increased. The tracks of these centers of low barometric pressure are charted by the United States Signal Office, and their maps indicate the direction, rate of movement and the rainfall in their progress. Prof. E. Loomis, of Yale University, has studied with great care and in detail these areas of low pressure, traversing the eastern part of our continent, and has divided them into three classes:

"I. Those whose course was for some days towards the west. II. Those whose course was towards some point between the south and east. III. Those whose course was towards some point between north and east." The dates of beginning and end, latitudes, longitudes, course and velocity in miles per hour are all tabulated. The storms of the II. and III. are the ones which cross our territory. Those of the second class occur more frequently during the colder months of the year. Their average velocity is 24 miles per hour. Their course is seldom maintained as far south as 30° north latitude, after which it frequently changes to the northeast, so that they cross our territory as northeast storms also. Of the storms which cross the United States north of 38°, nearly all pursue a course a little east of north; those coming from south of latitude 38° generally pursue a nearly northeast course. The storms of this class occur most frequently in autumn and least frequently in summer. The rate of movement of the storms in this class varies from 12.4 to 60.4 miles per hour, averaging 28.4 miles. At these rates such storms would move from Cape May or Delaware bay entirely across the State in two and a half to thirteen hours, or at the average rate, in about five

hours. Or from Delaware bay to Sandy Hook the passage would be made in nearly four hours.*

The duration of the storm, or of actual precipitation, varies from a few hours, as in the case of some of the summer storms, to two or even four days, in the longer and more slowly-moving areas of low pressure. And, generally, the rain or snow comes after the fall of the barometer, and is on the eastern side of the center of low pressure, the prevailing winds being from an easterly quarter.† In the colder months of the year, from the first of December to the end of March, the precipitation is, in part, in the form of snow, especially in the northern and mountainous districts of the State. In the extreme south there is more rain, even in the winter months, than snow. And in some years the proportionate quantity of rain exceeds largely that of snow throughout the whole State for all the months. On the other hand, there is no record of a winter season passing without some precipitation as snow, though it may be scarcely more than deep enough to cover the earth.

The warm season or months of the year are marked all over the State by the occurrence of thunder storms, which move rapidly and in a general easterly course, and are local in their extent. They are more frequent in the latter part of the summer, or during the months of July, August and September. And they are more common in the afternoon or early evening than in the morning hours of the day. The relative amounts of rain falling in the course of thunder storms and that which comes with the longer cyclonic storms cannot be given in figures, as there are no statistics or records of long periods and at stations distributed over the State; but from the observations made at Newark and at a few other localities, it is evident that in many years the summer rainfall is, to a considerable extent, due to thunder storms. It must be understood that in some instances these summer thunder storms are of wide range and mark the movement of a cyclonic storm or disturbance which traverses the whole Atlantic States. They are hardly classifiable with the local thunder storms characteristic of our summers.

The amount of precipitation in any given storm has a wide variation. It rarely exceeds four inches in depth, and three inches is a

* "Contributions to Meteorology," in the *American Journal of Science*, Vol. XXI., pp. 1-8; also Vol. XXX., pp. 7-11.

† Prof. E. Loomis, in *American Journal of Science*, Vol. XXV. (1883), pp. 9, 10.

heavy rain. In the Newark record the number of rains over three inches in thirty-seven years and eight months was thirty-six. Eight of them occurred in July; eight in August; five in October; three in November; two each in December and May; and one in each of the other months. These observations indicate the greater frequency of heavy rains in the late summer and in autumn. Of special heavy rains the storm of March 19th and 20th, 1881, at Paterson, is worthy of mention, when 5.44 inches fell in eleven hours. Another still heavier rainfall was that of March, 1875, at Parsippany, Morris county. F. A. Wilber (now of Rutgers College Faculty) kept a record at that time, and measured seven inches of rain and melted snow coming in a single storm. The greatest freshet ever known in parts of eastern Monmouth county, July 11th, 1871, was caused by a shower which did not last more than three hours. The fall during the extraordinary shower between Trenton and Bordentown, on August 24th, 1877, was thought by Dr. C. C. Abbott to be about nine inches.* No doubt other equally great and sudden rainfalls could be included in this list if records were more generally kept.

* Dr. C. C. Abbott, of Trenton, furnishes the following graphic account of this rain, written at the time, while every feature of it was still fresh in memory: "Previously to 1:30 P. M. the day offered no peculiar meteorological features. The temperature was 78° Fahrenheit at noon, wind southeast. About 1:30 P. M. the wind shifted to the southwest, and a heavy bank of blue-black clouds formed in the northwest. The appearance at this time was that of an ordinary summer shower. I did not notice any lightning or hear any distant thunder. While standing on the brow of the hill near where my house stands, and facing the southwest, I noticed that a somewhat similar bank of clouds to that in the southwest was also rapidly forming, and the two appeared to be approaching each other, although not from opposite directions, of course. * * * In a few moments there was a sudden change in the several conditions then obtaining. The stiff, northwest breeze suddenly ceased. A remarkable stillness pervaded the atmosphere and a feeling of oppression was very noticeable. * * * Just at this time the two masses of clouds came in contact, apparently, (and really, I think,) directly over the extensive stretch of meadows lying north of Bordentown, along the Delaware river. At the moment of contact of these cloud masses there was a loud, humming sound, clearly audible, *but not caused by a wind, the leaves were motionless.* The two masses formed one, but retained their peculiar coloring, and in less than a minute, I should think, a huge water-spout formed—or, at least, the clouds became a single conical mass, with the apex downwards. As suddenly as it formed it broke, and, in ten minutes, at most, thereafter, the meadows were flooded. The storm now took the form of a general rain and extended over a considerable area. Such a rain, however, I never previously or since have witnessed. I found by experiment that it was impossible to breathe while facing it, unless by protecting my nose and mouth with my hand. At a distance of 100 feet objects were wholly obscured from view. This fearful rainfall continued for about forty minutes

As has been said of the larger area of the eastern United States, "the distinguishing feature of the distribution * * * is its symmetry and uniformity in amount over larger areas." * It is possible to construct rain charts, using the longer records only. And such charts of the United States have been published by the Smithsonian Institution and the United States Signal Office. The mean annual rainfall for that portion of the Atlantic slope occupied by New Jersey, ranges from 42 to 46 inches. These figures correspond with those for the Middle Atlantic States. In the South Atlantic and Gulf States the yearly amount is somewhat greater; whereas, in the New England States and in the lake districts the average is a little less than in New Jersey. The excess in the former and the deficiency in the latter, as compared with New Jersey, are in the rainfall during the warm months rather than in the colder part of the year; and they are owing to the more severe and heavy summer thunder storms of more southern districts and States.

The table of rainfall appended gives the amount of rain and melted snow in inches at the stations where records have been kept. These stations or localities are distributed irregularly, and they leave wide gaps, especially in the northern part of the State, where no observations have been made, and which leave some doubts about the local differences in amount. For the Highlands, there is a valuable record at Lake Hopatcong. It was kept by the Morris Canal Company, and for 24 years (1846–1869). West Point and Goshen, N. Y., and Easton, Pa., have been added to represent the Highlands valleys and the Kittatinny valley. New York City and Fort Columbus give long records for comparisons. In the Red Sandstone plain there are comparatively long records at Newark, New Brunswick and Lambertville. The Morrisville and Philadelphia records are used, as they are so near our borders, and are of great length. In the southern interior, we have good records from Moorestown and Vineland. Dover, Del., and Baltimore, Md., have been added for comparisons with the Greenwich record, which is short. For the seacoast the records at Sandy Hook, Barnegat, Atlantic City and Cape May, ranging from twelve to fourteen years, give a fair average and permit comparisons, as they cover nearly the same years of the period, from

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and then began to abate, but it was not until 5 P. M. that the rain ceased and the sky became comparatively clear. This storm was remarkable for one feature other than that of the quantity of water that fell; this was the absence of lightning."

* Blodgett's "Climatology of the United States," p. 317.

1874 to 1888. The difference of latitude between the extreme northern and southern stations is 2° 28′, or 170 miles.

The records for short periods of observation are less valuable than the longer series of the table, on account of the probable error, or variation from the true average or normal quantity. According to Schott's tables,* this limit of error amounts to 1.4 inches in a series 30 years long at New York ; 0.6 inches in a forty-three-year series at Philadelphia, and in case of a single year to 12 per cent. Hence the difficulty in comparing places having short series of observations.†

For comparison of the broader features the following tables of stations, selected as representative of the north and south and the east and west sides of the State, are inserted. In the first table the stations in the northern part of the State have records ranging in length from that of New Germantown, 7 years and 10 months, to that of Newark, 45 years and 8 months. For the southern part of the State, Philadelphia, Pa., and Dover, Del., are inserted. And the records vary from periods of 9 years and 8 months at Dover, to 63 years at Philadelphia. The comparison of the eastern and western sides of the State is made in the second table. The selected stations have periods ranging from 8 to 63 years in length.

These comparative figures show that there is more rain and snow (total precipitation) in the southern than in the northern parts of the State, and that the excess is greater in the summer than in the winter months. As none of the stations are either on the ocean or in the mountainous districts of the State, they may be considered as representing fairly the differences due to the two sections, irrespective of local influences arising from surface features and peculiar situation.

The difference in the quantity of rain and snow on the eastern and western sides of the State, respectively, leaving out of the comparison the shore stations, is more marked than that between the north and south. It amounts to an excess of 1.3 inches for the four colder months, 1.7 inches for the four warmer months, and 3.7 inches for the year at the stations in East Jersey. If the shore stations were included in the table, the difference would be greater than it is here shown to be. Hence the normal lines of equal precipitation, if drawn

* "Tables and Results of the Precipitation in Rain and Snow in the United States."—*Smithsonian Contributions to Knowledge, Washington, 1872, No. 228, p. 144.*

† The errors from gauges inaccurate and not properly located are evident in some of the discrepancies of the shorter series ; but it is impossible to eliminate all of them. Some obviously incorrect records have been omitted.

Rain and Melted Snow, for Comparison of North and South. Expressed in Inches.

North.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Newark	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	45.95
Fort Columbus, New York Harbor	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	43.34
New Germantown	3.08	2.78	3.76	3.24	3.29	4.03	4.71	4.95	3.13	5.01	3.67	2.44	44.09
New Brunswick	3.07	2.97	3.38	3.75	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	44.31
Lambertville	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	43.92
Means	3.26	3.14	3.51	3.37	3.90	3.83	4.30	4.85	3.47	3.71	3.46	3.57	44.32

South.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Moorestown	3.44	3.50	3.39	2.92	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	43.23
Philadelphia, Pa	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	43.03
Atco	3.73	3.36	4.25	2.85	2.93	4.15	4.07	5.87	4.76	2.96	3.93	3.90	46.76
Vineland	4.60	4.06	4.43	3.12	3.76	3.52	4.25	5.09	4.38	3.33	3.72	4.01	48.27
Dover, Del	2.66	3.15	4.94	2.99	2.82	3.24	5.04	4.95	4.39	2.78	3.98	3.01	43.95
Means	3.54	3.43	4.09	3.07	3.40	3.76	4.31	4.96	4.18	3.09	3.65	3.55	45.05

Rain and Melted Snow, for Comparison of East and West. Expressed in Inches.

East.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Paterson	4.17	4.83	5.51	3.06	5.01	5.59	6.15	4.16	5.57	2.98	3.06	4.96	55.05
Newark	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	45.95
New Brunswick	3.07	2.97	3.38	3.78	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	44.31
Fort Columbus	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	43.34
Freehold	3.97	3.75	4.97	3.41	2.78	3.91	3.92	5.02	4.48	3.06	3.69	3.77	46.73
Means	3.63	3.28	4.20	3.39	3.98	4.18	4.52	4.73	4.12	3.25	3.46	4.01	47.08

West.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Lambertville	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	43.92
Morrisville	3.29	2.77	3.33	3.87	3.94	4.09	3.62	4.05	3.48	3.65	4.28	3.29	43.66
Fallsington, Pa	4.29	4.90	3.07	2.60	3.52	3.65	3.74	4.41	3.27	3.92	2.91	3.57	42.85
Philadelphia, Pa	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	43.03
Moorestown	3.44	3.50	3.39	2.82	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	43.23
Means	3.51	3.47	3.29	2.20	3.81	3.88	3.97	4.43	3.56	3.26	3.38	3.56	43.34

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on a State map, would have a course which is a resultant between north and east, or a northeasterly trend, and approximately parallel to the coast line. That is, there is an increasing rainfall in going from northwest to southeast. But this generalization, or law, has many exceptions. The elevation above tide-level, the relative position of land and water, of mountains and valleys, and the surface covering, or forests, all modify the effect of position. And the records are so incomplete that a few only of the exceptions and the characteristics of the several great natural divisions of the State can be given at this time. The discussion is here of the deductive type, from the natural features and topography as guides, rather than one wholly from meteorological data. The Highlands are best represented by the record of Lake Hopatcong. Its average annual rainfall is 42.5 inches, or 3.4 inches less than that of Newark. And this difference corresponds with the decreasing quantity on going northwest into New York. Goshen, in the valley west of the Highlands, appears to have a considerably lower quantity—an average of 33.82 inches in eight years' observations. Easton's ten-year record gives a mean of 46.1 inches. From the shape of the country it appears reasonable to believe that both of these records are not far from the correct means, and that there is a difference of at least seven inches between them in the year. But a further examination of the two by months shows that the difference is due to the relatively greater rainfall in the summer and autumn months. It would be expected that in the Highland valleys the larger rainfall would be in the warmer seasons, whereas in the broader Kittatinny valley the more uniform surface, and the greater area bared of forest, would show a deficiency. The five-year record at Dover, Morris county, in a narrow and rather deep valley, also shows a large summer rainfall, while the other seasonal averages agree closely with those of Easton, Pa. The single record in the Delaware river valley, beyond the Kittatinny mountain, is that kept at Port Jervis, New York. Although outside of the Highlands proper, it represents a deep valley in the mountainous belt, west of the great Kittatinny valley, and the extreme northwest section of the State. Its annual average rainfall, from a five-year record, is 39.2 inches, or 9 inches less than that of Dover, and 7 inches below that of Easton, Pa. In the absence of longer records it is not possible to express in figures the full influence of our mountains upon the rainfall. Their elevation and generally wooded slopes, as com-

pared with the deep, low-lying and cultivated valleys, must tend to condense the moisture of passing clouds and thereby produce an increase in the mean quantity precipitated upon their crests above what falls upon the adjacent valleys or plains. And the variation is most likely to be greatest at the southwest and south, on the border near the Red Sandstone plain. As stated on a preceding page, the precipitation on the hills is frequently in the form of snow, when it is rain in the valleys. The depth of snow is known to be greater on the higher grounds than in the valleys. But we have no records of any measurements.

In the Red Sandstone plain the two long series of Newark and New Brunswick differ by 1.6 inches in the average for the year. New Germantown, near the Highlands border, agrees closely with that of New Brunswick. There appears to be a greater quantity at Newark in the winter and the early spring months. In this particular, Newark corresponds with all the stations on the eastern side of the State in their greater average rainfall. The Lambertville seventeen-year record agrees with that of New Brunswick very closely by seasons and by the year. And the general correspondence between New Brunswick, New Germantown and Lambertville yields a very fair average for the central and western part of this division of the State. The forty-four-inch line would include it all. The South Orange record corresponds quite closely with that of Newark in all the yearly divisions.

The record at Paterson shows an apparent excess of nearly nine inches a year above that of Newark, and which is distributed through the winter, spring and summer months. Some of the monthly totals are abnormally large.* The situation of Paterson, in the gap in the First mountain, where the Passaic river crosses the trap-rock ranges, falling over this barrier, to the plain country on the east and northeast, may account for this apparent exception.

For the southern part of the State, the Moorestown record is one of the best, running nearly a quarter of a century. Its yearly average is 43.2 inches, and it corresponds closely with the sixty-three-year period observed at Philadelphia, whose mean is 43.0 inches. The close agreement between these places for months, seasons and year is noteworthy, and they may be taken as approximately correct averages

*That of March, 1881, was 16.1 inches, of September 1882, *25.98 inches*, or greatest in all of our records for a single month. The rainfall at Newark for the same month was 17.66 inches.

for these divisions of time. Going south, the Atco record does not differ much from that of Moorestown, excepting in the summer and September, when there seems to be a greater fall at Atco. The yearly average is 3.5 inches greater than at Moorestown. At Vineland the average is 5 inches greater, and this excess appears to be distributed, not through the warmer months, but through the winter and spring months. Thus, from December to March, inclusive, the excess amounts to 3.8 inches. Further observations are wanted to establish these differences.*

The seashore is represented by the four United States Signal Service stations, Sandy Hook, Barnegat, Atlantic City and Cape May. Inasmuch as the periods of observation are nearly identical, their comparative figures are suggestive of local peculiarities. The yearly average precipitation at these places is as follows:

	Year.	Spring.	Summer.	Autumn.	Winter.
Sandy Hook	51.1	13.8	13.1	12.0	. 12.2
Barnegat	48.3	10.8	12.3	12.5	12.7
Atlantic City	42.5	9.6	11.2	10.0	11.7
Cape May	47.1	10.8	12.9	10.9	12.5
Average for three stations	48.8	11.8	12.8	11.8	12.4

The average, exclusive of Atlantic City, which appears to be phenomenally low, is nearly 49 inches, or from three to six inches above what falls at the southern interior stations of Freehold, Moorestown and Atco. Even with Atlantic City included, the yearly average for the shore is 47.5 inchés, indicating still an excess of 2.5 inches above the average given for the southern stations in table on page 368. As to the monthly and seasonal distribution of this excess for the seashore, it is mainly in the winter and spring months. The summer and autumn averages compare closely with the same seasons at Philadelphia.

To show the annual fluctuation or distribution of rain among the months, the mean monthly values of twenty stations, each of whose periods exceeds five years in length, were charted in five groups. The

* The common errors in placing rain-gauges, or the differences in their form, or inaccurate measurements of the fall, may account for these figures.

curves representing the several stations were assumed as types of their respective localities. The stations of the northern and central parts of the State all agree in a maximum rainfall in August, the curves reaching their highest point in that month. In nearly all of them were three depressions or minima, viz., the first in February, a second in May or June, and a third in October. A second but lower maximum was noted in the spring, in March and in May. The average of all corresponds somewhat with that expressing the annual fluctuation for the Atlantic coast, from Portland, Me., to Washington.* According to this more general curve, May and August are the wettest months, then come November and December, while February, June, September and October are relatively drier. West Point, N. Y., Lake Hopatcong, Fort Columbus, Newark, New Brunswick, Lambertville and Trenton are expressed by this curve. Goshen shows exceptions in depressions for April and November. The stations of the southern interior, and the Atlantic coast and Cape May *provinces*, yield curves which vary somewhat from the above in the spring maximum, coming two months earlier in the year, and the succeeding minimum is in May instead of June. The October minimum is also more pronounced. And in these respects the type for the southern part of the State approaches that for the Atlantic coast (Virginia to Florida).† The wet months are, first, August, then March, and the drier months are May, second, October, and then February. The southern part of the State has its first dry period earlier in the year, and the second is one month later. These correspond with the longer season at the South. Greenwich appears exceptional in having a wet May, but longer observations may remove this apparent exception.

EXTREME PRECIPITATION AND DROUGHTS.

The following tabular statement of extreme rainfalls by months and years, at stations having long records, shows the extreme variation in amount, and the wide range even for a period of one year in length :

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* "Smithsonian Contributions to Knowledge," No. 288, p. 129.

† The rainfall of the coast stations of the United States Signal Service in Virginia, North Carolina and South Carolina is greater than in New Jersey—the average annual precipitation at Cape Henry, Norfolk, Hatteras, Kitty Hawk and Charlestón being 59.8 inches. Examined by months, the greater fall is in July-September, and, second, in December-January; the dry months are May-June and October-November. This greater fall corresponds with the greater amount at the coast stations, Sandy Hook, Barnegat and Cape May.

Table of Extreme Monthly Rainfall, in Inches and Hundredths.

	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.	
	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.	Greatest.	Lowest.
Lake Hopatcong.	5.15	0.48	5.84	0.40	7.54	0.40	7.35	0.25	7.69	1.89	7.64	0.93	7.91	0.90	10.70	0.50	11.44	0.85	9.82	1.04	8.46	1.61	7.30	0.60
Newark..............	6.52	0.64	6.07	0.82	10.00	0.98	8.71	0.39	8.74	0.76	9.74	1.04	8.94	1.12	22.48	0.28	17.66	0.25	7.73	0.32	8.74	0.87	7.54	0.92
New Brunswick..	5.37	0.64	6.01	0.46	6.04	0.80	9.22	1.38	7.57	0.65	10.90	0.24	10.42	1.26	11.52	0.70	8.61	0.34	8.53	0.00	8.77	0.00	5.95	0.96
Moorestown........	5.82	1.13	5.96	0.56	5.78	1.42	8.40	1.15	7.38	0.47	7.56	1.61	6.97	1.98	9.29	1.26	8.27	0.67	6.83	0.47	6.30	1.52	5.77	0.90
Vineland...........	6.30	1.30	6.25	1.73	6.84	1.22	8.32	1.73	8.45	0.77	5.59	0.60	9.82	1.85	10.64	1.28	9.91	0.69	6.75	1.08	7.24	1.49	7.52	1.88

Extreme Annual Rainfall.

	GREATEST.	YEAR.	LEAST.	YEAR.	LENGTH OF PERIOD.
Fort Columbus	65.51	1837	27.57	1836	24 years.
Lake Hopatcong..	54.61	1850	30.06	1866	24 "
Newark..	57.31	1859	34.07	1856	45 "
New Brunswick..	59.95	1873	30.33	1876	27 "
Lambertville	57.36	1841	32.32	1856	22 "

This table gives the extreme monthly precipitation from none (no measurable quantity) to 22.5 inches, and for the years the least and the greatest are 30.1 inches and 65.5 inches respectively. The extreme annual variation at Newark amounts to 23.2 inches; at New Brunswick to 29.6 inches, or about as much as the lowest annual fall. As the dry months or years do not generally occur consecutively, the severity of the droughts thus occasioned is not so great as it might be. But droughts running over three to four months occur. One of the most severe droughts felt in the northern part of the State was that of 1881. The following account of it is taken from the report for October, at Newark: "The year 1881 will ever be remembered for its remarkable drought. The fall of rain in July was 1.34 inches, the fall in August only 0.28, the fall in September 0.87, and the fall in October 2.23 inches, making a *total for four months of only 5.22 inches.* The least quantity *for the corresponding months of any year* since 1843, inclusive, was 10.08 inches, in 1848; the greatest, 34.28 inches, in 1843 (the quantity in August of that year, 22.485 inches, being unprecedented), and the mean of the 38 years 17.028 inches."* At Paterson the total rainfall for July to October, inclusive, that year, amounted to only 7.8 inches, or only 45 per cent. of the average fall for these months.

The rainfall in the southern and on the western sides of the State was heavier than at the northeast, but the severity of the drought was distressing to farmers, and water was very low in the streams. The effect upon the Delaware river was noticed in the very low stage of the water. "In the fall of 1831, and before the feeder of the Delaware and Raritan canal was located, the water of the Delaware was lower than it had been for many years. Conrad White, at that time engineer of the canal company, requested Col. Simpson Torbert to make permanent recording marks along the river shore, which he did, assisted by Martin Coryell. One of these marks was made upon the New Jersey abutment of Centre bridge, on the lower or downstream side, being twelve feet above the surface of the water at the bridge. Mr. George Van Camp, supervisor of the canal feeder, had levels taken in November, 1879, and also in September, 1881, to compare the elevations of low-water mark one with the other, and found them as follows:

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* *Sentinel of Freedom.*

1831	12	feet below mark.	
1879	12.5	"	"
1881	13.215	"	"

At Vineland the rainfall for July, August and September amounted to 6 inches, as compared with the average of 14.2 inches. And there were two periods of 21 and 22 days respectively when no rain fell.

At New Brunswick the drought continued until November, and the rain in 123 days was in all only 2.9 inches.

The following table of droughts or *dry periods*, kept at Lake Hopatcong, by W. H. Talcott, C.E., is here pertinent:

Of Droughts shown by Records kept at Lake Hopatcong, January, 1846, to December, 1869.

YEAR.	FIRST DAY.	LAST DAY.	LENGTH.	RAINFALL IN TIME.
1847	Mar. 27.	May 30.	65 days.	1.53 inches.
1848	" 12.	" 2.	52 "	1.95 "
"	July 4.	Sept. 13.	72 "	1.84 "
1849	Dec. 31 ('48.)	Mar. 20.	80 "	2.37 "
"	May 31.	July 20.	51 "	1.57 "
1851	July 25.	Oct. 29.	98 "	4.79 "
1855	Jan. 29.	Mar. 16.	47 "	0.65 "
1856	" 6.	Apr. 19.	105 "	2.66 "
"	June 19.	Aug. 3.	47 "	0.95 "
"	Sept. 29.	Nov. 21.	53 "	1.70 "
1858	Feb. 21.	Apr. 8.	47 "	0.40 "
1864	Dec. 30 ('63.)	Mar. 1.	63 "	1.44 "
1867	Aug. 29.	Nov. 30.	92 "	5.01 "
1868	Nov. 30 ('67.)	Apr. 4.	127 "	4.49 "

The most severe and long-sustained droughts in this record were those of 1856, 105 days, with but 2.66 inches of rain, and those of 1867 and 1868, the latter covering 219 days, or equivalent to seven months, and receiving 9.5 inches of rain and snow over the cold half of the year.

For notes of droughts in the earlier period of the State's history, see appended Chronological Notes of the Weather.

SNOW.

The *depth* of snow is not indicated in the above tables and statements of rainfall, since it is measured melted, as so much water or rain. The depth varies greatly from winter to winter, and in the same winter in different parts of the State. The quantity in the Highlands is much greater than it is in the extreme southern counties, and it lies for a much longer time, and later in the spring. We have no records of the depth in the more northern parts of the State. The measurements of Mr. Whitehead, at Newark, range between 6 feet 3 inches in the winter of 1867–8, and 1 foot 2 inches in that of 1877–8; and they give an average depth for thirty-seven winters of 40 inches. The average depth measured at Lambertville during the years 1839–1859, inclusive, was 29.5 inches. It is probable that the average for the Highlands corresponds nearly with that of Northern Pennsylvania, which is put at 60 inches for the winter season. The sleighing season continues for several weeks every winter in the Kittatinny valley and the Highlands. In the Red Sandstone plain it is shorter; and in the central and southern part of the State a winter may pass with only a few days of snow depth sufficient for sleighing.

The variation between localities is illustrated in the differences between Paterson and Freehold during the winter of 1880–1. At the former place the total fall of snow was 48 inches; at the latter it amounted to 77 inches, exceeding the greatest depth at Newark by 2 inches.

The snow melts much more rapidly near the coast than in the interior, and although the depth of fall may amount to nearly as much, sleighing is rarely possible beyond a few days at a time; and on the beaches, as at Atlantic City, sometimes for a single day only. And frequently the storms which begin with snow, end in rain. But the sea wind appears to have a very powerful effect in causing it to melt rapidly.

Snow is confined to the three winter months, and to November, March and April. April snows are generally light and infrequent. And the November falls often do little more than whiten the ground. In the Highlands snow may be expected about the first of

December; in the southern part of the State, snow deep enough to lie for several days rarely comes before Christmas. According to the Hazard "Register of Pennsylvania" there was a snowfall at Philadelphia, May 8th, 1803, which broke down trees which were in leaf. But that occurrence is the sole one of a century or more.*

SANITARY RELATIONS.

The climate of New Jersey, as a whole, is salubrious. It is more equable than that of the same parallels further west. And yet it is not the equability accompanied by great moisture and dampness, or cold, which may make an even temperature undesirable and unhealthy. The extremes of temperature, or the range, are not so great as in the northern part of New York and New England generally. The lowest temperatures of our winters are not so low by 10° to 20° as in these States to the north. And diseases of the respiratory organs are neither so prevalent nor so acute and fatal. Persons from New England and New York find the climate of the southern part of the State more comfortable and beneficial in the case of any predisposition to lung diseases. Lakewood, Vineland and Atlantic City have become winter resorts for this class of patients, who escape the rigors of a more northern climate. For evenness of temperature, Cape May has already been indicated as a remarkable locality, and the advantages of so equable a climate within our borders deserve the attention of all interested in the study of medical geography, or in exemption from the extreme cold and sudden changes of our winters. In general, our seaside is so accessible, and so well provided with comfortable and luxurious accommodations, that many prefer to go there rather than further south, and find it quite as beneficial. The growth and prosperity of Atlantic City are largely owing to its winter homes and its patronage throughout the year. These seaside towns are so easily and quickly reached that they are becoming the homes for many invalids and delicate people, who cannot live further inland, where the extremes of both heat and cold are more intense and trying.

On the other hand, our climate is not like that of the Southwest and South Atlantic Coast States, in the heavier summer rainfall and

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*The storm of March 11th-14th, 1888, was remarkable for its severity and the depth of snow. (See Chronological Notes appended.)

prolonged heat periods. The heated terms are shorter, and the nights are cooler than at the South, and, consequently, they are not so enervating or exhausting. There is less malarial fever, so prevalent and fatal along the more southern Atlantic coast and in the Gulf States. Our seaside offers the escape from the extremes of heat also, and it is thronged during the whole summer by a large population seeking comfort and health.

Taking the year through, our situation is favorable so far as climate is concerned, and the records of longevity are evidence of the general healthfulness of our State.

The diversities of climate within the limits of the State must have their effect, and the general healthfulness is modified more or less by these varying conditions. The equable character of the coast and its sanitary advantages have been mentioned above. In the northern part of the State the Highlands offer many locations where the air is very bracing and dry, and where there are no swampy tracts or wet lands to give rise to any dampness or malarious exhalations. It would be beyond the scope of this article to mention localities. The general statements of the preceding pages indicate the districts.

In the southern interior, the dry, sandy soil, and the extensive pine forests, appear to conduce to healthfulness, and a few localities were noted long ago as *sanitariums* for persons with weak lungs.

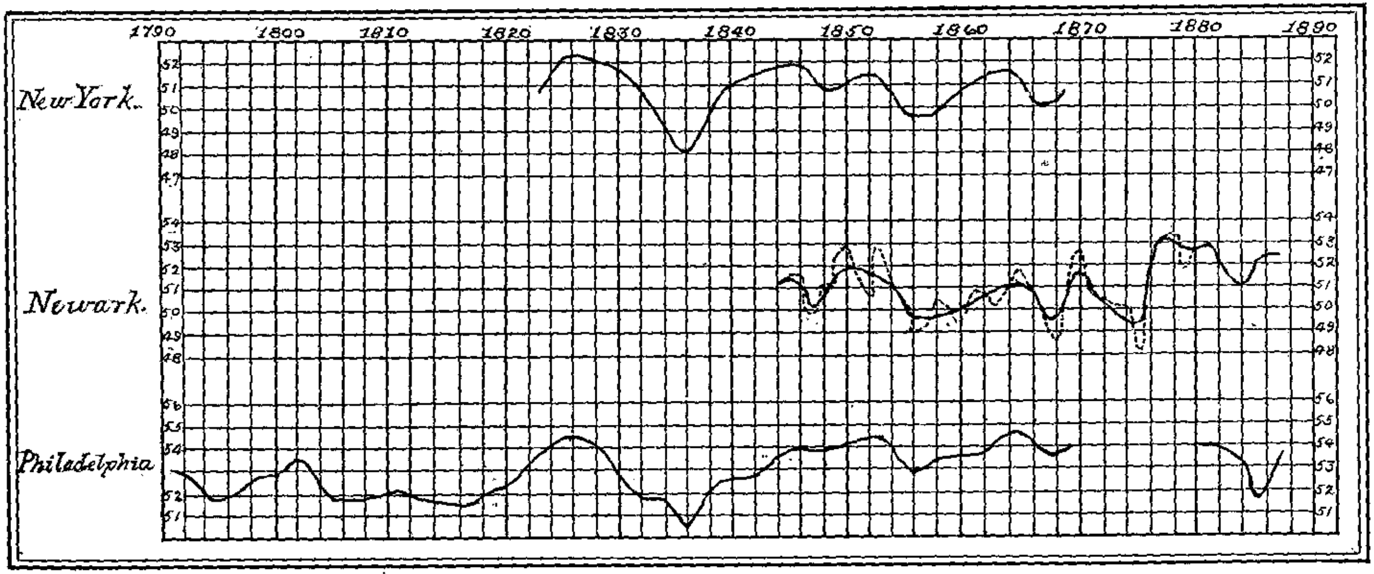
In conclusion it may be said that the study of climate in its sanitary relations is still in its infancy. This is largely due to the absence of accurate meteorological data and a general ignorance of the peculiarities of our climate. The study of disease and of climatological conditions must go together. The claims of a suffering humanity call for all the aid which science can give. And it may be found that in our own borders there are many of the peculiar conditions and local features which can be of service not only in prolonging life, but also in restoring health, quite as well as the famous resorts of the South or far West. The field is an inviting one, and encouraging of success.

PERMANENCY OF CLIMATE.

There is a prevalent impression that the climates of the globe have undergone material changes within the historic period, or since records of observations on temperature and rainfall have been kept;

and that changes are still in progress. It is generally believed that in our country the alternations of temperature are more sudden and the extremes greater; that the springs are earlier and the seasons, in general, more variable; that the rainfall is less and more unequally distributed through the year, and, consequently, that the river floods are higher and the variations in springs and streams more irregular than formerly. In Europe, the changes in climate have been thoroughly discussed by Humboldt, Dove, Glaisher, and other eminent meteorologists. Both the fluctuations in temperature and those of rainfall have been investigated. The results do not indicate any changes, or any regular variations, or cycles of definite length, although there are found to be comparatively short rainfall periods, which correspond somewhat with observed sun-spot periods. It is doubtful if even these will prove coincident throughout when tested by longer series of observations. The fluctuations of temperature do not appear capable of resolution into any orderly arrangement. Warm and cold terms of years, of varying lengths, alternate irregularly. The weather records of our country do not go back so far as some of the European series, but they also exhibit the same apparent irregularity in the sequence of warm and cold years and a lack of any periodicity in the annual rainfall. Our temperature records are mostly confined to the present century. Those of New Haven date from 1780; those of Philadelphia from 1758 (with some gaps in the eighteenth century); those of New York from 1821. In the investigation of the secular variation in temperature, the annual means for the stations having long records, have been plotted, and their curves presented in plate facing page 310 of Schott's Tables of Atmospheric Temperature. Two of the curves, those for Philadelphia and New York, are reproduced in Plate 2, and with them that of Newark for its term (1843–1887). The general curve and also the yearly irregularities or departures from it are shown, the former by a continuous, the latter by a broken line. The vertical lines represent two-year periods, and the decades are indicated by figures at the top, beginning with 1790. The horizontal lines are for temperature, the figures for which are at the sides of the diagram. They stand for *mean* annual temperature. We note a depression about 1794, in the Philadelphia curve, then a rise to a maximum in 1802. From that year to 1816 there was a general decline. Thence, onward, for ten years, the mean temperature increased quite rapidly, and here the

PLATE 2.



CURVES OF SECULAR CHANGE IN THE MEAN ANNUAL TEMPERATURE

New York curve begins; both then as rapidly fall, and reach a very decided minimum in 1836. From that depression the Philadelphia curve rises irregularly to a maximum about 1853. Both cities show a depression about 1856–7; and the same appears in that of Newark, also. From that forward the undulations, as shown in Newark, are shorter, and there are notable depressions for the years 1867–8, and again in 1875. The rise thence to 1877–80 and the decline from 1882 to 1885 are also remarkable. The cold epochs were therefore 1794, 1816, 1836, 1856–7, 1867–8, 1875 and 1884, or at intervals of about 22, 20, 21, 11, 7 and 9 years. But the subject of change of climate is best stated in Schott's conclusion: "There is nothing in these curves to countenance the idea of any permanent change in the climate having taken place or being about to take place; in the last 90 years of thermometric records, the mean temperatures showing no indication whatever of a sustained rise or fall. The same conclusion was reached in the discussion of the secular change in the rainfall, which appears also to have remained permanent in amount as well as in annual distribution."*

Going back quite as far as any of our temperature observations, are the records of seasons of navigation and ice in rivers and harbors. One of the best is that of the season of navigation in the Hudson river. The dates of opening and closing of the river at Albany, N. Y., indicate the severity of the winter, by the longer periods, or the mildness, by the shorter time, between the closing by ice in fall or winter, and the spring date when the river was again free from ice.† This table will be found appended to this article.

None of the records indicate any diminution in rainfall in the mean quantity for year or seasons, nor does there appear to be an increased number of dry periods. In severity the drought of 1881 was certainly extreme. From the clearing away of forests, particularly in the Red Sandstone plain, and the general cultivation of the soil, drainage of wet tracts, etc., it is reasonable to suppose that the rainfall might be slightly diminished in quantity, judging by the well-known comparative observations on rainfall in forests and in

* "Tables of Atmospheric Temperature: Smithsonian Contributions to Knowledge," No. 277, p. 311. Washington, 1876.

† Although Albany is 100 miles north of our boundary on the north, the condition of the ice in the Hudson marks our winters—of Northern New Jersey—quite as well as any other record which we could have, and hence it is here inserted as applicable to our State.

cleared areas, in Germany, France and Switzerland. But the records do not show any such desiccation in the climate, nor will measurements, as usually made, exhibit the probable changes. The distribution of the rains through the months and seasons is probably less uniform since the settlement and clearing of the country. That is, they are more irregular, and heavy rainfalls are probably more common. Of course the rains run away more quickly, and that the streams, especially the larger rivers and creeks, are more subject to very high freshets, appears to be generally conceded, and reasonably so, since there is a vastly diminished area of swamp and woodland to retain in the surface the rains, and to allow their more gentle flowing away. The drying up of springs, supposed to be lasting, and of streams which formerly carried water even in very dry seasons, are evidences of the greater *desiccation* of the soil at times, if not of the climate. (See Marsh's "Earth as Modified by Human Action.")

HISTORICAL NOTES OF CLIMATE AND WEATHER PHENOMENA.

The earliest printed notice of the climate of New Jersey is in "A Description of the Province of New Albion, etc., published in 1648." The following extract from it is here given: "Whereas that part of America, or North Virginia, lying about 39 degrees on Delaware bay, called the province of New Albion, is situate in the best and same temper as Italy, between too cold Germany, and too hot Barbary; so this lying just midway between New England 200 miles and Virginia 150 miles south, where now are settled 8,000 English, and 140 ships in trade, is freed from the extreme cold and barrenesse of the one, and heat and aguish marshes of the other, and is like Lumbardy, and a rich fat soil, plain, and having 34 rivers on the mainland, 17 great Isles, and partaketh of the healthiest aire and most excellent commodities of Europe, and replenished with the goodliest woods of oaks and all timber for ships and masts, mulberries, sweet cypresse, cedars, pines and firres, 4 sorts of grapes for wine, and raisins, and with the greatest variety of choice fruits, fish and fowl, stored with all sorts of corn, yeelding 5, 7 and 10 quarters an acre." *

* That the name New Albion was then applied to New Jersey appears in a letter of Robert Evelin, which was included in the same pamphlet. We extract: "But nevertheless to satisfie you of the truth, I thought good to write unto you my knowledge, and first to describe you from the north side of Delaware unto Hudson's river in Sir

From the account of Thomas Rudyard, Deputy Governor of East Jersey, written in 1683, we extract the following paragraph, descriptive of that Province: "As for the temperature of the air, it is wonderfully situated to the humors of mankind; the wind and weather rarely holding one point, or one kind, for ten days together; it is a rare thing for a vessel to be wind-bound for a week together, the wind seldom holding in a point more than 48 hours; and in a short time we have wet and dry, warm and cold weather." This description is as pertinent to-day as it could have been in 1683.

In Thomas Budd's "Good Order Established in Pennsylvania and New Jersey in America," printed in 1685, there is the following: "The dayes in the winter are about two hours longer, and in the summer two hours shorter than in *England;* the summer somewhat hotter, which causeth the fruits and corn somewhat to ripen faster than in *England,* and the harvest for Wheat, Rye and Barley, being about the latter end of *June.* In the winter season it is cold and freezing weather, and sometimes Snow, but commonly very clear and Sun-shine, which soon dissolves it."

Peter Kalm, a celebrated Swedish traveler and natural philosopher, who spent the winter of 1748–9 in West Jersey, and afterwards, in 1750, traveled through the State, writes as follows of the snow at Penn's Neck, February 23d, 1749: "Snow lay yet in several parts of the woods, especially where the trees stood very thick, and the sun could not make its way; however, it was not above four inches deep. All along the roads was ice, especially in the woods, and, therefore, it was very difficult to ride horses which were not sharp-shoed. The people who are settled here know little of sledges, but ride on horseback to church in winter, though the snow is sometimes near a foot deep. It lays seldom above a week before it melts, and then some fresh snow falls."*

While residing at *Raccoon,* a locality in Gloucester county, this traveler collected notes about the effects of severe cold upon trees and of late frosts in spring in killing blossoms and leaves. We extract the following:

"I often inquired among the old *Englishmen* and *Swedes* whether they had found that any trees were killed in very severe winters, or

Edmunds' patent, called New Albion, which lieth just between New England and Maryland, and that ocean sea, I take it to be about 160 miles."—*Smith's History of New Jersey, pp.* 27, 28.

* "Travels into North America," by Peter Kalm, London, 1771, Vol. II., p. 73.

had received much hurt. I was answered that young hickory trees are commonly killed in very cold weather, and the young black oaks likewise suffer in the same manner. Nay, sometimes black oaks five inches in diameter were killed by the frost in a severe winter, and sometimes, though very seldom, a single mulberry tree was killed. Peach trees very frequently die in a cold winter, and often all the peach trees in a whole district are killed by a severe frost. It has been found repeatedly, with regard to these trees, that they can stand the frost much better on hills than in valleys; insomuch that when the trees in a valley were killed by frost, those on a hill were not hurt at all. They assured me that they had never observed that the black walnut tree, the sassafras, and other trees, had been hurt in winter. In regard to a frost in spring, they had observed at different times that a cold night or two happened often after the trees were furnished with pretty large leaves, and that by this most of the leaves were killed. But the leaves thus killed have always been supplied by fresh ones. It is remarkable that in such cold nights the frost acts chiefly upon the more delicate trees, and in such a manner that all the leaves, to the height of seven and even of ten feet from the ground, were killed by the frost, and all the top remained unhurt. Several old *Swedes* and *Englishmen* assured me they had made this observation, and the attentive engineer, Mr. Lewis Evans, has shown it me among his notes. Such a cold night happened here in the year 1746, in the night, between the 14th and 15th of *June*, new style, attended with the same effect as appears from Mr. *Evans'* observations. The trees which were then in blossom, had lost both their leaves and their flowers in those parts which were nearest the ground; some time after they got fresh leaves, but no new flowers. Further, it is observable that the cold nights which happen in spring and summer never do any hurt to high grounds, damaging only the low and moist ones. They are likewise very perceptible in such places where limestone is to be met with, and though all the other parts of the country be not visited by such cold nights in a summer, yet those where limestone lies have commonly one or two every summer. Frequently the places where the limestone lies are situated on a high ground; but they suffer, notwithstanding their situation; whilst a little way off, in a lower ground, where no limestone is to be found, the effects of the cold nights are not felt. Mr. *Evans* was the first who made this observation, and I have had occasion at different times to see the truth of it on my travels, as I shall mention in the sequel. The young hickory trees have their leaves killed sooner than other trees in such a cold night, and the young oaks next; this has been observed by other people, and I have found it to be true in the years 1749 and 1750." *

The occurrence of a frost in June, having a like effect upon tender leaves of trees, has been referred to on another page.

* Kalm, Vol. II., pp. 83-85.

One of the most remarkable of his inquiries was in regard to the weather and its changes and the permanency of climate. The answers of that day were substantially what might be obtained now. We quote:

"The following account the old man gave me, in answer to my questions with regard to the weather and its changes; it was his opinion that the weather had always been pretty uniform ever since his childhood; that there happen as great storms at present as formerly; that the summers now are sometimes hotter, sometimes colder, than they were at that time; that the winters were often as cold and as long as formerly; and that still there often falls as great a quantity of snow as in former times. However, he thought that no cold winter came up to that which happened in the year 1697, and which is often mentioned in the almanacks of this country; and I have mentioned it in the preceding volume. For in that winter the river *Delaware* was so strongly covered with ice that the old man brought many waggons full of hay over it near *Christina*, and that it was passable in sledges even lower. No cattle, as far as he could recollect, were starved to death in cold winters, except in later years, such cattle as were lean, and had no stables to retire into. It commonly does not rain, neither more nor less, in summer than it did formerly, excepting that, during the last years, the summers have been more dry. Nor could the old *Swede* find a diminution of water in brooks, rivers and swamps. He allowed, as a very common and certain fact, that wherever you dig wells you meet with oyster shells in the ground.

"The winter came sooner formerly than it does now. Mr. *Isaac Norris*, a wealthy merchant, who has a considerable share in the government of *Pennsylvania*, confirmed this by a particular account. His father, one of the first *English* merchants in this country, observed, that in his younger years, the river Delaware was commonly covered with ice, about the middle of *November*, old style, so that the merchants were obliged to bring down their ships in great haste before that time, for fear of their being obliged to lie all winter. On the contrary, this river seldom freezes over at present, before the middle of *December*, old style.

"It snowed much more in winter, formerly, than it does now; but the weather in general was likewise more constant and uniform, and when the cold set in, it continued to the end of *February*, or till *March*, old style, when it commonly began to grow warm. At present it is warm, even the very next day after a severe cold, and sometimes the weather changes several times a day.

"Most of the old people here were of opinion, that spring came much later at present than formerly, and that it was now much colder in the latter end of *February* and the whole month of *May* than when they were young. Formerly the fields were as green, and

the air as warm, towards the end of *February*, as it is now in *March*, or in the beginning of *April*, old style. The *Swedes* at that time made use of this phrase, *Pask bitida, Pask sent, altid Gras*, that is, we have always grass at *Easter*, whether it be soon or late in the year. But perhaps we can account as follows, for the opinion which the people here have, that vegetation appeared formerly more forward than it does now. Formerly the cattle were not so numerous as now; however, the woods were full of grass and herbs, which, according to the testimony of all the old people here, grew to the height of a man. At present a great part of the annual grasses and plants have been entirely extirpated by the continual grazing of numbers of cattle. These annual grasses were probably green very early in the spring, and (being extirpated) might lead the people to believe, that everything came on sooner formerly than it does at present. It used to rain more abundantly than it does now; during the harvest especially the rains fell in such plenty that it was very difficult to bring home the hay and corn. Some of the last years had been extremely dry. However, a few people were of opinion that it rained as plentifully at present as formerly.

"All the people agreed that the weather was not by far so inconstant when they were young as it is now. For at present it happens at all times of the year, that when a day has been warm, the next is very cold, and *vice versa*. It frequently happens that the weather alters several times in one day, so that when it has been a pretty warm morning, the wind blows from northwest about ten o'clock and brings a cold air with it; yet a little after noon it may be warm again. My meteorological observations sufficiently confirm the reality of these sudden changes of weather, which are said to cause, in a great measure, the people to be more unhealthy at present than they were formerly.

"I likewise found everybody agree in asserting that the winter betwixt the autumn of the year 1697, and the spring of the year 1698, was the coldest and the severest which they ever felt." *

* Kalm, Vol. II., pp. 119, 120, and 127-130.

EXPLANATION OF TABLE OF TEMPERATURE.

The table of temperature has been modeled after those of Chas. A. Schott (of United States Coast Survey), as published in "Smithsonian Contributions to Knowledge," No. 277. It contains the name of station, geographical position, elevation, mean, maximum and minimum temperatures by months, mean temperatures by seasons, and for the year and length of period of observation.

The arrangement of the localities, or meteorological stations, is geographical, beginning with those furthest north and going southward. And they appear in groups, corresponding in general to the divisions of the State, designated as climatological provinces.

The geographical positions are given to the nearest minute of latitude and longitude. The longitude is that west of Greenwich.

The elevations are expressed in feet above mean tide level, so far as they could be ascertained from railroad surveys, and from the topographical maps of the Geological Survey.

The "Tables of Atmospheric Temperature" in "Smithsonian Contributions to Knowledge," furnish heights for several stations.

The temperature is given in columns arranged by months, by the year and by seasons. In the monthly columns, the first of each gives the maximum or highest temperature *observed for that month* during the period covered by the record. The second column gives the minimum or lowest observed temperature for the month. And the third gives the mean daily temperature. The range for any given month is, therefore, apparent in the difference between the maximum and the minimum temperatures, as shown in the first and second columns. The mean annual temperature is the mean obtained from the several mean monthly temperatures. Following this column for the mean, are three columns giving the maximum, the minimum and the range of temperature for the year. Then follow the mean temperatures for the four seasons, consisting of the calendar months as commonly placed in them. In the three columns headed "Series," the dates of commencement, of end and the length of the observing period are given. The length in most cases consists of the actual time covered by the record,* and it is not always the same as that

* The length of record of observation in some cases consists of the number of months and twelve-months observed, but not calendar years. Hence, in a few cases the months are unequally represented. But in all the longer series the dates give the length.

comprised between the dates of beginning and end. The names of observers, so far as obtainable, are given in the last column.

The authorities for the tables are Schott's "Tables of Atmospheric Temperature," in "Smithsonian Contributions to Knowledge," No. 277; copies of records furnished by the Smithsonian Institution; copies of the records of the United States Signal Service Stations, contributed by the Chief Signal Officer of the United States Army; "Army Meteorological Register," Washington, 1851 and 1856; annual reports of the Chief Signal Officer, 1870 to 1886, inclusive; the Monthly Weather Review issued from same office; New York Meteorology, *by F. B. Hough, First and Second Series;* the American Almanac, for 1861; and original data furnished by local observers. In the case of nearly all the existing stations the records have been submitted to the observers, and revised by them wherever necessary, to correspond with their original records of observations. The mean temperatures are believed to be as nearly correct as it is possible to make them. In the columns for maximum and minimum temperatures, the extremes do not in all cases correspond to the whole length of periods covered by the mean temperatures, as the data were not accessible. It is possible that they do not, therefore, in a few localities, represent the extremes or indicate so wide a range as may have been observed.

In order to a more accurate comparison, the records of mean temperature of Newark and of Morrisville, Pa., where the observing hours are not the ordinary ones, (7 A. M., 2 P. M. and 9 P. M.,) have been corrected to correspond with observations made at those hours.

The temperatures are expressed in degrees and fractions of a degree, and according to the Fahrenheit scale.

Table of Extreme Temperatures in Degrees Fahrenheit.

STATIONS.	JANUARY.		FEBRUARY.		MARCH.		APRIL.		MAY.		JUNE.		JULY.		AUGUST.		SEPTEMBER.		OCTOBER.		NOVEMBER.		DECEMBER.		YEAR.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Goshen, N. Y......	60	-30	60	-16	78	-5	84	10	89	26	96	36	96	42	91	36	88	32	82	14	78	4	62	-10	96	-30
Paterson............	62	-14	65	-6	72	1	87	22	95	30	97	48	98	58	95	51	98	39	85	26	70	9	60	-2	98	-14
Newark..............	65	-12	68	-8	77	2	86	17	96	31	97	38	99.7	46	99	46.7	76	34	83	22	74	8	68.5	-6.5	99.7	-12.5
New Brunswick..	67	-12	67	-1	77	4	83	21	98	29	98	45	101	56	99	48	103	39	89	26	74	11	65	-12	103	-12
Lambertville	61	-20	67	-8.4	77	-0.7	85	14	93	29	100	38	101	44	97	40	97	32	88	20	75	10	70	-16.5	100	-20
Philadelphia, Pa.	67	-9	75	-2	79	5	88	17	96	31	98	42	101	50	99	50	101	37	88	17	80	10	72	-5	101	-9
Moorestown	69	-16	72	-5	79	2	86	22	97	36	99	45	102	58	98	46	103	37	90	22	78	10	71	-9	103	-16
Vineland............	69	-11	75	-6	81	2	90	18	96	32	100	44	106	46	102	49	101	37	92	25	80	9	70	-10	104	-11
Greenwich..........	62	-9	67	2	76	7	82	25	87	40	94	50	95	55	93	53	89	42	79	29	73	17	67	1	95	-9
Atlantic City.......	64	-3	71	-5	72	8	84	19	89	33	95	45	99	53	92	49	94	40	83	29	72	10	64	-7	99	-7
Baltimore, Md.....	69	-15	78	-4	76	0	89	20	95	31	100	45	102	54	100	50	101	38	89	25	78	11	73	-3	102	-15
Extremes......	69	-30	78	-16	81	-5	90	10	97	26	100	36	106	42	102	36	104	32	92	14	80	4	73	-16	104	-30

EXPLANATION OF TABLE OF RAIN AND MELTED SNOW.

The second column gives the names of localities or stations. Their more exact location is given in the columns of latitude and longitude.* The elevations are expressed in feet, above mean tide level, and are from the topographical maps of the Geological Survey, and from railroad surveys.

The amount of rain and melted snow is given in inches and hundredths, and the figures stand for the mean or average quantities for each month of the year. Following them are the mean quantities for the several seasons, and, lastly, that for the year. The dates of commencement and end of the record, and the length, are next given. The last column has the observers' names, or other authority for the records.

The mean quantities for the months are obtained by adding together the quantities for the given months in the several years observed, and dividing by the number of years. Inasmuch as there are often gaps—months without any record—allowance is made for them. Consequently, the means at any given station may not represent any equal number of records for all the months of the year. The mean for any given month is the quotient of the total rainfall of that month throughout the period, divided by the number of months observed. The averages for the seasons are made by adding together the monthly averages belonging to the calendar months of the several seasons. Thus, spring covers the months of March, April and May. The annual fall is the sum of the months, or that of the four seasons.†

The length of the period includes the actual number of years (or twelve-months) and months observed, and is not, in many cases, coincident with the length of time between the dates of beginning and end, as they appear in the preceding columns. But in all the longer series there are no gaps. The records for short periods are of much less importance, and hence omissions in them of single months are of less account.

* The longitudes are west from Greenwich.

† Slight discrepancies between the sum of months or seasons and the year, in the case of two stations, are owing to differences in the yearly means as furnished by observers.

Table of Rain and Melted Snow. Inches and Hundredths of Inches.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October	November.	December.	
1	White Plains, Westchester Co., N. Y.	42° 02′	73° 40′	200	6.09	5.63	4.21	3.84	3.34	4.62	4.87	3.74	3.03	3.58	3.25	4.79	1
2	West Point, Orange Co., N. Y.	41° 24′	73° 57′	167	3.86	3.47	3.32	3.89	4.79	3.58	4.42	4.88	3.42	4.32	4.11	4.10	2
3	Goshen, Orange Co., N. Y.	41° 23′	74° 20′	425	2.59	2.55	2.61	2.05	3.44	3.27	2.95	2.66	2.79	3.13	2.34	3.44	3
4	Port Jervis, Orange Co., N. Y.	41° 22′	74° 42′	450	3.53	3.61	3.30	3.09	3.43	3.69	4.68	3.02	3.12	2.60	2.29	2.82	4
5	Deckertown, Sussex Co.	41° 12′	74° 36′	470	1.94	2.41	2.86	2.16	2.73	.....	.....	2.92	2.47	.....	.....	.....	5
6	Newton, Sussex Co	41° 03′	74° 45′	659	4.05	1.88	4.89	1.79	3.57	3.49	1.92	.....	.....	.....	.....	2.45	6
7	Dodge Mine, Morris Co.	41° 01′	74° 35′	1,160	3.01	2.57	4.68	2.31	0.99	4.12	7.22	4.75	2.70	2.51	2.04	1.47	7
8	Lake Hopatcong, Morris Co.	40° 55′	74° 39′	914	2.37	2.44	2.79	3.47	4.67	3.66	3.95	4.31	3.98	3.77	3.67	3.46	8
9	Dover, Morris Co.	40° 53′	74° 34′	580	4.61	3.22	2.44	2.36	5.45	5.47	5.62	5.81	2.90	3.12	3.45	4.18	9
10	Belvidere, Warren Co.	40° 50′	75° 05′	280	4.49	4.78	.....	2.36	.....	.....	6.12	5.90	1.21	5.07	1.55	3.03	10
11	Phillipsburg, Warren Co.	40° 41′	75° 11′	220	4.00	3.95	3.12	2.15	4.07	3.29	3.76	3.69	3.66	2.63	1.81	2.70	11
12	New York City, N. Y.	40° 42½′	74° 00′	164	3.71	3.73	3.96	3.29	2.82	3.51	4.49	4.77	3.21	3.29	3.48	3.34	12
13	Fort Columbus, New York Harbor	40° 42′	74° 01′	20	3.29	3.23	3.34	3.16	4.31	3.92	3.62	4.48	3.39	3.30	3.27	4.03	13
14	Jersey City, Hudson Co.	40° 43′	74° 03′	20	3.16	3.00	4.53	4.10	2.71	3.14	5.11	5.45	3.61	2.99	3.77	2.65	14
15	Tenafly, Bergen Co.	40° 55′	73° 58′	100	2.61	3.11	3.86	0.91	.....	9.57	4.86	5.50	2.22	2.87	2.06	3.64	15
16	Paterson, Passaic Co.	40° 55′	74° 10′	60	4.17	4.83	5.51	3.06	5.01	5.59	6.15	4.16	5.57	2.98	3.06	4.96	16
17	Upper Montclair, Essex Co.	40° 51′	74° 13′	340	2.96	.....	.....	.....	6.20	5.17	5.27	2.59	1.33	3.40	4.38	1.62	17
18	Bloomfield, Essex Co.	40° 48′	74° 12′	120	3.39	2.99	2.68	4.05	4.61	3.64	4.19	4.54	2.41	3.30	3.47	3.11	18
19	Newark, Essex Co.	40° 44′	74° 10′	35	3.65	3.60	3.81	3.53	3.97	3.57	4.28	5.07	3.75	3.58	3.63	3.81	19

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
20	East Orange, Essex Co.	40° 46′	74° 12′	160	2.65	2.17	4.08	4.56	2.47	3.43	4.62	5.61	2.22	5.05	5.77	4.33	20
21	Orange, Essex Co	40° 47′	74° 13′	185	1.10	2.55	3.55	5.12	2.98	3.45	6.70	5.43	5.50	3.70	3.27	3.13	21
22	South Orange, Essex Co.	40° 45′	74° 15′	140	3.96	3.72	3.68	2.91	2.82	3.35	4.72	5.05	3.42	3.39	3.28	3.81	22
23	Elizabeth, Union Co.	40° 40′	74° 13′	30	....	4.48	3.56	2.89	0.53	6.60	7.71	2.79	2.87	2.79	2.11	2.81	23
24	Union, Union Co.	40° 41′	74° 16′	110	6.35	5.03	3.27	2.47	0.97	6.87	9.29	2.60	2.56	2.47	1.92	3.64	24
25	Linden, Union Co.	40° 38′	74° 15′	30	4.47	2.85	4.70	2.46	2.31	2.78	5.19	5.35	3.09	2.81	4.47	3.45	25
26	Pequanac, Morris Co.	40° 57′	74° 17′	170	....	....	....	....	....	....	3.14	1.38	12.39	....	....	....	26
27	Caldwell, Essex Co.	40° 50′	74° 17′	420	5.54	4.89	4.65	4.29	3.87	6.36	4.49	4.14	5.56	5.28	1.30	3.54	27
28	Gillette, Union Co.	40° 41′	74° 28′	220	....	....	....	....	....	....	....	2.98	1.62	....	0.95	5.36	28
29	New Germantown, Hunterdon Co.	40° 40′	74° 45′	260	3.08	2.78	3.76	3.24	3.29	4.03	4.71	4.95	3.13	5.01	3.67	2.44	29
30	Readington, Hunterdon Co.	40° 34′	74° 44′	110	3.62	4.30	3.01	4.65	3.85	3.95	5.67	5.63	4.20	4.77	3.54	4.63	30
31	Ringoes, Hunterdon Co.	40° 26′	74° 52′	248	2.52	2.84	5.34	2.71	2.10	3.87	5.80	5.24	4.14	3.32	3.97	3.93	31
32	Somerville, Somerset Co.	40° 34′	74° 36′	65	3.91	3.77	3.96	2.57	2.59	4.77	5.67	4.43	1.77	3.19	3.25	4.74	32
33	New Brunswick, Middlesex Co.	40° 29′	74° 27′	90	3.07	2.97	3.38	3.78	3.82	3.89	4.63	4.94	3.39	3.33	3.64	3.47	33
34	Princeton, Mercer Co.	40° 21′	74° 40′	220	4.05	4.06	3.74	2.96	2.59	2.06	6.27	2.98	1.97	2.26	2.59	4.24	34
35	Locktown, Hunterdon Co.	40° 29′	74° 59′	490	3.82	6.16	3.06	2.08	1.99	7.78	7.86	5.37	3.04	2.23	1.32	6.01	35
36	Lambertville, Hunterdon Co.	40° 22′	74° 57′	96	3.22	3.12	3.25	3.16	4.12	3.76	4.26	4.83	3.68	3.33	3.11	4.08	36
37	Trenton, Mercer Co.	40° 13′	74° 46′	50	3.25	2.59	3.87	3.86	3.10	4.01	5.61	5.39	3.61	3.67	4.43	3.11	37
38	Morrisville, Bucks Co., Penna.	40° 13′	74° 47′	30	3.29	2.77	3.33	3.87	3.94	4.09	3.62	4.05	3.48	3.65	4.28	3.29	38

Table of Rain and Melted Snow. Inches and Hundredth of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
39	Fallsington, Bucks Co., Penna	40° 12′	74° 48′	30	4 29	4.90	3.07	2.60	3.52	3.65	3.74	4.41	3.27	2.92	2.91	3.57	39
40	Sandy Hook, Monmouth Co	40° 28′	74° 01′	30	4.33	3.82	5.01	4.43	4.52	4.09	4.41	4.61	4.09	3.66	4.27	4.04	40
41	Riceville, Monmouth Co	40° 24′	74° 02′	80	5.68	2 32	3.61	4.52	5.74	2 00	1.65	2.61	....	....	....	....	41
42	Middletown, Monmouth Co	40° 24′	74° 07′	120	5.72	2.55	1.16	2.50	4.50	4.10	3.40	1.70	2.50	4.60	3.13	1.37	42
43	Oceanic, Monmouth Co	40° 23′	74° 01′	20	....	1.13	4.64	3.35	0.85	7.67	6.95	5.15	3.75	3.90	2.54	5.43	43
44	Long Branch, Monmouth Co	40° 18′	73° 59′	28	3.59	3.76	5.71	6.48	3.34	3.28	5.30	7.07	7.52	3.28	5.32	3.68	44
45	Lakewood, Ocean Co	40° 05′	74° 13′	50	....	4.57	3.89	3.57	1.44	....	....	....	....	....	2.14	....	45
46	Toms River, Ocean Co	39° 57′	74° 12′	20	....	....	....	....	....	....	....	....	5.93	3.14	2.18	4.18	46
47	Squan Beach, Ocean Co	40° 08′	74° 01′	23	3.71	3.03	4 79	3.31	2.98	3.76	4.39	6.20	3.31	2.73	5.50	3.88	47
48	Matawan, Monmouth Co	40° 25′	74° 14′	50	2.00	4.65	2.77	2.12	0.08	6.47	14.00	3 34	3.18	2.43	1.55	4.25	48
49	Freehold, Monmouth Co	40° 15′	74° 17′	190	3.97	3.75	4.97	3.41	2.78	3.91	3.92	5.02	4.48	3.06	3.69	3.77	49
50	Imlaystown, Monmouth Co	40° 10′	74° 31′	110	3.28	6.45	3.22	2.90	1.17	8.19	6.81	2.12	4.92	2.68	1.74	6.00	50
51	Hightstown, Mercer Co	40° 16′	74° 32′	100	1.58	4.91	5.77	2.73	2.91	....	....	....	....	0.90	5.38	....	51
52	Bordentown, Burlington Co	40° 09′	74° 43′	60	4.21	5.19	2.92	3.09	1.87	8.15	7.90	2.09	8.35	1.86	1.88	4.32	52
53	Burlington, Burlington Co	40° 05′	74° 51′	20	3.26	3.57	3.49	3.83	5.86	5.04	3.51	5.31	3.47	3.36	2.86	4 32	53
54	Beverly, Burlington Co	40° 04′	74° 55′	30	3.25	4.78	3.44	4.04	4.79	4.73	7.51	2.51	3.28	2.61	2.85	4.18	54
55	Philadelphia, Penna	39° 56′	74° 10′	36	3.29	3.08	3.42	3.47	3.73	3.96	4.03	4.47	3.57	3.21	3.37	3.43	55
56	Mount Holly, Burlington Co	40° 00′	74° 47′	30	1.34	3.60	2.69	2.73	2.29	3.25	3.49	7.11	3.69	1.55	3.93	3.07	56
57	Moorestown, Burlington Co	39° 58′	74° 57′	104	3.44	3.50	3 39	2.92	3.77	3.93	4.18	4.43	3.82	3.18	3.25	3.42	57

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	Latitude.	Longitude.	Height—feet.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	
58	Haddonfield, Camden Co.	39° 53′	75° 02′	50	3.13	2.92	4.17	3.38	6.20	3.57	2.79	4.97	4.59	3.55	3.39	4.04	58
59	Atco, Camden Co.	39° 46′	74° 53′	150	3.73	3.36	4.25	2.85	2.93	4.15	4.07	5.87	4.76	2.96	3.93	3.90	59
60	Harrisville, Burlington Co.	39° 40′	74° 31′	20	......	4.69	3.68	3.20	1.15	6.79	3.73	5.19	5.10	2.70	2.39	......	60
61	Egg Harbor City, Atlantic Co.	39° 32′	74° 38′	40	......	......	4.50	9.20	15.07	5.79	7.95	5.36	1.25	3.15	3.37	3.39	61
62	Clayton, Gloucester Co.	39° 39′	75° 05′	130	3.81	6.47	2.98	2.69	2.99	4.97	3.77	3.06	3.40	2.29	3.52	4.30	62
63	Vineland, Cumberland Co	39° 29′	75° 01′	120	4.60	4.06	4.43	3.12	3.76	3.52	4.25	5.09	4.38	3.33	3.72	4.01	63
64	Barnegat, Ocean Co.	39° 46′	74° 07′	20	4.93	3.52	4.66	3.56	2.54	3.51	3.86	4.97	4.74	3.50	4.28	4.24	64
65	Little Egg Harbor, Burlington Co.	39° 30′	74° 17′	14	4.95	5.48	3.67	2.86	1.38	2.14	2.75	7.69	5.48	3.52	1.74	2.75	65
66	Atlantic City, Atlantic Co.	39° 22′	74° 25′	14	3.91	3.51	3.77	3.33	2.46	3.20	3.27	4.82	3.15	3.24	3.62	4.33	66
67	Pecks Beach, Cape May Co.	39° 11′	74° 40′	20	3.54	3.99	4.13	7.17	1.72	2.66	2.21	3.79	6.26	1.24	4.01	4.86	67
68	Ocean City, Cape May Co.	39° 17′	74° 34′	20	......	5.25	......	......	......	......	......	2.10	3.80	5.00	2.00	5.50	68
69	Cape May, Cape May Co.	38° 56′	74° 58′	28	4.37	3.79	4.97	3.16	2.71	3.50	3.28	6.08	4.13	3.26	3.51	4.34	69
70	Salem, Salem Co	39° 35′	75° 28′	15	4.51	......	1.00	2.96	2.34	3.25	3.15	6.28	3.11	1.93	2.22	2.85	70
71	Allowaystown, Salem Co.	39° 34′	75° 22′	20	3.61	3.52	2.65	2.43	2.97	3.27	2.76	8.98	3.36	3.73	3.93	4.00	71
72	Greenwich, Cumberland Co.	39° 23′	75° 20′	15	2.97	3.86	4.28	2.51	4.74	3.17	2.81	4.29	4.06	2.95	3.25	2.61	72
73	Dover, Kent Co., Del	39° 10′	75° 30′	40	2.66	3.15	4.94	2.99	2.82	3.24	5.04	4.95	4.39	2.78	3.98	3.01	73
74	Baltimore and Fort McHenry	39° 16′	76° 35′	36	2.95	2.98	3.79	3.33	3.55	3.59	3.81	4.34	3.41	3.18	3.33	3.72	74

For Observers, see pages 396–399.

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.					SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.	Year.	Beginning.	End.	Length. Yrs.	Length. Mos.		
1	White Plains, Westchester Co., N. Y.	11.39	13.23	9.86	16.51	50.99	——, 1873	Dec., 1887	14	4	Prof. O. R. Willis	1
2	West Point, Orange Co., N. Y.	12.00	12.88	11.85	11.43	48.16	Jan., 1840	Dec., 1887	25	2	United States Military Post	2
3	Goshen, Orange Co., N. Y.	8.10	8.88	8.26	8.58	33.82	Jan., 1835	Dec., 1849	8	......	New York University System	3
4	Port Jervis, Orange Co., N. Y.	9.82	11.39	8.01	9.96	39.18	Jan., 1880	Dec., 1884	5	......	Charles F. Van Inwegen	4
5	Deckertown, Sussex Co	7.75	......	......	......	......	Jan., 1880	Sept., 1880	......	7	A. C. Noble	5
6	Newton, Sussex Co	10.25	......	......	8.38	......	Dec., 1868	July, 1869	......	8	Dr. Thomas Ryerson	6
7	Dodge Mine, Morris Co	7.98	16.09	7.28	7.05	38.40	Jan., 1880	June, 1881	1	6	Wm. Allen Smith	7
8	Lake Hopatcong, Morris Co	10.93	11.93	11.42	8.26	42.54	Jan., 1846	Dec., 1869	24	......	Morris Canal Co., W. H. Talcott, Engineer	8
9	Dover, Morris Co	10.25	16.90	9.47	12.01	48.63	Nov., 1866	Dec., 1887	5	2	H. Shriver, W. Harris	9
10	Belvidere, Warren Co	......	......	7.83	12.30	......	Oct., 1883	Oct., 1884	......	10	......	10
11	Phillipsburg, Warren Co	9.31	10.74	8.10	10.65	38.83	Jan., 1881	Aug., 1886	3	8	Jos. C. Kent	11
12	New York City, N. Y.	10.07	12.77	9.98	10.78	43.60	Jan., 1871	Dec., 1887	17	......	United States Signal Station	12
13	Fort Columbus, New York Harbor	10.81	12.02	9.96	10.55	43.34	Jan., 1836	Dec., 1887	30	4	United States Military Post	13
14	Jersey City, Hudson Co	11.34	13.70	10.37	8.81	44.20	Mar., 1871	Nov., 1877	6	......	Thomas T. Howard, Jr	14
15	Tenafly, Bergen Co	......	19.93	7.15	9.36	......	Jan., 1887	Dec., 1887	......	11	A. D. Atwood	15
16	Paterson, Passaic Co	13.58	15.90	11.61	13.96	55.05	Jan., 1878	Dec., 1887	8	9	W. Aug. Fonda, J. T. Hilton	16
17	Upper Montclair, Essex Co	......	18.03	9.11	......	......	Jan., 1887	Dec., 1887	......	9	F. L. Van Gieson	17
18	Bloomfield, Essex Co	11.34	12.37	9.18	9.49	42.38	Mar., 1849	Dec., 1862	10	4	R. L. Cooke	18
19	Newark, Essex Co	11.31	12.92	10.96	11.06	45.95	May, 1843	Dec., 1887	44	8	Fred'k W. Ricord	19

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS.					SERIES.				OBSERVERS.	
		Spring.	Summer.	Autumn.	Winter.	Year.	Beginning	End.	Length. Yrs.	Length. Mos.		
20	East Orange, Essex Co.	11.11	13.66	13.04	9.15	46.96	June, 1877	Sept., 1879	1	10	Thomas T. Howard, Jr.	20
21	Orange, Essex Co	11.65	15.58	12.47	6.78	46.48	Jan, 1872	Dec., 1874	2	8	Dr. W. H. Stockwell	21
22	South Orange, Essex Co	9.41	13.12	10.09	14.49	44.11	Sept., 1870	Dec., 1887	17	3	Dr. Wm. J. Chandler	22
23	Elizabeth, Union Co	6.98	17.10	7.77	......	......	Feb., 1887	Dec., 1887	......	11	N. S. Wilson, M.D	23
24	Union, Union Co	6.71	18.76	6.95	15.02	47.44	Jan., 1887	Dec., 1887	1	......	T. L Dunbar	24
25	Linden, Union Co	9.41	13.23	10.37	10.77	43.78	Sept., 1876	April, 1881	4	8	Arthur B. Noll	25
26	Pequanac, Morris Co	......	......	......	......	......	July, 1882	Sept., 1882	......	3	......	26
27	Caldwell, Essex Co	12.81	14.99	12.09	13 97	53.86	Feb., 1883	Aug., 1884	1	6	Marcus Harrison	27
28	Gillette, Union Co	......	......	......	......	......	Aug., 1887	Dec., 1887	......	4	R. N. Cornish	28
29	New Germantown, Hunterdon Co	10.29	13.69	11.81	8.30	44.09	Nov., 1868	Aug., 1876	7	10	Arthur B. Noll	29
30	Readington, Hunterdon Co	11.51	15.25	12.51	12.55	53.82	Dec., 1866	Dec., 1885	1	9	John Fleming and W. T. Kerr	30
31	Ringoes, Hunterdon Co	10.15	14.91	11.40	9.29	45.75	Jan., 1876	Dec., 1880	5	......	Prof. C. W. Larison	31
32	Somerville, Somerset Co	9.12	14.87	8 21	12.42	44.62	Sept., 1878	Dec., 1887	7	7	Wm. J. Morgan	32
33	New Brunswick, Middlesex Co	10.98	13.46	10 36	9.51	44.31	Jan., 1854	Dec., 1887	34	......	P. V. Spader, Dr. Geo. H. Cook, E. W. McGann	33
34	Princeton, Mercer Co	9.29	11.31	6.82	12.35	39.77	Sept., 1878	Dec., 1887	4	......	Profs. Chas. G. Rockwood and M. M. McNeil	34
35	Locktown, Hunterdon Co	7.13	21.01	6 59	15.99	50.72	Jan., 1887	Dec., 1887	1	......	G. W. Hockenbury	35
36	Lambertville, Hunterdon Co	10.53	12.85	10.12	10.42	53.92	July, 1843	Dec., 1887	18	......	L. H. Parsons	36
37	Trenton, Mercer Co	10.83	15.01	11.71	8.95	47.55	Jan., 1866	Dec., 1880	15	......	E. R. Cook	37
38	Morrisville, Bucks Co, Penna	11.14	11.76	11.41	9.35	43.66	Oct., 1798	Dec., 1866	45	1	Ch. Pierce and E. Hance	38

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS. Spring.	Summer.	Autumn.	Winter.	Year.	SERIES. Beginning.	End.	Length. Yrs.	Mos.	OBSERVERS.	
39	Fallsington, Bucks Co	9.19	11.80	9 10	12.76	42.85	Jan., 1881	Dec., 1887	6	6	E. Hance	39
40	Sandy Hook, Monmouth Co	13.76	13.11	12.02	12.19	51.08	Jan., 1874	Nov., 1886	12	11	United States Signal Station	40
41	Riceville, Monmouth Co	13.87	6.26	......	......	......	Jan., 1861	Aug., 1861	......	8	Prof. L. Harper	41
42	Middletown, Monmouth Co	8.16	9.20	9 63	9.64	36.63	June, 1831	May, 1832	1	......	From Smithsonian Coll	42
43	Oceanic, Monmouth Co	8.84	19.77	10.19	......	45.36	Feb., 1887	Dec., 1887	......	11	Rev. S. W. Knipe	43
44	Long Branch, Monmouth Co	15.53	15.65	16.12	11.03	58.32	Jan., 1874	June, 1876	2	6	United States Signal Station	44
45	Lakewood, Ocean Co	......	......	......	......	......	Feb., 1887	Nov., 1887	......	5	Dr. W. C. Stone	45
46	Toms River, Ocean Co	......	......	......	......	......	Sept., 1887	Dec., 1887	......	4	J. P. Haines	46
47	Squan Beach, Ocean Co	16.08	14.35	16.54	10.62	57.59	Jan, 1874	Jan., 1876	2	1	United States Signal Station	47
48	Matawan, Monmouth Co	4.97	23.81	7.16	10.90	46.84	Jan., 1887	Dec., 1887	1	......	Prof. J. C. Rice	48
49	Freehold, Monmouth Co	11.16	12.85	11.23	11 49	46 73	Apr., 1874	Dec., 1883	9	7	Prof Chas. F. Richardson	49
50	Imlaystown, Monmouth Co	7.29	17.12	9 34	15.73	49.48	Jan., 1887	Dec., 1887	1	......	Dr. H. G. Norton	50
51	Hightstown, Mercer Co	11.31	......	......	......	......	Jan., 1876	Oct., 1876	......	7	Peddie Institute	51
52	Bordentown, Burlington Co	7.88	18.14	12.09	13.72	51.83	Sept., 1882	Dec., 1887	1	9	M. S. Simpson, M.D	52
53	Burlington, Burlington Co	13.18	13.86	9.69	11.15	47.88	July, 1856	Mar., 1868	5	10	Dr. E. R. Schmidt, Rev. A. Frost, T. C. Deacon	53
54	Beverly, Burlington Co	12.27	14.75	8.77	12.21	48.00	Jan., 1886	Dec., 1887	2	......	Charles H. Richardson	54
55	Philadelphia, Penna	10.62	12.46	10.15	9.80	43.03	Jan., 1825	Dec., 1887	63	......	United States Signal Station, Obs. Penn. Hospital	55
56	Mount Holly, Burlington Co	7.71	13.85	9.17	8.01	38.74	Sept., 1874	June, 1876	1	9	Dr. F. Ashhurst	56
57	Moorestown, Burlington Co	10.08	12.51	10.25	10 36	43.23	May, 1863	Dec., 1887	24	4	Thomas J. Beans	57

Table of Rain and Melted Snow. Inches and Hundredths of Inches—Continued.

	STATIONS.	SEASONS. Spring.	Summer.	Autumn.	Winter.	Year.	SERIES. Beginning.	End.	Length. Yrs.	Mos.	OBSERVERS.	
58	Haddonfield, Camden Co	13.75	11.33	11.53	10.09	46.70	Feb., 1864	Dec., 1870	6	6	J. S. Lippincott, S. Wood, J. Boadle	58
59	Atco, Camden Co	10.03	14.09	11.65	10.99	46.76	Jan, 1872	Sept., 1882	10	5	H. A. Green	59
60	Harrisville, Burlington Co	8.03	15.71	10.19	......	......	Feb., 1887	Nov., 1887	......	10	J. W. Harris	60
61	Egg Harbor City, Atlantic Co	28.77	19.10	7.77	......	......	Mar., 1886	Dec., 1886	......	10	......	61
62	Clayton, Gloucester Co	8.66	11.80	9.21	14.61	44.28	Jan., 1886	Dec., 1887	2	......	Wm. T. Wilson	62
63	Vineland, Cumberland Co	11.31	12.86	11.43	12.67	48.27	Jan., 1866	Dec., 1886	21	......	Dr. O. H. Adams, Dr. J. Ingram	63
64	Barnegat, Ocean Co	10.76	12.34	12.52	12.69	48.31	Jan, 1874	Dec., 1885	12	......	United States Signal Station	64
65	Little Egg Harbor, Burlington Co	7.91	12.58	10.74	13.18	44.41	July, 1882	June, 1884	2	......	United States Signal Station	65
66	Atlantic City, Atlantic Co	9.56	11.22	10.02	11.75	42.55	Jan, 1874	Dec., 1887	14	......	United States Signal Station	66
67	Pecks Beach, Cape May Co	13.02	8.66	11.51	12.39	45.58	Jan., 1874	Jan., 1876	2	1	United States Signal Station	67
68	Ocean City, Cape May Co	......	......	10.80	......	......	Feb., 1887	Dec., 1887	......	6	William Lake	68
69	Cape May, Cape May Co	10.84	12.86	10.90	12.50	47.10	Sept, 1871	Oct., 1885	13	8	United States Signal Station	69
70	Salem, Salem Co	6.30	12.68	7.26	......	......	May, 1877	Dec., 1887	1	11	W. B. Mattaock, S. L Richmond	70
71	Allowaystown, Salem Co	8.05	15.01	13.02	11.13	47.21	Jan., 1872	Nov., 1873	1	11	H. C. Perry	71
72	Greenwich, Cumberland Co	11.53	10.27	10.26	9.47	41.53	Mar., 1864	Feb., 1873	9	......	Rebecca C. Sheppard	72
73	Dover, Kent Co., Del	10.75	13.23	11.15	8.82	43.95	July, 1870	Jan., 1881	9	9	J. H. Bateman	73
74	Baltimore, and Fort McHenry	10.67	11.74	9.92	9.65	41.98	May, 1836	Dec., 1887	51	8	United States Signal Station. United States Military Post	74

Climate of Newark, 1843-1887.

From Records kept by Wm. A. Whitehead and Frederick W. Ricord.

	Maximum Temperature.		Minimum Temperature.		Range of Temperature for Period.	Mean Temperature.		Greatest Number of Days on which Temperature was 32° and below.	Greatest Number of Days on which Temperature was 85° and upwards.	Range of Fair Days.		Rainy Days.		Days of Snow.		Average Number of Fair Days.	Percentage of Fair Days.	Range of Dry Periods. Days.	
	Highest.	Lowest.	Highest.	Lowest.		Highest.	Lowest.			Greatest Number.	Least Number.	Greatest Number.	Least Number.	Greatest Number.	Least Number.			Longest.	Shortest.
January	65.00	30.60	16.00	-12.70	77.70	37.64	19.33	22	......	21	13	11	1	12	1	17.00	55	15	5
February	68.50	44.70	16.00	-8.00	76.50	36.99	21.86	18	......	21	12	11	1	13	2	16.50	58	14	4
March	77.25	50.00	28.00	2.00	75.25	46.17	30.23	7	......	23	13	16	2	11	1	18.00	58	16	5
April	86.00	62.25	40.00	17.00	69.00	55.55	40.30	......	......	23	12	13	5	9	......	17.50	58	15	3
May	96.00	71.00	42.50	31.00	65.00	68.38	54.72	......	8	25	12	17	5	2	......	18.70	60	14	4
June	97.00	84.00	57.50	38.25	58.75	73.70	60.25	......	11	26	15	15	5	......	......	20.50	68	20	3
July	99.75	86.25	66.00	46.25	53.50	79.60	70.23	......	24	25	14	15	4	......	......	19.75	64	15	6
August	99.00	83.75	60.00	46.75	52.25	76.60	67.30	......	20	26	14	15	5	......	......	19.75	64	20	5
September	100.50	76.50	50.70	34.50	66.00	73.72	59.98	......	11	24	12	14	3	......	......	18.75	62	21	3
October	83.00	67.00	36.00	22.25	60.75	59.40	48.61	6	......	24	12	12	3	2	......	18.00	58	29	3
November	73.75	57.25	29.00	8.00	65.75	49.66	36.12	21	......	22	10	15	4	10	......	16.00	53	18	3
December	68.50	42.00	22.75	-7.50	76.00	40.31	23.81	18	......	24	11	13	2	10	1	17.00	55	24	3
Spring	......	......	......	......	......	53.81	45.13	......	......	......	......	......	......	......	......	......	......	......	......
Summer	......	......	......	......	......	75.34	68.12	......	......	......	......	......	......	......	......	......	......	......	......
Autumn	......	......	......	......	......	58.77	50.77	......	......	......	......	......	......	......	......	......	......	......	......
Winter	......	......	......	......	......	35.91	24.81	......	......	......	......	......	......	......	......	......	......	......	......

Climate of Cape May, N. J.

PERIOD OF OBSERVATION, JUNE 1ST, 1871, TO DECEMBER, 1883. DEGREES FAHRENHEIT.

[Taken from Dr. Huntington Richards' Article on Cape May, in "Wood's Hand-book of Reference to the Medical Sciences."]

	A.			AA.	B.		C.	D.	E.		F.		G.	H.	J.	K.	N.	O.	R.	S.
	Mean Temperature of Months at the *Hours of—*			Average Mean Temperature Deduced from Column A.	Mean Temperature for Period *of Observation.*		Average Maximum Temperature for Period.	Average Minimum Temperature for Period.	Absolute Maximum Temperature *for Period.*		Absolute Minimum Temperature *for Period.*		Greatest Number of Days in any Single Month on which the Temperature was Below 32°.	Greatest Number of Days in any Single Month on which the Temperature was Above 90°.	Range of Temperature for Period.	Mean Relative Humidity.	Average Number of Fair and Clear Days.	Average Rainfall, in Inches.	*Prevailing Direction* of Wind.	Average Velocity of Wind, in Miles, per Hour.
	7 A. M.	3 P. M.	11 P. M.		Highest.	Lowest.			Highest.	Lowest.	Highest.	Lowest.							From	
January.....	31.9	36.6	34.1	34.2	43.2	28.6	41.2	29.4	58	43	18	1	26	0	57	78.2	20.0	4.22	N.W.	14.3
February....	33.1	38.6	35.3	35.6	41.7	28.0	45.0	31.8	59	42	23	2	22	0	57	76.7	18.2	3.60	N.W.	16.1
March........	37.9	42.9	39.6	40.1	47.7	33.3	47.7	35.1	65	48	25	9	16	0	56	74.9	19.2	5.14	N.W.	16.4
April	45.9	51.2	47.2	48.1	54.7	44.0	54.8	43.0	76	59	43	24	5	0	54	74.2	19.5	3.34	N.W.	14.6
May	56.7	62.1	57.1	58.6	65.2	55.1	65.8	53.7	81	72	48	34	0	0	47	76.7	23.2	2.62	S.	12.5
June..........	66.8	71.6	66.6	68.3	71.2	64.8	74.3	63.2	89	79	60	47	0	0	42	79.5	22.1	3.81	S.	10.8
July	72.1	77.2	71.6	73.6	75.6	69.5	80.0	69.3	91	79	70	56	0	1	35	79.7	23.7	3.30	S.	10.0
August......	71.6	76.3	71.5	73.1	76.6	68.7	78.5	67.5	88	80	64	55	0	0	33	80.3	21.5	5.77	S.	9.8
September	65.8	71.3	66.7	67.9	74.5	63.8	75.3	64.6	87	75	55	42	0	0	45	76.8	21.4	4.46	E.	11.7
October......	56.5	62.1	57.9	58.8	64.3	55.2	66.2	51.2	81	67	48	31	0	0	50	75.1	22.7	3.53	N.W.	13.6
November..	44.2	48.9	45.5	46.2	51.6	41.9	54.1	41.8	69	55	30	14	10	0	55	72.5	18.3	3.73	N.W.	15.7
December ..	35.4	39.5	37.3	37.4	43.9	31.1	44.0	32.1	62	43	26	2	27	0	60	75.7	18.9	4.15	N.W.	15.9
Spring	......	......	......	48.9	54.2	45.6	......	......	....	....	....	....	....	....	72	75.3	61.9	11.10	N.W.	14.5
Summer.....	......	......	......	71.6	74.2	68.8	......	......	....	....	....	....	....	....	44	79.8	67.3	12.88	S.	10.2
Autumn.....	......	......	......	57.6	62.9	54.2	......	......	....	....	....	....	....	....	73	74.8	62.4	11.72	N.W.	13.7
Winter.......	......	......	......	35.7	42.9	31.3	......	......	....	....	....	....	....	....	61	76.9	57.1	11.97	N.W.	15.4
Year...........	......	......	......	53.5	56.0	50.2	......	......	....	....	....	....	....	....	90	76.7	248.7	47.67	N.W.	13.4

Table of Mean A. M., P. M. and Midnight Temperatures at Atlantic City and Sandy Hook, N. J., Baltimore, Md., Philadelphia, Pa., New York City, Jacksonville, Fla., and San Diego, Cal. Degrees Fahrenheit.

[From Annual Report Chief Signal Officer of the Army for 1887.]

STATIONS.	JANUARY.			FEBRUARY.			MARCH.			APRIL			MAY.			JUNE.		
	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.
Atlantic City	29.2	35.0	31.0	30.5	36.6	32.2	35.4	41.8	36.6	44.9	50.1	44.5	55.9	60.5	54.6	65.8	70.4	63.9
Sandy Hook	28.5	32.9	30.1	29.0	34.8	30.7	34.1	40.5	36.0	43.6	50.9	44.6	55.6	63.5	56.1	65.6	73.5	65.6
Baltimore, Md	31.0	37.5	33.6	32.7	41.2	35.8	37.9	46.6	41.1	48.7	59.1	51.5	60.2	70.9	61.9	70.2	79.9	70.7
Philadelphia, Pa	28.6	34.6	30.6	29.8	37.6	32.5	35.2	44.0	38.1	45.7	56.3	47.9	57.5	69.0	59.2	67.4	77.7	68.1
New York City	27.1	33.0	29.1	27.9	34.7	30.1	33.2	40.8	35.3	43.9	52.4	45.4	55.7	64.2	56.7	65.3	73.9	66.0
Jacksonville, Fla	50.2	61.9	53.6	52.5	64.8	56.2	57.2	69.5	60.4	65.1	75.6	65.6	73.3	80.9	71.8	79.3	85.0	77.1
San Diego, Cal	48.3	60.7	52.8	49.5	61.0	53.9	51.1	61.6	55.1	52.9	63.8	57.2	56.8	66.3	60.2	60.4	69.5	63.1

STATIONS.	JULY.			AUGUST.			SEPTEMBER.			OCTOBER.			NOVEMBER.			DECEMBER.		
	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.	A. M.	P. M.	Mid.
Atlantic City	71.2	76.2	69.6	70.4	75.5	70.1	65.1	71.0	65.4	51.6	61.6	55.5	42.0	48.5	43.4	33.3	38.6	34.9
Sandy Hook	71.5	78.9	71.5	70.0	77.2	70.7	64.3	71.6	65.5	54.2	60.8	55.5	42.6	47.9	44.2	33.1	37.5	34.8
Baltimore, Md	74.7	84.5	75.2	71.2	81.3	72.9	63.8	74.5	66.1	53.3	61.0	56.0	42.2	49.8	44.2	33.5	40.4	36.2
Philadelphia, Pa	72.2	82.4	73.4	70.1	79.6	71.2	62.7	73.1	64.8	52.1	62.6	54.3	40.2	48.1	42.4	31.5	37.6	33.8
New York City	70.8	78.6	71.1	69.1	77.0	70.0	62.4	70.8	63.7	52.2	60.4	54.1	39.9	46.5	41.3	30.7	36.1	32.5
Jacksonville, Fla	80.9	87.3	79.1	79.2	85.7	77.7	75.0	82.7	75.9	66.1	75.8	68.0	56.5	68.1	59.7	50.2	62.5	54.1
San Diego, Cal	63.5	72.4	65.7	65.3	74.2	67.8	62.7	72.1	65.5	57.9	68.8	61.2	52.5	65.7	56.5	50.2	62.6	54.1

NOTE.—Observations prior to August 25th, 1872, were taken at 7:35 A. M., 4:35 and 11:35 P. M., Washington time; from August 25th, 1872, to November 1st, 1879, at 7:35 A. M., 4:35 and 11 P. M.; from November 1st, 1879, to December 31st, 1884, at 7 A. M., and 3 and 11 P. M., Washington time; and from January 1st, 1885, to December 31st, 1886, at 7 A. M., and 3 and 11 P. M., Seventy-fifth Meridian time.

CHRONOLOGICAL NOTES OF THE WEATHER.

REMARKABLE SEASONS; ICE IN RIVERS AND HARBORS; DROUGHTS, ETC., ETC., ETC.

[Abbreviations: W, Webster; H, Hazard; B, Blodgett; G, Gordon.]

The following brief notes of the weather have been gathered from S. Hazard's "Register of Pennsylvania," Vol. II., pp. 23-26 and 379-386, Philadelphia, 1828; Watson's "Annals of Philadelphia," 1844; Dr. Noah Webster's "A Brief History of Epidemics and Pestilential Diseases," Hartford, 1798; Blodgett's "Climatology of the United States," Philadelphia, 1857; and from meteorological data from various stations in New Jersey and Philadelphia since 1843.

1607-8.—Winter extremely cold. W.

1631.—De Vries arrived in the Delaware about the first of February; the season was so mild that his men could work in the open air in their shirt sleeves; (the earliest notice of weather on the Delaware.) G.

1638.—Summer very hot and dry. W.

1639.—No rain from April 26th to June 4th, O. S. W.

1641.—Summer wet and cold; very sickly on the Delaware river; settlement from New Haven broken up, and Swedes suffered greatly. W.

1641-2.—Chesapeake bay nearly frozen over. W.

1656.—Summer very hot. W.

1678.—December 10th, the Shield arrived at Burlington; river frozen next day. G.

1681.—December 11th, Delaware river frozen over; the Bristol Factor arrived at Chester with settlers for Pennsylvania, where they lay all winter. H.

1683-4.—Winter was excessively severe. W.

1697-8.—Winter very cold. Kalm.

1704.—Snow fell a yard deep. H.

1708-9.—A very severe winter. W.

1714.—February; flowers seen in the woods. H.

1717.—February 19th-24th, great snow—"greatest ever known," up to that time, in New England and on Long Island. W.

1719-20.—Winter very cold. W.

1720.—February 23d, Delaware clear of ice. H.
December 20th, Delaware full of ice; 27th, again clear. H.

1721.—December 19th, Delaware full of ice. H.

1722.—February 6th, Delaware open again to navigation. H.

1723.—January 6th, Delaware free from ice, and weather yet moderate. H.

1723-4.—December and January, river open. H.

1724.—December 15th, Delaware full of ice. H.

1725.—March 3d, snow two feet deep. H.

1725-6.—December 21st, Delaware full of ice until January 18th.
February 1st-15th, again blocked with ice. H.

1727.—February 14th, very cold weather. H.
Summer hot. W.

1728.—January 23d, severe weather for two weeks; booths set up on the Delaware; no clearance of vessels mentioned until March 5th. H.

1729.—December; Delaware open all the month. H.

1730.—January 20th, a deep snow, the like not known these several years; navigation closed. H.
December 21st, vessels forced back by ice; 29th, open. H.

1731.—February 9th, Delaware open again. H.

1731-2.—Delaware full of ice on December 14th; February 22d, navigation unobstructed. H.

1732-3.—December, Delaware open; January 18th, great snow at Lewes; March 8th, river open. H.

1734.—January 1st, Delaware continues open; very moderate weather. H.
December 21st, weather fine and open; Delaware free from ice. H.

1735.—January 16th, weather fine and open; Delaware free from ice. H.
December, weather fine and open; Delaware free from ice. H.

1736.—January 6th, Delaware fast and full of ice; February 5th, open. H.
December, Delaware open. H.

1737.—January 20th, weather very cold; February 3d, ice broke up in Schuylkill. H.

1738.—January and February, Delaware open. H.

1739.—January 25th, Delaware now open, having been fast since December 18th. H.

1739-40.—December, Delaware open; January 10th, closed; February 21st, arrivals; March 15th, ice broke up. H.

1740-41.—An exceptionally cold winter. Jefferson says that it was only less severe than that of 1779-80. B. Long Island Sound frozen over three leagues across. W. Delaware not navigable from December 19th until March 13th; January 8th, at Lewes, Del., 'tis all ice towards the sea as far as the eye can reach; snow three feet deep in back country. Much suffering among inhabitants and cattle. H.

1741-2.—Delaware open during December and January, and no mention of ice in February and March. H.

1742-3.—Another open winter. H.

1744.—January 3d, Delaware full of ice; January 19th, open. H.

1744-5.—No mention of ice; clearances and entries in all the winter months. H.

1745-6.—No ice mentioned; entries and clearances in December. H.

1746-7.—Delaware closed (no arrivals) from December 23d to February 24th. H.

1747-8.—December 15th, Delaware full of ice; January 12th, open; 26th, closed, and severe weather; February 2d, open; 9th, closed until March 1st. H.

1748-9.—Delaware open during December; closed in January; February 14th, arrivals. H.

1750.—January 22d, Delaware opened; February 6th, free of ice; May 30th, frost last week and snow in places. H.

1750-51.—Very severe winter. W. Delaware open January 22d. H.

1751-52.—Delaware full of ice, December 24th; clear again, February 18th. H.

1752.—A summer marked by intense heat in all parts of America; sickly. W.

1753.—January 2d, navigation on Delaware stopped; January 9th, open; 23d, clear. H.

1754.—January 15th, Delaware for some days clear of ice. H.

1754-5.—Winter unusually mild. Troops sailed from New York to Albany in January and February. W. January 14th, Delaware stopped; 21st, clear again. H.

1755-6.—Another mild winter. W. No mention of ice in the Delaware this winter, and entries and clearances every month. H.

1756-7.—No mention of ice in the Delaware, and entries and clearances throughout December and January. H.

1757-8.—Delaware open in December; February 2d, closed for few days. H.

1758-9.—December 28th, Delaware full of ice; January 11th, open; 25th, interrupted; February 1st, open. H.

1759-60.—December 28th, Delaware closed for a week; February 14th, open; March 20th, extraordinary snow storm, and greatest fall of snow since the settlement of the Province. H.

1760-61.—No entries or clearances at Philadelphia from January 15th to February 5th. H.

1761-2.—December 17th, Delaware interrupted by ice for several days; December 24th, quite stopped; January 21st, open. H.

1762.—Heat and drought exceeded what was ever known before; from June to September scarcely a drop of rain; forest trees scorched. W.

1762-3.—Snow fell November 8th, and it lay until March 20th. W. Delaware open in December; January 13th, stopped for some days. H.

1763-4.—Delaware open during December and January. H.

1764-5.—Navigation in the Delaware much obstructed by ice, from December 27th until February 28th; February 7th, an ox roasted whole on the ice at Philadelphia. H. March 28th, snow fell two to two and one-half feet deep on a level (last Saturday night and Sunday). H.

1765-6.—Delaware open until January 9th; February 6th, arrivals. H.

1766-7.—Delaware open until January 1st; a thaw, January 8th. H. At Brandywine, Del., 20° below zero. W.

1767-8.—Delaware closed for a day or two, December 24th; clear of ice, February 11th. H.

1768-9.—Navigation throughout December and January. H.

1769-70.—December 21st, navigation at a stand for several days; February 15th, river clear. H.

1770-1.—December, Delaware open; January, Delaware open; February 14th, river full of ice, stopping navigation; 28th, clear. H.

1771-2.—December 26th, Delaware full of ice; January, excessively cold month; February 20th, river open; March 16th, snow in many places two feet deep; much ice in river. H. April 2d, snow fell in several places six inches deep. H.

1772-3.—January 20th, Delaware full of ice; 21st, very cold; March 3d, navigation opened. H.

1773-4.—Delaware open in December; stopped January 12th, and February 14th, still fast. H.

1774-5.—December 30th, ice in river; open January 17th. H.

1778.—Summer very hot. W.

1779.—January 19th, Delaware closed; February, leaves of willows, blossoms of peach, and dandelion flowers were seen. H.

1779-80.—Coldest winter since 1740-41; from November 25th to middle of March cold was intense and almost uninterrupted; snow nearly four feet deep for three months; the sound was entirely covered with ice between Long Island and the main, and between New York and Staten Island. W. Troops crossed from New Jersey to Staten Island on the ice; the Delaware river was closed from the first of December to the fourteenth of March—the ice being two to three feet thick. B. During the month of January the mercury in Philadelphia did not rise to the freezing point, excepting one day. H.

1780.—May 19th, dark day, which reached as far south as New Jersey. W. Summer hot. W.

1780-81.—January 27th, winter thus far remarkably mild, so that the earth has scarcely been frozen half an inch deep. H.

1782.—January, Delaware frozen up since December 30th; closed to February 16th. H.

1783.—November 28th, navigation in Delaware stopped, and river frozen over until March 18th. B.

1784.—January, a thaw for two days; then a fall of 53° in a few hours. H. Summer extremely hot at Hartford. W.

1784-5.—December 26th, Delaware navigation at a stand; open January 3d; closed again 4th; open last of January; February 2d, closed. H.

1786.—January 26th, mild winter until middle of January; May, remarkable for the absence of the sun for two weeks, and a constantly damp or rainy weather. H.

1786-7.—Winter began early and was very severe. W.

1788-9.—A severe winter; the Delaware was closed from December 26th to March 10th; at Hartford, Conn., 28° below zero, February 2d. W.

1789-90.—Very open winter; February 7th to 17th, Delaware stopped with ice; March 10th, only considerable snow of the winter—remaining on the ground three days. H.

1790-91.—Delaware closed from December 18th to January 18th. H.

1791.—Excessively hot summer. W.

1791-2.—Delaware closed December 23d to end of month. H.

1792-3.—Delaware open during December; April weather in middle of January.

1793.—April 1st, blossoms universally—two weeks earlier than usual. H.

1793-4.—Very mild winter; lowest in New York, 13° above zero. W. January 13th, Delaware open. H.

1794-5.—Mild weather until middle of January; the Delaware closed from January 21st to 26th. H.

1795-6.—Winter most moderate for forty-five years; navigation interrupted on Delaware for one week in February by driving ice. H. The Hudson river closed by ice at Albany, January 23d, 1796.

1796-7.—Delaware closed, December 23d; Susquehanna closed, December 6th; January 10th, as cold weather as remembered in fifty years. H. At South and West extremely cold. W.

1797-8.—Winter long and cold; Hudson river closed in November. W. Delaware frozen over, December 1st; open again, February 5th. H.

1798-9.—A long and severe winter, with much snow; March 12th, deep snow. H.

1799.—Cold weather in spring; ice, April 20th; frost, June 6th. H.

1799-1800.—A remarkably open winter until January 6th; Delaware open again on 18th. H. Snow three feet deep in Georgia; snow and hail at St. Mary's river, in Florida. B.

1801-2.—February 22d, no obstructions this winter to impede navigation in Delaware, except floating ice. H.

1802-3.—Delaware frozen over December 19th. H.

1803.—May 7th, ice; on the 8th, a snow which broke down the poplars and other trees in leaf. H.

1804.—January 1st, vessels come and go on Delaware as in summer. H.
January 21st, river full of ice; March 5th, still frozen; clear on March 7th. H.

1804-5.—Delaware obstructed by ice, December 18th; February 28th, again navigable; a variable winter. H.

1805.—Summer; no rain after middle of June; all through July, heat 90°-96°. Watson.

1805-6.—An open winter; Hudson river free from ice, February 20th. H.

1806-7.—Navigation stopped December 18th until 20th. H.

1807-8.—Delaware open until January 11th. H.

1808-9.—Delaware open until January 5th; then much ice drifting at Cape May. H.

1809.—April 13th, snow; 26th, ice as thick as a dollar. H.
May 6th, ice; 13th, frost; cold May. H.
November 24th, snow one foot deep; sleighing. H.

1810.—January 10th, first ice of the season in the Delaware; river closed and opened several times; clear February 11th. H.
Hudson river open until January 19th. H.

1810-11.—Navigation on Delaware stopped December 18th; open early part of January; ice in February. H.

1811-12.—December 25th, Delaware full of ice; January 12th, river fast until February 8th. H.

1812.—May 4th, rain and snow; spring very backward. H. Memorable as a "cold summer." B. Very wet at harvest. W.

1812-13.—December 9th, Schuylkill fast; Delaware full of ice; January 11th, Delaware full of ice; February 26th, open. H.

1814.—January 9th, Delaware closed to navigation; February 2d, open and arrivals. H.

1814-15.—December 15th, floating ice in Delaware; March 5th, ice cleared. H.

1816.—Summer cold; both 1812 and 1816 were memorable as "cold summers" for all the northern United States; from May to September of 1812, each month was from 3°.6 to 7°.2 below the average; June and July, 1816, were 5° and 5°.8 below; in the Northern States snows and frosts occurred in every month of both summers; Indian corn did not ripen. B. Frosts at Philadelphia in June, July and August. B. & H.

1817.—January 19th, Delaware closed; March 9th, opened. H.

1817-18.—January 31st, Delaware closed; February 28th, opened. H. Hudson river closed for 108 days, until March 25th.

1818-19.—Winter severe in New England. B. Delaware was obstructed by ice in December; open in January for a time. H. Hudson river free from ice April 3d.

1819.—October 25th, snow in southeastern Pennsylvania. H.

1819-20.—December, Delaware open; February 4th, bay full of ice. H.

1820-21.—"This winter was one of four, during a century, in which the Hudson, between New York and Paulus Hook, was crossed on the ice." B. It closed November 13th, but opened again on 20th; closed December 1st; Delaware open during December; open February 14th. H.

1823.—January 22d, navigation in Delaware clear. H.

1824-5.—December, Delaware open; February 14th, clear of ice. H. Hudson river open until January 5th, 1825.

1824.—July 29th, 4½ inches of rain fell at Philadelphia; 11 inches at Germantown.

1825-6.—A cold winter; December 28th, ice in Delaware; January 31st, closed until February 8th. H.

1826-7.—Delaware open during December. H.

1827-8.—Navigation uninterrupted on the Delaware this winter; ice-houses unfilled. H. The Hudson at Albany closed for 43 days only; February 8th, free from ice.

1828-9.—Hudson river closed December 23d; free from ice April 1st.

1829-30.—Hudson river at Albany closed January 11th (1830); and free from ice again March 15th.

1830-1.—Winter very cold at Southwest; ice formed at New Orleans. B.

1835.—January and February both very cold; February 8th, thermometer fell below zero, nearly all over the country north of Savannah and Natchez; Long Island Sound was closed by ice; coldest winter since 1779-80. B.

1837.—Summer mean temperature, low. B.

1843.—March was coldest month of *winter* of 1842-3; snow 15 inches deep in Georgia. B. August, a remarkably heavy rainfall at Newark, 22.84 inches; at Lambertville, 15.26 inches; Hudson river free from ice at Albany April 13th, having closed November 26th, 1842.

1844.—January, cold; spring, warm; summer, below the mean temperature.

1845.—January, warm; minima, 8° to 18° above zero; minima for winter of 1844-5, 3° to 6° above zero.

1846.—Winter of 1845-6, colder than usual, but no very low temperatures; spring and summer cooler, and autumn warmer than average seasons.

1848.—Winter of 1847-8, warmer than average.

1849.—Below zero in January and also in February; autumn, warm.

1850.—Mean temperature for the year, high; winter of 1849-50, warm; minima, 3° to 8° above zero; autumn remarkable for its high mean temperature.

1851.—Winter of 1850-1 also warmer than average; no temperatures below zero recorded.

1852.—Winter of 1851-2, cold; mean temperatures of the months, 3° to 8° below the average; East river crossed on the ice January 30th, and for three days following; Susquehanna at Havre de Grace frozen over for seven weeks; cold and snows as far south as New Orleans and Jacksonville, Fla. B.

1853.—A warm year; range of temperature 2° to 93°; winter of 1852-3, one of the warmest on record, and very wet, the rainfall at Newark having been 15.85 inches.

1856.—One of the coldest years in our records; the first three months of this year very cold; a reproduction of 1779-80; March had minima of 0°.75 below zero to 4° above; in April the lowest temperature at Lambertville was only 17°; the mean temperatures for each of the spring months were below their averages since; Long Island Sound was closed to navigation from January 25th to February 27th; New York harbor was much obstructed by ice, and that of Philadelphia was closed until late in March; the Hudson river did not open until April 10th. The rainfall at Newark for the year only 34.07 inches.

1857.—Followed as another cold year; and the mean temperatures for the winter of 1856-7, of the following spring, summer and autumn were all low; all of the winter months were marked by low temperatures, and in January of this year the cold was intense; on the 24th, readings of 1° to 20° below zero were recorded, and the highest reached 35° to 47° only; the means for the month were 16°.22 to 22°.06; like 1856, the spring months were colder than the average; the summer was notable for its absence of extremely high temperatures, and its mean was low; altogether it was an exceptional year.

1858.—The cold seasons of 1857 were succeeded by the warm winter of 1857-8, although in February the thermometer, at several localities, fell to 6° to 8° below zero.

1859.—The year was exceptional in its cold summer; at Newark, the coldest in thirty-eight years, and 3°.2 below the average; the July mean was nearly 4° below the mean for the summers of the whole period; at Lambertville, the difference was 1°.4; the maximum, however, ranged from 91° to 100°; all the seasons were wet.

1860-2.—These years were noted for their rather cooler summers, and the absence of excessively high temperatures; February, 1861, was marked by depressions of 2° above zero to 7°.5 below zero.

1863.—The winter of 1862-3, like those of 1859-60 and 1860-1, was also characterized by its minimum occurring in February.

1865.—January was cold; the extremes were 11° below zero and 57° above.

1866.—This year was everywhere one of great range of temperature; the mean temperatures of the months and seasons were not far from the average; January 8th, the readings ranged between 9° and 20° below zero, at the several stations in New Jersey, and in the adjacent parts of Pennsylvania and New York; on the 17th of July, the maxima at these same places were 92° to 102°, making the range for the year 107° to 114°; in this respect the year is altogether exceptional.

1867.—Unlike the last, 1867 was more even in temperature, the range being from 0°.5 to 88° at Newark; the spring and summer were cooler and the autumn a little warmer than the means for 38 years; the year was wet, and the summer rainfall at Newark amounted to 24.11 inches; at Philadelphia, Pa., to 30.82 inches, and that for the year to 62.94 inches—a great excess.

1868.—The winter of 1867-8 was cold; at Newark it was the coldest of the thirty-eight-year period; and on forty-seven days the thermometer did not rise above freezing (32°). In February, records of 3° to 10° below

zero were made at several stations, and the mean for that month ranged from 5° to 10° below the average; it was the coldest February observed at Newark; the total depth of snow was six feet three inches, the deepest in the series; March and April were cold, and freezing weather continued to the middle of April; the Hudson river was not open to navigation at Albany until April 5th; the yearly mean was also lower than usual.

1869.—The winter of 1868-9 had no extremely cold weather, and the lowest temperatures were 3° to 8° *above zero;* the Hudson river closed early—December 5th.

1870.—Again in 1869-70 the winter was warm and remarkable for its low range of temperature; the lowest readings did not reach zero, and the average among the several stations was between 5° and 13° above; the summer was above the average temperature.

1871.—The extremes of the winter of 1870-1 were quite low in all the months, although the average was high; the spring was warmer than usual, and readings of 82° and upwards occurred in April; a depression of 1° to 6° below zero took place in December (21st); the Hudson river closed at Albany very early—November 29th.

1872.—The spring was colder and the summer warmer than the means for those seasons show; March, at Newark, was the coldest in the 38 years of observations.

1873.—The winter months (1872-3) all were remarkable for low temperatures; the minima of December, 1872, were zero to 7° above; those of January, 1873, were between 0°.5 and 22° below zero; the depression over the northern half of the State was severe (12° to 22° *below zero);* in February, also, the observations showed readings for zero to 6° below zero; the Newark record shows that in 43 days the thermometer did not rise above freezing; the Hudson river was closed from December 9th to April 16th.

1874.—The year was notable for its lesser range of temperatures than ordinary.

1875.—A cold year; its mean temperature at Newark, only 48°.2, or nearly 3° below the average, and the coldest in the series; the winter of 1874-5, the following spring and autumn were all cold; the spring and autumn were the coldest observed at Newark, in that all the months were either below or little above the average mean, and the monthly ranges were generally small; the highest temperature in January, in the northern part of the State, was 41°; the lowest 8° below zero; the summer was very wet.

1876.—The winter of 1875-6 was comparatively mild; the summer was remarkable for its long-continued heat and its severe drought; the records show maxima of 90° and upwards for each of the summer months at all the stations; the mean monthly temperatures range from 70° to 80° at very nearly all of them; the rainfall at Newark was little more than half the usual depth.

1877.—The winter of 1876-7 was cold; December, at Newark, had a mean temperature of 23°.8, the lowest in the 44 years' period; the month corresponded to our January, ordinarily; the Hudson river closed at Albany on the 2d of December, and did not open until March 30th; the summer of 1877 was the warmest in the Newark series; the

autumn, also, was warmer than usual; no readings below freezing (32°) were recorded in October, and the length of the seasons between frosts was much greater than common; the Moorestown record shows 203 days, from April 13th to November 4th; December of this year is noted for the entire absence of snow in all the central part of the State.

1878.—The winter of 1877-8 had a high mean temperature; the snowfall at Newark was but 1 foot 2 inches in depth; the Hudson river did not close until December 31st; the spring was unusually warm, and the month of April was the warmest in the Newark series, its minimum being 40° and its mean temperature 55°.5, or within 5° of the average May temperature; the summer, also, was warmer than the average. The yearly mean temperature at Newark was 53°.6, the highest in 44 years.

1879.—The winter of 1878-9 ranked among the colder winters; the Hudson was closed between December 20th and April 4th—100 days; the autumn was remarkably dry, the rainfall at New Brunswick amounting to 3.58 inches only.

1880.—An exceptional year in several ways. The winter of 1879-80 was remarkably warm—above the average at Newark; the average for January being 37°.6, highest in the 44 years' record, and 18°.3 above that of January, 1857; May remarkably warm, the average at Newark, 68°.4, highest in the record, and having reached a maximum of 96°; December was noted for its low temperatures, from zero downwards, all over the State, north of Cape May. The year was dry, and the drought was such that wells and springs were lower than for 38 years past.

1881.—The winter of 1880-1 was a cold one, and the snowfall was deep. *For 153 days, from November 22d, 1880, to April 23d, 1881, inclusive, the average temperature at New Brunswick was 29°.3, or the average for the three winter months (a winter of five months).* At Freehold, 75 inches of snow. Hudson river closed at Albany, November 25th, and opened March 21st, 1881. The summer and autumn were warm, and marked by a most severe drought. [See page 375.] At Newark and New Brunswick the months of August, September and October were marked by uncommonly high temperatures. The 7th of September had an average temperature of 89°.7 at Newark; and the maximum was 100°.5—"*above that of any day in any month in any year during the whole period.*"

1882.—The winter of 1881-2 was one of the warmest on record, the average temperature at Newark being 33°.7; the Hudson river, at Albany, was open until January 2d, 1882; the summer was warm and dry; the autumn was exceptionally wet, and September was memorable for its heavy rainfall, amounting to 17.6 inches at Newark, 15.5 inches at New Brunswick, 14.9 inches at Atlantic City, and 25.9 inches at Paterson.

1883.—The winter of 1882-3 was longer and colder than the average; the summer was marked by an absence of excessively hot weather.

1884.—An average year in temperature and rainfall. September was the driest on record, the rainfall varying from two to four-tenths of an inch only. Warmest April on the Newark record.

1885.—Another year of comparatively more even temperature, excepting April, whose maximum was 86° at Newark; Hudson river at Albany closed to navigation until April 7th.

1886.—No great extremes either in temperature or rainfall marked the year; the minimum for October, at Newark, was 36°, the highest on the record at that place.

1887.—The average winter temperature for the State was 32°.6; the range from 102° to —4°.5; the rainfall varied from 37.9 inches, at Atlantic City, to 53.3 inches at Somerville.* The year, at Newark, had the following extremes: minimum of 16° for February, maximum of 50° in March, minimum of 46° in May, and of 66° in July.

1888.—March 12th and 13th were noted for the occurrence of a furious storm (blizzard) of wind, snow and extreme cold; the snow drifted into hard-packed banks 5 to 15 feet high; the thermometer was but little above zero, and all railroad and telegraphic communication was stopped for several days. It was an unexampled storm in this generation.

These notes show the great variation in temperature and rainfall from year to year and for the corresponding seasons of the years. Extending as they do, over two and a half centuries, this range of extremes is greater than that which is shown by our meteorological records, whose lengths are limited to periods of twenty to thirty, and in three cases only, to more than forty years. They show further how incomplete measures of these extreme phenomena our records are, although the averages may be approximately attained in the twenty to fifty-year periods or series. Of course many of the earlier notes are very fragmentary, and give results of great heat and severe cold instead of any proper meteorological measurements of their intensity. However, the winters of 1740–1, of 1779–80, of 1820–1, and of 1856; the snows and ice in May, 1808; the severe snow storm and blockaded roads and railways in March, 1888; the frosts every month in the summer of 1812, and again in that of 1816, are quite as decisive and emphatic as any thermometric records would be, and they indicate to us the possibilities in weather phenomena. In short, they may occur again, and the experiences of the past be repeated in our time. They constitute a striking illustration of the uncertainties of the weather, and in them we discover no law which would enable us to predict the seasons in advance, or solve the problem of meteorology.

*From Mr. E. W. McGann's Ann. Sum. for 1887.

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation.

[From the reports of the Regents of the University, and other sources.]

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1646		November 25th	
1675-6	February 26th		
1786	March 23d		
1789		February 3d, (1790)	
1790	March 27th	December 8th	256
1791	March 17th	December 8th	266
1792		December 12th	
1793	March 6th	December 26th	295
1794	March 17th	January 12th, (1795)	301
1795		January 23d, (1796)	
1796		November 28th	
1797		November 26th	
1798		November 23d	
1799		January 6th, (1800)	
1800		January 3d, (1801)	
1801	February 28th	February 3d, (1802)	340
1802		December 16th	
1803		January 12th, (1804)	
1804	April 6th	December 13th	251
1805		January 9th, (1806)	
1806	February 20th	December 11th	294
1807	April 8th	January 4th, (1808)	271
1808	March 10th	December 9th	274
1809		January 19th, (1810)	
1810		December 14th	
1811		December 20th	
1812		December 21st	
1813	March 12th	December 22d	285

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1814		December 10th	
1815		December 2d	
1816		December 16th	
1817		December 7th	
1818	March 25th	December 14th	264
1819	April 3d	December 13th	254
1820	March 25th	November 13th	233
1821	March 15th	December 13th	273
1822	March 15th	December 24th	284
1823	March 24th	December 16th	267
1824	March 3d	January 5th, (1825)	308
1825	March 6th	December 13th	282
1826	February 26th	December 24th	301
1827	March 20th	December 25th	280
1828	February 8th	December 23d	319
1829	April 1st	January 11th, (1830)	285
1830	March 15th	December 23d	283
1831	March 15th	December 5th	265
1832	March 25th	December 21st	271
1833	March 21st	December 13th	267
1834	February 21st	December 15th	297
1835	March 25th	November 30th	250
1836	April 4th	December 7th	247
1837	March 28th	December 13th	260
1838	March 19th	November 25th	251
1839	March 21st	December 18th	272
1840	February 21st	December 5th	288
1841	March 24th	December 19th	270
1842	February 4th	November 29th	298

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1843	April 13th	December 9th	240
1844	March 14th	December 11th	272
1845	February 24th	December 4th	283
1846	March 15th	December 15th	275
1847	April 6th	December 24th	262
1848	March 22d	December 27th	280
1849	March 19th	December 25th	281
1850	March 9th	December 17th	283
1851	February 25th	December 13th	291
1852	March 28th	December 22d	269
1853	March 21st	December 21st	275
1854	March 17th	December 8th	266
1855	March 20th	December 20th	275
1856	April 10th	December 16th	250
1857	February 27th	December 27th	303
1858	March 20th	December 18th	273
1859	March 13th	December 10th	272
1860	March 6th	December 14th	283
1861	March 5th	December 23d	293
1862	April 4th	December 19th	259
1863	April 3d	December 11th	252
1864	March 11th	December 12th	276
1865	March 22d	December 16th	269
1866	March 20th	December 15th	270
1867	March 26th	December 8th	257
1868	March 24th	December 5th	256
1869	April 5th	December 9th	248
1870	March 31st	December 17th	261
1871	March 12th	November 29th	262

Dates of Opening and Closing of the Hudson River, at Albany, and the Number of Days of Navigation—Continued.

SEASONS.	RIVER FREE FROM ICE.	RIVER CLOSED BY ICE.	NO. OF DAYS OPEN.
1872	April 7th	December 9th	246
1873	April 16th	November 22d	220
1874	March 19th	December 12th	268
1875	April 13th	November 29th	230
1876	April 1st	December 2d	245
1877	March 30th	December 31st	276
1878	March 14th	December 20th	281
1879	April 4th	December 20th	260
1880	March 5th	November 25th	265
1881	March 21st	January 2d, (1882)	287
1882	March 8th	December 4th	272
1883	March 29th	December 15th	261
1884	March 25th	December 19th	269
1885	April 7th	December 13th	250
1886	March 30th	December 3d	248
1887	April 9th	December 20th	255
1888	April 5th		

Dates of Closing of Navigation on the Delaware River since 1872.

YEAR.	CLOSING.	YEAR.	CLOSING.
1872	December 1st.	1880	December 11th.
1873	January 15th, 1874.	1881	January 4th, 1882.
1874	December 30th.	1882	December 20th.
1875	December 19th.	1883	December 25th.
1876	December 10th.	1884	December 20th.
1877	January 3d, 1878.	1885	January 10th, 1886.
1878	December 23d.	1886	December 6th.
1879	December 31st.	1887	December 29th.

The above dates were kindly furnished by Capt. H. E. Melville, Superintendent of the Philadelphia city ice boats, who states in his letter of transmittal "that the Delaware river is not closed by ice, as the ice boats are maintained by the city of Philadelphia to keep it open. The dates are those when the river was sufficiently obstructed by ice to warrant the city ice boats being placed in commission, since the year 1872. They are generally in commission until the middle of February, with a few exceptional seasons."

2B

Dates of Opening and Closing of Navigation on Delaware and Raritan Canal, from 1834 to 1888.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1834	August 20th	December 15th	117
1835	March 16th		
1836	April 18th		
1837	April 20th		
1838	April 10th		
1839	March 15th		
1841	April 5th		
1842	March 28th		
1843	May 1st		
1845	March 18th		
1846	April 15th		
1847	March 5th		
1848	March 20th	December 25th	280
1849	March 15th	December 20th	280
1850	March 11th	December 28th	292
1851	March 14th	December 20th	281
1852	March 15th	December 24th	284
1853	April 4th		
1854	March 1st		
1855	February 15th	December 25th	313
1856	March 28th	December 25th	272
1857	March 12th	January 10th (1858)	304
1858		December 25th	
1859	March 15th	December 24th	284
1860	March 20th	December 24th	279
1861	March 21st	December 20th	274
1862	March 20th	December 20th	275
1863	March 10th	December 25th	290
1864	March 8th	December 17th	284

Dates of Opening and Closing of Navigation on Delaware and Raritan Canal, from 1834 to 1888—Continued.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1865	March 14th	December 23d	284
1866	March 15th	December 18th	278
1867	March 18th	December 20th	277
1868	March 23d	December 19th	271
1869	March 10th	December 25th	290
1870	March 10th	December 24th	289
1871	March 13th	December 15th	277
1872	March 15th	December 15th	275
1873	March 17th	December 20th	278
1874	March 16th	December 19th	278
1875	March 22d	December 24th	277
1876	March 20th	December 20th	275
1877	March 19th	December 22d	278
1878	March 18th	December 21st	278
1879	March 17th	December 20th	278
1880	March 15th	December 18th	278
1881	March 21st	December 20th	274
1882	March 6th	December 20th	289
1883	March 12th	December 20th	288
1884	March 10th	December 20th	285
1885	March 16th	December 19th	278
1886	March 15th	December 20th	280
1887	March 14th	December 19th	280
1888	March 12th	....	....

Dates of Opening and Closing of Navigation on Morris Canal, from 1869 to 1887.

YEAR.	OPENING.	CLOSING.	NO. OF DAYS OPEN.
1869	March 25th	December 6th.	256
1870	March 28th	December 6th	253
1871	April 1st	December 5th.	248
1872	April 9th	December 4th	239
1873	April 9th	November 27th	232
1874	March 23d	November 27th	249
1875	April 9th	December 7th	242
1876	April 7th	December 1st.	238
1877	March 26th	December 5th	254
1878	March 20th	December 6th.	261
1879	March 29th	December 5th.	251
1880	March 23d	November 27th	249
1881	March 28th	December 10th	257
1882	March 29th	November 29th	245
1883	April 2d	December 8th	250
1884	March 29th	December 8th.	254
1885	April 13th	December 11th	242
1886	March 29th	December 4th	250
1887	April 1st	December 2d	245

First-Frost Notes.

The first-frost notes at Rio Grande, Cape May county, New Jersey, since 1882, are recorded as follows:

1882	November 3d.
1883	October 3d.
1884	October 10th.
1887	September 26th.
1888	October 4th.

The following statement relating to dates of first killing frosts is taken from the "United States Signal Service Weather Review," for July, 1888.

STATION.	Number of years' record.	AVERAGE DATE.	EARLIEST DATE.	LATEST DATE.	Number of variations from the average of 10 days or more.	Per cent. of variations of less than 10 days.
Dover	5	September 19th.	September 10th.	October 1st	1	80
South Orange	18	October 20th	October 5th	November 3d.	5	72
Readington	13	October 4th	September 14th.	November 3d.	5	62
Billingsport	7	October 16th	October 3d.	November 3d.	3	57

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TABLE OF TEMPERATURE.

No.	Stations.	Latitude.	Longitude.	Height—feet.	January.			February.			March.			April.			May.		
					Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
1	White Plains, N. Y.	42° 02′	73° 40′	200	66.0	-20.0	29.16	68.0	-9.0	30.77	70.0	1.0	35.11	84.0	15.0	47.84	89.0	28.0	58.97
2	West Point, N. Y	41° 24′	73° 57′	167	68.0	-30.0	28.30	67.0	-11.0	29.41	82.0	-6.00	37.26	89.0	14.0	49.07	98.0	27.0	60.59
3	Goshen, N. Y.	41° 23′	74° 20′	425	60.0	-30.0	25.65	60.0	-16.0	26.31	78.0	-5.0	36.54	84.0	10.0	47.41	89.0	26.0	56.22
4	Port Jervis, N. Y.	41° 22′	74° 42′	450	56.0	-16.0	23.18	61.0	-7.0	27.80	64.0	0.0	32.42	84.0	18.0	44.86	95.0	34.0	58.94
5	Deckertown, Sussex Co	41° 12′	74° 36′	470	54.0	-2.0	32.90	64.0	-7.0	31.20	64.0	14.0	34.70	73.0	24.0	46.00	98.0	35.0	60.50
6	Newton, Sussex Co.	41° 03′	74° 45′	659	51.0	2.0	28.71	52.0	7.0	28.71	60.00	3.0	30.83	78.0	29.0	47.34	83.0	36.0	55.96
7	Dodge Mine, Morris Co	41° 01′	74° 35′	1160	35.0	-6.0	20.27	65.0	-10.0	26.29	65.0	10.0	32.89	87.0	24.0	47.00	96.0	36.5	66.05
8	Mount Olive, Morris Co	40° 52′	74° 43′	1206	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
9	Dover, Morris Co	40° 53′	74° 34′	580	58.0	-10.0	26.58	60.0	-7.0	27.40	68.0	1.0	32.29	87.0	19.5	46.59	90.0	29.0	56.85
10	Phillipsburg, Warren Co	40° 41′	75° 11′	220	60.0	-10.0	25.84	58.0	-2.0	29 65	66.0	4.0	35.00	68.0	24.0	47.90	84 0	33.0	54.35
11	New York City, N. Y	40° 42′	74° 00′	164	64.0	-13.0	29.87	65.0	-8.0	31.37	74.0	3.0	37.50	84.0	20.0	48.25	94.0	34.0	58.92
12	Fort Columbus, N. Y. Harbor	40° 41′	74° 01′	23	61 0	-12.0	29.97	68.0	-7.0	30.57	78.0	2.0	37.65	84.0	17.0	48.42	93.0	31.0	59.35
13	Jersey City, Hudson Co	40° 43′	74° 03′	20	68.6	-5.7	31.51	74.6	-3.0	31.70	73.0	0.0	37.80	89.3	23.7	48.90	93.4	35.5	62.30
14	Tenafly, Bergen Co	40° 55′	73° 58′	100	......	......	......	60.0	1.0	29.00	52.0	12.0	31.80	83.0	16.0	45.90	......	......	......
15	Paterson, Passaic Co.	40° 55′	74° 10′	60	62.0	-14.0	27.68	65.0	-6.0	30.06	72.0	1.0	36.02	87.0	22.0	48.24	95.0	30.0	60.66
16	Bloomfield, Essex Co	40° 48′	74° 12′	120	57.0	-16.0	28.58	69.0	-9.0	30.58	74.0	2.0	36.01	84.5	16.0	47.36	94.0	34.0	57.60
17	Newark, Essex Co	40° 44′	74° 10′	35	65.0	-12.5	28.80	68.5	-8.0	30.50	77.2	2.0	37.40	86.0	17.0	48.60	96.0	31.0	59.30
18	East Orange, Essex Co.	40° 46′	74° 12′	160	53.0	-4.3	......	49.4	9.0	......	65.2	8.1	......	76.1	23.6	......	83.9	33.4	......
19	Orange, Essex Co	40° 47′	74° 13′	185	53.0	-2.0	29.78	59.0	-0.5	30.75	70.0	3.0	33.91	90.0	35.0	47.32	98.0	38.0	62.65
20	South Orange, Essex Co	40° 45′	74° 15′	140	70.0	-22.0	28.21	74.0	-5.0	29.63	72.0	-0.5	35.79	88.0	20.0	47.66	95.0	36.0	60.26
21	Elizabeth, Union Co	40° 40′	74° 13′	30	61.7	17.5	36.90	60.0	14.0	33.90	52.0	14.0	31.90	84.0	23.0	46.00	86.5	42.0	60.30
22	Union, Union Co	40° 41′	74° 16′	110	58.0	4.7	26.70	61.0	13.0	31.00	48.0	17.0	31.70	79.0	29.7	45.60	85.0	49.5	61.80
23	Linden, Union Co.	40° 38′	74° 15′	30	63.5	-18.0	27.27	65.0	-5.0	30.10	72.0	15.0	35.43	83.0	21.0	48.06	97.0	37.5	60.88
24	Pequanac, Morris Co	40° 57′	74° 17′	170	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
25	Hanover, Morris Co	40° 48′	74° 22′	160	......	......	......	......	......	......	52.0	13.0	31.00	81.0	20.0	44.10	89.0	35.0	62.90
26	Gillette, Union Co	40° 41′	74° 28′	220	60.5	0.0	26.70	54.5	8.0	31.70	51.5	10.5	32.40	83.0	16.0	47.70	87.0	42.0	63.40
27	Passaic Valley, Union Co	40° 41′	74° 27′	210	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
28	New Germantown, Hunterdon Co	40° 40′	74° 45′	260	64.5	-14.5	28.50	71.0	-4.5	27.63	66.5	-1.0	33.70	83.0	23.0	47.01	92.0	37.5	59.73
29	Pleasant Run, Hunterdon Co	40° 33′	74° 48′	160	......	......	......	......	......	......	68.0	18.0	......	74.0	40.0	......	84.0	40.0	......
30	Readington, Hunterdon Co	40° 34′	74° 44′	110	68.0	-4.0	28.69	64.0	-6.0	31.29	62.0	5 0	34.82	92.0	28.0	51.41	90.0	30.0	62.51
31	White House, Hunterdon Co	40° 37′	74° 46′	180	......	......	......	......	......	......	......	......	......	......	......	......	81.0	44.0	62.00
32	Sergeantsville, Hunterdon Co	40° 27′	74° 57′	340	68.0	-12.0	28.54	67.0	-3.0	31.39	81.0	6.0	38.65	71.0	10.0	43.02	87.0	35.0	60.42
33	Lesser Cross Roads, Somerset Co.	40° 41′	74° 38′	184	58.0	14.0	36.13	56.0	9.0	31.73	......	......	......	......	......	......	......	......	......
34	Ringoes, Hunterdon Co	40° 26′	74° 52′	248	70.0	16.0	......	73.0	-3.0	......	70.0	4.0	......	85.0	18.0	......	92.0	30.0	......
35	Somerville, Somerset Co	40° 34′	74° 36′	65	61.0	-12.0	26.90	62.0	-3.0	29.20	69.0	3.0	34.66	87.0	21.0	46.62	94.0	30.50	60.49
36	Roycefield, Somerset Co	40° 32′	74° 38′	110	50.0	-22.0	27.02	60.0	-2.0	29.57	......	......	......	82.0	34.0	51.80	95.0	44.0	63.08
37	New Brunswick, Middlesex Co	40° 29′	74° 27′	90	67.0	-12.0	28.30	67.0	-10.0	30.60	77.0	4.0	36.20	83.0	21.0	49.40	98.0	29.0	59.40
38	Princeton, Mercer Co	40° 21′	74° 40′	220	60.0	-11.0	27.12	67.0	-5.0	29.82	71.0	4.0	35.66	85.0	19.0	48.72	97.0	27.0	62.35
39	Pennington, Mercer Co	40° 19′	74° 48′	210	......	......	......	54.0	18.0	......	60.0	14.0	......	......	......	......	......	......	......
40	Locktown, Hunterdon Co	40° 29′	74° 59′	490	58.0	0.0	26.70	60.0	10.0	29.70	50.0	12.0	29.30	82.0	24.0	43.20	86.0	41.0	61.20
41	Lambertville, Hunterdon Co	40° 22′	74° 57′	96	61.0	-20.0	29.72	67.4	-8.7	29.62	77.00	-0.7	38.27	85.0	14.1	48.35	93.5	29.0	59.16
42	Trenton, Mercer Co	40° 13′	74° 46′	50	68.0	-13.0	30.55	68.0	-7.0	32.12	76.0	1.0	39.66	85.0	27.0	52.16	94.0	31.0	61.67
43	Morrisville, Bucks Co., Pa	40° 13′	74° 47′	30	......	......	30.08	......	......	29.41	......	......	38.23	......	......	50.63	......	......	62.80
44	Fallsington, Bucks Co., Pa	40° 12′	74° 48′	30	65.0	-14.0	29.04	68.0	-6.0	31.58	78.0	0.0	37.67	84.0	24.0	49.33	92.0	37.0	59.95
45	Sandy Hook, Monmouth Co	40° 28′	74° 01′	30	63.0	-3.0	30.71	74.0	-2.2	31.75	67.0	7.0	37.01	80.0	23.0	46.46	93.0	35.0	58.39
46	Riceville, Monmouth Co	40° 24′	74° 02′	30	51.0	1.0	29.77	66.0	-5.0	36.80	75.0	14.0	38.67	88.0	33.0	48.68	74.0	36.0	55.55
47	Middletown, Monmouth Co	40° 24′	74° 07′	120	......	......	34.80	......	......	35.48	......	......	41.81	......	......	53.10	......	......	61.47
48	Oceanic, Monmouth Co	40° 23′	74° 01′	20	......	......	......	69.0	16.0	36.60	57.0	18.0	35.30	81.0	28.0	47.10	90.5	47.0	62.60
49	Long Branch, Monmouth Co	40° 18′	73° 59′	28	68.0	-5.0	34.23	73.0	1.0	31.60	69.0	12.0	36.90	67.0	20.0	42.80	87.0	35.0	56.30
50	Ocean Grove, Monmouth Co.	40° 13′	74° 01′	10	......	......	......	54.0	10.0	......	54.0	12.0	......	......	......	......	86.0	43.0	......
51	Lakewood, Ocean Co	40° 05′	74° 13′	50	......	......	......	53.5	18.0	35.60	59.5	20.0	39.80	77.0	29.0	50.60	86.5	44.0	64.00
52	Toms River, Ocean Co	39° 57′	74° 12′	20	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
53	Squan Beach, Ocean Co	40° 08′	74° 01′	23	70.0	-10.0	31.80	57.0	-5.0	27.50	67.0	9.0	35.00	67.0	15.0	40.60	88.0	30.0	54.40
54	Matawan, Monmouth Co	40° 25′	74° 14′	50	59.0	8.0	33.70	61.2	17.0	36.30	60.0	18.0	34.90	82.0	30.0	46.50	94.0	42.0	59.20
55	Freehold, Monmouth Co	40° 15′	74° 17′	190	68.0	-8.0	29.15	69.0	-6.0	30.99	76.0	7.0	37.51	86.0	17.0	46.29	94.0	32.0	59.11
56	Imlaystown, Monmouth Co	40° 10′	74° 31′	110	66.0	3.0	32.00	67.0	4.0	34.70	52.0	11.0	34.00	82.0	25.0	46.30	90.0	43.0	64.10
57	Hightstown, Mercer Co	40° 16′	74° 32′	100	66.0	15.0	39.80	64.0	7.0	36.80	67.0	11.0	39.10	75.0	30.0	49.80	87.0	36.0	59.40
58	Bordentown, Burlington Co	40° 09′	74° 43′	60	65.5	3.0	26.15	66.5	13.0	32.40	64.0	12.0	33.05	86.0	22.0	45.30	91.0	42.0	62.90
59	Florence, Burlington Co	40° 07′	74° 48′	80	66.0	15.0	38.30	......	......	......	......	......	......	......	......	......	......	......	......
60	Burlington, Burlington Co	40° 05′	74° 51′	20	......	......	28.87	......	......	31.39	......	......	30.10	......	......	49.85	......	......	60.17
61	Beverly, Burlington Co	40° 04′	74° 55′	30	63.0	-4.0	27.80	67.0	-4.0	31.60	68.0	12.0	36.50	85.0	29.0	49.30	87.0	46.0	61.60
62	Camden, Camden Co	39° 57′	75° 08′	20	......	......	......	......	......	......	72 0	17.0	......	88.0	28.0	......	93.0	40.0	......
63	Philadelphia, Pa	39° 56′	75° 10′	36	67.0	-9.0	31.29	75.0	-2.4	32.86	79.0	5.0	39.89	88.0	17.5	50.38	96.0	31.0	61.46
64	Billingsport Lighthouse, Gloucester Co	39° 51′	75° 15′	33	64.0	6.0	28.40	68.0	18.0	34.10	54.0	21.0	35.80	78.0	31.0	49.60	85.0	48.0	66.80
65	New Lisbon, Burlington Co	39° 57′	74° 38′	52	62.0	6.0	......	77.0	11.0	......	74.0	20.0	......	84.0	22.0	......	101.0	40.0	......
66	Mount Holly, Burlington Co	40° 00′	74° 47′	30	59.0	-9.0	29.60	65.0	-2.0	33.51	76.0	2.0	39.67	84.0	31.0	50.98	85.0	34.0	60.35
67	Moorestown, Burlington Co	39° 58′	74° 57′	104	69.0	-16.0	28.94	72.0	-5.0	31.20	79.0	2.0	37.67	86.0	22.0	49.35	97.0	36.0	60.60
68	Haddonfield, Camden Co	39° 53′	75° 02′	50	67.0	-12.0	29.61	61.0	-3.0	31.94	78.0	4.0	38.31	84.0	22.0	50.54	85.0	37.0	59.41
69	Atco, Camden Co	39° 46′	74° 53′	150	70.0	-24.0	31.64	69.0	-6.0	32.58	74.0	3.0	38.82	92.0	22.0	48.61	97.0	28.0	62.45
70	Harrisville, Burlington Co	39° 40′	74° 31′	20	......	......	......	68.0	10.0	37.30	61.2	8.2	33.20	84.0	21.3	45.10	91.5	38.8	63.50
71	Elwood, Atlantic Co	39° 34′	74° 43′	90	......	......	......	......	......	......	75.0	4.0	39.80	71.0	19.0	46.40	80.0	......	56.23
72	Clayton, Gloucester Co	39° 39′	75° 05′	130	67.0	00.0	28.00	67.0	-2.0	32.40	70.0	13.0	36.50	87.0	26.0	49.60	92.0	43.0	62.60
73	Newfield, Gloucester Co	39° 33′	75° 01′	125	68.0	1.0	35.18	68.0	-7.0	31.49	80.0	4.0	36.97	86.0	22.0	48.78	92.0	43.0	59.73
74	Vineland, Cumberland Co	39° 29′	75° 01′	120	69.0	-11.0	31.23	75.0	-10.0	33.51	81.0	2.0	39.02	90.0	18.0	50.60	96.0	32.0	22.11
75	Barnegat, Ocean Co	39° 46′	74° 07′	20	61.0	-12.0	31.79	70.0	-4.0	32.77	73.0	9.0	37.64	79.0	19.0	45.79	91.0	34.0	56.61
76	Little Egg Harbor, Burlington Co	39° 30′	74° 17′	14	......	......	......	53.1	13.5	......	60.2	10.8	......	66.0	30.0	......	90.0	41.0	......
77	Atlantic City, Atlantic Co	39° 22′	74° 25′	14	64.0	-3.0	32.05	71.0	-5.0	33.49	72.0	8.0	37.75	84.0	19.0	46.42	89.0	33.0	56.99
78	Somers Point, Atlantic Co	39° 19′	74° 36′	20	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
79	Ocean City, Cape May Co	39° 17′	74° 34′	20	57.0	1.0	35.90	56.0	21.0	37.50	52.0	24.0	36.00	79.0	29.0	47.80	78.0	50.0	61.00
80	Pecks Beach, Cape May Co	39° 11′	74° 40′	20	63.0	-3.0	34.10	61.0	0.0	31.30	65.0	12.0	37.00	66.0	20.0	42.80	86.0	33.0	55.60
81	Seaville, Cape May Co	39° 11′	74° 45′	18	......	......	26.26	......	......	37.35	......	......	40.17	......	......	51.16	......	......	53.38
82	Rio Grande, Cape May Co	39° 01′	74° 53′	13	......	......	33.38	......	......	33.78	......	......	37.25	......	......	48.91	......	......	58.38
83	Cape May, Cape May Co	38° 56′	74° 58′	28	57.0	5.0	34.38	58.0	4.0	35.30	63.0	11.0	39.90	82.0	27.0	47.88	80.0	34.0	58.15
84	Woodstown, Salem Co	39° 39′	75° 19′	30	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
85	Salem, Salem Co	39° 35′	75° 28′	15	63.0	-4.0	31.48	69.0	5.0	33.20	65.0	13.0	35.60	88.0	31.0	51.70	96.0	39.0	64.20
86	Allowaystown, Salem Co	39° 34′	75° 22′	20	62.0	-6.0	28.99	60.0	0.0	29.94	64.0	3.0	33.28	87.0	32.0	48.55	94.0	40.0	60.64
87	Fort Delaware, Del	39° 35′	75° 34′	10	62.0	-5.0	32.26	65.0	0.0	33.80	80.0	5.0	40.08	85.0	24.0	51.59	91.0	38.0	63.44
88	Greenwich, Cumberland Co	39° 23′	75° 20′	15	62.0	-9.0	31.14	67.0	2.0	33.64	76.0	7.0	39.89	82.0	25.0	52.11	87.0	40.0	61.01
89	Dover, Kent Co., Del	39° 10′	75° 30′	40	67.0	0.0	34.27	70.0	-3.0	36.79	74.0	8.0	42.12	88.0	28.0	52.62	92.0	40.0	63.65
90	Baltimore, Baltimore Co., Md	39° 17′	76° 37′	80	69.0	-15.0	33.16	78.0	-4.0	35.07	76.0	0.0	41.87	89.0	20.0	52.80	95.0	31.0	63.36

No.	June.			July.			August.			September.			October.			November.			December.		
	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.	Maximum.	Minimum.	Mean.
1	93.0	48.0	68.19	92.0	55.0	73.14	89.0	44.0	69.73	91.0	35.0	63.66	85.0	23.0	54.05	73.0	8.0	42.09	66.0	-14.0	31.89
2	99.0	40.0	69.37	101.0	50.0	74.38	101.0	40.0	72.41	99.0	33.0	65.02	93.0	22.0	54.17	73.0	6.0	42.83	70.0	-12.0	32.24
3	96.0	36.0	64.73	96.0	42.0	68.69	91.0	36.0	67.64	88.0	32.0	59.76	82.0	14.0	48.87	78.0	4.0	38.78	62.0	-10.0	28.01
4	92.0	45.0	66.76	91.0	53.0	70.08	95.0	46.0	68.46	97.0	36.0	64.10	86.0	23.0	49.90	66.0	5.0	37.26	56.0	-14.0	28.42
5	......	......	......	......	......	......	100.0	46.0	74.60	89.0	40.0	64.40	......	......	......	......	......	......	......	......	......
6	84.0	48.0	64.78	92.0	57.0	69.40	......	......	......	......	......	......	......	......	......	......	......	......	46.0	6.0	23.90
7	94.0	46.5	67.13	90.0	50.0	68.93	91.0	48.0	66.74	87.0	40.0	59.98	78.0	30.0	48.56	67.0	7.0	32.37	42.0	-11.0	22.08
8	......	......	......	87.0	57.0	......	86.0	51.0	67.48	84.0	......	......	......	......	......	......	......	......	......	......	......
9	91.5	39.0	66.08	98.0	44.0	72.22	94.0	40.0	67.97	88.0	32.0	61.23	83.0	21.0	50.49	76.0	17.0	41.53	58.0	1.0	30.35
10	92.0	46.0	67.92	97.0	50.0	71.52	92.0	45.0	71.73	90.0	38.0	67.55	78.0	20.0	54.17	63.0	17 0	41.55	64.0	-2.0	32.25
11	97.0	46.0	69.22	99.0	56.0	74.48	96.0	51.0	73.30	100.2	40.0	65.63	88.0	31.0	54.56	74.0	7.0	44.77	69.0	-6.0	33.33
12	98.0	42.0	69.32	104.0	54.0	74.96	99.0	49.0	73.24	101.0	39.0	66.13	88.0	29.0	54.67	76.0	12.0	43.71	69.0	-3.0	33.67
13	96.2	48.5	72.90	99.5	52.0	77.50	93.6	53.2	74.40	92.8	35.7	67.20	84.0	30.0	55.30	74.0	7.3	42.40	67.7	-3.0	32.40
14	96.0	......	......	99.0	56.0	74.20	91.0	42.0	69.10	85.0	30.0	58.60	84.0	20.0	49.80	67.0	13.0	38.80	58.0	8.0	32.10
15	97.0	48.0	69.58	98.0	58.0	74.41	95.0	51.0	71.73	98.0	39.0	65.79	85.0	26.0	53.19	70.0	9.0	42.26	60.0	-2.0	31.51
16	99.0	48.0	69.16	102.0	53.0	73.99	99.0	45.5	71.01	95.0	36.0	64.60	90.0	28.0	54.19	75.0	15.0	43.65	66.0	1.0	33.67
17	97.0	38.2	68.70	99.7	46.2	74.20	99.0	46.7	71.80	100.5	34.5	64.50	83.0	22.2	53.40	73.7	8.0	42.80	68.5	-6.5	32.30
18	94.9	43.7	69.70	99.0	53.0	76.75	93.5	51.1	75.07	89.7	35.4	64.00	79.8	31.7	53.20	68.4	23.6	43.50	62.0	11.3	......
19	99.0	55.0	73.42	98.0	63.0	75.93	94.0	58.0	74.35	93.0	39.0	67.17	84.0	30.0	53.92	66.0	17.0	38.41	64.0	3.0	31.32
20	100.0	46.0	68.97	101.0	55.0	73.50	99.0	50.0	70.40	103.0	33.0	63.29	90.0	22.0	53.34	77.0	8.0	39.09	70.0	-8.0	31.56
21	91.0	46.0	67.10	95.5	60.0	75.40	90.5	46.0	67.80	81.5	35.0	60.30	80.0	26.0	49.90	71.0	20.0	38.30	59.0	11.0	32.50
22	88.0	53.7	67.10	93.0	64.0	75.70	88.0	56.0	68.80	82.0	40.0	60.10	77.0	28.0	52.10	67.0	20.0	40.10	58.0	11.0	32.40
23	92.2	47.5	68.57	100.0	55.0	73.47	93.2	53.2	70.31	92.9	37.6	63.18	85.5	23.0	52.79	81.0	9.5	40.76	59.0	-17.0	30.43
24	......	......	......	94.0	52.0	70.30	96.0	46.0	69.50	88.0	42.0	63.60	......	......	......	......	......	......	......	......	......
25	90.5	42.0	68.10	95.5	54.0	76.90	91.5	42.0	68.30	84.0	30.0	57.06	79.0	21.0	48.60	61.0	17.0	37.80	59.0	8.0	30.30
26	93.0	42.0	67.80	96.0	58.0	77.40	92.0	40.0	69.30	85.0	32.0	59.60	77.0	26.0	......	69.0	18.0	40.70	61.0	9.0	31.30
27	98.0	48.0	68.00	......	......	......	......	......	......	......	......	......	72.0	24.0	51.90	......	......	......	55.0	2.0	29.00
28	97.0	36.5	70.11	97.3	58.2	74.06	96.0	51.0	71.26	90.2	38.0	62.56	77.0	22.0	50.71	70.0	6.0	37.23	64.0	-6.50	29.02
29	......	......	......	......	......	......	......	......	......	94.0	48.0	67.70	90.0	34.0	58.80	......	......	......	......	......	......
30	100.0	46.0	71.46	102.0	54.0	76.23	100.0	50.0	73.98	104.0	36.0	66.22	90.0	22.0	55.58	75.0	12.0	42.90	66.0	-2.0	32.06
31	87.0	50.0	71.80	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
32	93.0	55.0	69.61	97.0	55.0	74.86	96.0	61.0	76.45	87.0	46.0	71.17	86.0	40.0	62.83	......	12.0	43.46	66.0	15.0	36.62
33	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	60.0	22.0	39.88	52.0	6.0	33.40
34	103.0	40.0	......	102.0	50.0	......	101.0	46.0	......	104.0	35.0	......	92.0	20.0	......	74.0	6.0	......	65.0	11.0	......
35	94.0	47.0	69.16	96.0	53.0	73.95	95.0	48.0	70.24	102.0	35.0	64.90	86.0	25.0	53.46	72.0	4.0	40.54	63.0	-9.0	32.47
36	92.0	54.0	71.12	......	......	......	......	......	......	90.0	50.0	66.52	72.0	36.0	51.78	80.0	20.0	39.73	52.0	6.0	29.73
37	98.0	45.0	68.80	101.0	56.0	74.70	99.0	48.0	71.90	103.0	39.0	63.80	89.0	26.0	53.90	74.0	11.0	41.70	65.0	-8.0	30.70
38	97.0	48.0	71.23	107.0	54.0	73.83	103.0	49.0	70.87	103.0	35.0	65.30	88.0	21.0	55.12	72.0	4.0	41.58	68.0	-11.0	33.01
39	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
40	91.0	47.0	66.30	96.0	61.0	74.00	87.0	48.0	66.60	83.0	35.0	57.80	82.0	25.0	47.40	68.0	19.0	36.80	57.0	7.0	29.20
41	100.0	38.0	68.37	101.5	44.0	73.52	97.5	40.0	70.78	97.0	32.5	62.93	88.6	20.0	51.17	75.5	10.2	41.38	70.0	-16.5	31.75
42	95.0	39.0	71.92*	99.0	55.0	75.97	96.0	53.0	74.01	92.0	39.0	66.64	83.0	28.0	55.33	74.0	9.0	44.09	64.0	-8.0	32.91
43	......	......	71.45	......	......	75.36	......	......	72.30	......	......	65.57	......	......	53.60	......	......	42.30	......	......	30.87
44	95.0	50.0	69.19	98.0	55.0	74.00	99.0	51.0	72.01	103.0	41.0	65.60	88.0	29.0	54.14	76.0	17.0	43.15	63.0	0.0	32.94
45	97.0	49.0	68.11	100.0	50.0	73.92	96.2	55.0	72.54	101.0	40.0	67.14	87.0	32.0	56.93	73.0	8.0	45.07	69.0	-5.0	35.28
46	88.0	51.0	68.00	93.0	53.0	71.24	97.0	58.0	67.70	......	......	......	......	......	......	......	......	......	......	......	......
47	......	......	66.83	......	......	71.93	......	......	72.23	......	......	66.40	......	......	57.37	......	......	45.73	......	......	34.80
48	95.0	54.0	68.00	101.0	67.0	79.00	92.0	54.0	73.00	92.0	42.0	63.90	80.0	34.0	54.40	69.0	22.0	43.40	59.0	16.0	34.60
49	94.0	49.0	67.56	94.0	57.0	72.10	92.0	56.0	70.55	88.5	45.0	65.80	73.0	36,0	54.25	66.0	11.0	41.95	61.0	7.0	37.00
50	92.0	56.0	......	93.0	60.0	......	86.0	62.0	72.70	96.0	49.0	......	84.0	32.0	......	72.0	12.0	......	66.0	8.0	......
51	......	......	......	......	......	......	......	......	......	......	......	......	79.0	30.5	54.80	70.0	25.0	45.60	......	......	......
52	......	......	......	......	......	......	......	......	......	85.0	34.0	61.50	81.0	25.0	52.40	71.0	19.0	41.60	61.0	13.0	35.80
53	95.0	40.0	65.80	91.0	52.0	70.30	94.0	48.0	69.80	90.0	35.0	64.70	75.0	26.0	51.40	68.0	8.0	39.70	63.0	5.0	34.50
54	98.0	50.0	67.60	102.0	65.0	76.50	93.0	50.0	68.40	87.0	43.0	60.20	86.0	34.0	53.80	71.0	25.0	44.30	62.0	11.0	38.30
55	96.0	40.50	69.04	99.0	50.0	73.66	96.0	46.5	71.25	102.0	37.0	64.47	89.0	24.5	53.79	77.0	8.0	41.49	70.0	-11.0	32.84
56	95.0	47.00	67.70	98.0	60.0	76.60	89.0	49.0	69.80	82.0	35.0	61.30	81.0	28.0	52.40	70.0	12.0	41.10	59.0	12.0	33.70
57	......	......	......	......	......	......	......	......	......	......	......	......	73.0	31.0	48.80	76.0	23.0	44.30	......	......	......
58	94.0	48.0	66.80	99.5	60.0	75.00	88.0	49.0	69.35	88.0	36.0	59.00	82.0	27.5	49.50	72.0	21.5	40.45	61.0	12.0	32.75
59	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
60	......	......	70.09	......	......	74.57	......	......	71.36	......	......	65.54	......	......	54.43	......	......	44.46	......	......	33.39
61	94.0	52.0	69.00	97.0	59.0	75.80	92.0	55.0	71.40	88.0	36.0	65.00	81.0	29.0	54.50	70.0	22.0	43.90	53.0	6.0	31.00
62	......	......	......	......	......	......	......	......	......	......	......	......	80.0	42.0	......	......	......	......	......	......	......
63	98.0	42.0	71.14	101.0	50.0	76.10	99.0	50.0	73.45	101.5	37.0	66.01	88.0	17.0	54.70	80.0	10.0	43.69	72.0	-5.0	33.99
64	90.0	56.0	72.20	96.0	70.0	82.50	87.0	58.0	74.10	86.0	45.0	63.80	78.0	32.0	55.40	68.0	22.0	43.20	58.5	16.0	35.60
65	100.0	50.0	73.50	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......	......
66	95.0	50.0	69.03	98.0	56.0	73.03	92.0	51.0	71.65	86.0	45.0	65.31	82.0	33.0	54.37	71.0	21.0	44.59	68.0	4.0	34.58
67	99.0	44.0	70.32	102.0	58.0	75.34	98.0	46.0	72.34	103.0	37.0	65.29	90.0	22.0	53.69	78.0	10.0	41.79	71.0	-9.0	32.26
68	96.0	50.0	70.06	102.0	58.0	74.66	97.0	51.0	72.19	90.0	45.0	65.47	78.0	27.0	52.23	72.0	19.0	42.98	62.0	2.0	32.59
69	99.0	48.0	71.35	101.0	56.0	75.48	100.0	46.0	73.02	104.0	36.0	65.99	88.0	23.0	54.39	82.0	9.0	41.43	70.0	-15.0	34.00
70	94.0	45.0	68.40	102.3	59.0	76.80	92.0	46.5	70.60	86.7	34.8	61.00	84.7	24.7	52.20	72.0	18.5	41.60	......	......	......
71	94.0	......	67.90	96.0	62.0	76.85	90.0	55.0	72.48	90.0	39.0	65.88	78.0	24.0	51.55	73.0	23.0	43.08	......	......	......
72	94.0	47.0	68.50	102.0	52.0	76.50	96.0	50.0	71.70	95.0	38.0	64.90	89.0	24.0	53.80	72.0	20.0	42.30	60.0	2.0	31.30
73	100.0	51.0	72.83	101.0	58.0	77.45	101.0	55.0	73.43	95.0	40.0	65.87	87.0	22.0	55.42	75.0	15.0	41.94	60.0	5.0	32.61
74	100.0	44.0	72.82	106.0	46.0	77.69	102.0	49.0	73.67	104.0	37.0	66.82	92.0	25.0	55.55	80.0	9.0	43.24	70.0	-10.0	33.81
75	95.6	47.0	66.19	96.0	53.0	72.04	95.0	52.0	71.44	96.0	41.0	66.94	82.5	28.0	56.57	73.0	11.0	44.46	63.0	-7.0	35.61
76	96.0	46.0	......	98.0	55.0	......	92.0	55.0	......	86.0	47.3	......	74.8	36.0	......	66.7	21.3	46.20	59.4	-2.0	37.60
77	95.0	45.0	66.36	99.0	53.0	72.36	91.8	49.0	71.85	94.0	40.5	66.99	87.0	29.0	57.12	72.0	10.0	44.11	64.0	-7.0	35.90
78	......	......	......	......	......	......	......	......	......	......	......	......	79.0	31.0	58.50	......	......	......	......	......	......
79	92.0	54.0	67.00	97.0	68.0	76.90	89.50	66.5	75.10	84.0	45.0	67.10	76.0	38.0	58.90	68.0	27.0	45.80	63.0	16.0	38.50
80	90.0	48.0	65.00	94.0	56.0	71.90	87.0	50.0	70.50	88.0	38.0	65.70	72.0	29.0	54.40	69.0	10.0	41.80	61.0	4.0	35.90
81	......	......	70.98	......	......	76.72	......	......	74.48	......	......	69.69	......	......	53.54	......	......	44.48	......	......	28.36
82	......	......	72.33	......	......	74.70	......	......	73.76	......	......	66.38	......	......	55.68	......	......	41.96	......	......	33.34
83	86.0	49.0	67.96	89.0	59.0	74.01	87.0	54.0	73.06	85.0	44.5	68.05	85.7	36.0	57.60	69.0	22.0	46.83	62.0	4.6	38.08
84	......	......	......	......	......	......	......	......	......	......	......	......	67.0	30.0	45.33	......	28.0	47.84	68.0	9.0	31.96
85	98.0	42.0	72.50	101.0	65.0	77.50	95.0	48.0	73.70	95.0	41.0	62.80	87.0	36.0	......	70.0	23.0	......	70.0	5.0	36.90
86	95.0	52.0	70.36	103.0	65.0	78.46	94.0	57.0	73.60	98.0	45.0	66.51	82.0	26.0	53.67	61.0	15.0	38.81	52.0	-6.0	28.42
87	97.0	49.0	72.25	101.0	53.0	77.61	101.0	51.0	75.84	90.0	47.0	69.60	88.0	32.0	57.32	75.0	20.0	45.90	65.0	9.0	36.62
88	94.0	50.0	71.17	95.0	55.0	76.09	93.0	53.0	73.69	89.0	42.0	66.28	79.0	29.0	54.23	73.0	17.0	43.67	67.0	1.0	33.71
89	96.0	56.0	73.45	99.0	60.0	77.87	99.0	60.0	75.45	96.0	42.0	67.09	83.0	23.0	57.07	76.0	15.0	44.38	70.0	-6.0	35.60
90	100.0	45.0	72.26	101.8	54.0	77.17	100.0	50.0	75.01	101.0	38.0	68.20	89.0	25.0	56.69	78.0	11.0	45.53	73.0	-3.0	36.08

No.	Year.				Mean Temperature.				Series.				Observers.	Stations.	No.
	Mean Annual Temperature.	Maximum.	Minimum.	Range for Year.	Spring.	Summer.	Autumn.	Winter.	Beginning.	End.	Length. Yrs.	Length. Mos.			
1	50.38	91.00	-14.00	105.00	47.31	70.35	53.27	30.61	Jan., 1863	Dec., 1887	22	6	O. R. Willis	White Plains, N. Y.	1
2	51.20	101.0	-30.0	131.00	48.97	72.05	54.01	29.98	Jan., 1824	Dec., 1887	51	5	U. S. Military Post	West Point, N. Y.	2
3	47.38	96.00	-30.00	126.00	46.72	67.02	49.13	26.66	Jan., 1835	Dec., 1849	11	...	Various Observers, New York University System	Goshen, Orange Co., N. Y.	3
4	47.67	97.00	-16.00	113.00	45.41	68.43	50.42	26.43	Jan., 1880	Dec., 1884	5	...	C. F. Van Inwegen	Port Jervis, N. Y.	4
5	......	......	......	......	......	......	......	......	Jan., 1880	Sept., 1880	...	7	A. C. Noble	Deckertown, Sussex Co.	5
6	......	......	......	......	44.71	......	......	27.11	Dec., 1868	July, 1869	...	8	Dr. Thomas Ryerson	Newton, Sussex Co	6
7	46.52	96.00	-11.00	107.00	48.65	67.60	46.97	22.88	Jan., 1880	June, 1881	1	6	William Allen Smith	Dodge Mine, Morris Co	7
8	......	......	......	......	......	......	......	......	Aug., 1879	Aug., 1880	...	4	A. A. Titsworth	Mount Olive, Morris Co	8
9	48.29	98.00	-10.00	108.00	45.24	68.76	51.08	28.11	Oct., 1866	Dec., 1887	5	3	H. Shriver, W. C. Harris	Dover, Morris Co.	9
10	49.95	97.00	-10.00	107.00	45.75	70.39	54.42	29.25	Jan., 1881	Feb., 1886	4	4	Miss E. Kent	Phillipsburg, Warren Co	10
11	51.40	100.20	-13.00	113.20	48.11	71.00	54.99	31.52	Jan., 1844	Dec., 1887	38	11	Smithsonian Contributions to Knowledge, U. S. Signal Station	New York City, N. Y.	11
12	51.80	104.00	-12.00	116.00	48.47	72.51	54.83	31.40	Oct., 1821	Dec., 1887	55	8	U. S. Military Post	Fort Columbus, N. Y. Harbor	12
13	52.86	99.50	-5.70	105.20	49.66	74.93	54.96	31.86	Jan., 1871	Dec., 1878	6	7	T. T. Howard, Jr., and F. S. Cook	Jersey City, Hudson Co	13
14	......	......	......	......	......	......	......	......	Feb., 1887	Dec., 1887	...	10	A. D. Atwood	Tenafly, Bergen Co	14
15	50.93	98.00	-14.00	112.00	48.31	71.91	53.75	29.75	Oct., 1863	Dec., 1887	14	6	W. Brooks, John T. Hilton, Prof. A B. Wiggin	Paterson, Passaic Co.	15
16	50.87	102.00	-16.00	118.00	46.99	71.39	54.15	30.94	March, 1849	Dec., 1862	10	7	R. L. Cooke and A. Merrick	Bloomfield, Essex Co	16
17	51.10	100.50	-12.70	113.20	48.43	71.56	53.56	30.53	May, 1843	Dec., 1887	44	8	Frederick W. Ricord	Newark, Essex Co	17
18	......	99.00	-4.00	103.00	......	73.84	53.50	......	June, 1877	Sept., 1879	2	1	Thomas T. Howard, Jr	East Orange, Essex Co	18
19	51.57	99.00	-2.00	101.00	47.96	74.56	53.16	30.62	Jan., 1872	Dec., 1874	2	9	Dr. W. H. Stackwell	Orange, Essex Co	19
20	50.14	103.00	-22.00	125.00	47.90	70.96	51.91	29.80	Sept., 1870	Dec., 1887	17	1	Dr. W. J. Chandler	South Orange, Essex Co	20
21	50.02	95.50	11.00	84.50	46.07	70.10	49.50	34.43	Jan., 1887	Dec., 1887	1	...	N. S. Wilson, M.D	Elizabeth, Union Co	21
22	49.42	93.00	4.70	88.30	46.37	70.53	50.77	30.03	Jan., 1887	Dec., 1887	1	...	T. L. Dunbar	Union, Union Co.	22
23	50.10	100.00	-18.00	118.00	48.12	70.78	52.24	29.27	Nov., 1876	April, 1881	4	6	Arthur B. Noll	Linden, Union Co	23
24	......	......	......	......	......	......	......	......	July, 1882	Sept., 1882	...	3	......	Pequanac, Morris Co	24
25	......	95.50	......	......	46.00	71.10	47.82	......	March, 1887	Dec., 1887	...	10	M. M. Cook	Hanover, Morris Co	25
26	......	96.00	0.00	96.00	47.83	71.50	......	29.90	Jan., 1887	Dec., 1887	...	...	R. N. Cornish	Gillette, Union Co	26
27	......	......	......	......	......	......	......	......	Oct., 1863	June, 1864	...	3	W. Brooks	Passaic Valley, Union Co	27
28	49.28	97.30	-14.50	111.80	46.81	71.81	50.17	28.38	Nov., 1868	Aug., 1876	7	10	Arthur B. Noll	New Germantown, Hunterdon Co	28
29	......	......	......	......	......	......	......	......	Sept., 1877	May, 1878	...	5	......	Pleasant Run, Hunterdon Co	29
30	52.26	104.00	-6.00	110.00	49.58	73.89	54.90	30.68	Nov., 1866	Dec., 1887	8	5	John Fleming, W. T. Keen	Readington, Hunterdon Co	30
31	......	......	......	......	......	......	......	......	May, 1869	June, 1869	...	2	......	White House, Hunterdon Co	31
32	53.08	97.00	-12.00	109.00	47.36	73.64	59.15	32.18	Jan., 1857	March, 1858	1	3	J. T. Sergeant	Sergeantsville, Hunterdon Co	32
33	......	......	......	......	......	......	......	33.75	Nov., 1869	Feb., 1870	...	4	John Fleming	Lesser Cross Roads, Somerset Co	33
34	......	104.0	17.0	......	......	......	......	......	Jan., 1873	Dec., 1881	9	...	Prof. C. W. Larison, M.D	Ringoes, Hunterdon Co	34
35	50.21	102.00	-12.00	114.00	47.26	71.12	52.96	29.52	Sept., 1878	Dec., 1887	7	6	Wm. J. Morgan, A. C. Linsley	Somerville, Somerset Co	35
36	......	......	......	......	......	......	52.68	28.77	Jan., 1872	Feb., 1873	...	9	......	Roycefield, Somerset Co	36
37	50.80	103.00	-12.00	115.00	48.30	71.80	53.10	29.90	......	Dec., 1887	18	1	Prof. Geo. H. Cook and Geo. W. Thompson, Agricultural College Farm	New Brunswick, Middlesex Co	37
38	51.22	107.00	-11.00	118.00	48.91	71.98	54.00	29.98	Sept., 1878	May, 1887	5	...	Prof. Chas. G. Rockwood, Jr., and Prof. M. McNeil	Princeton, Mercer Co	38
39	......	......	......	......	......	......	......	......	Feb., 1877	March, 1877	...	2	Rev. Frank Miller	Pennington, Mercer Co	39
40	47.35	96.00	0.00	96.00	44 57	68.97	47.33	28.53	Jan., 1887	Dec., 1887	1	...	J. W. Hockenbury	Locktown, Hunterdon Co	40
41	50.42	101.50	-20.00	121.50	48.5[illegible]	70.89	51.83	30.36	Jan., 1837	Aug., 1860	23	8	L. H. Parsons	Lambertville, Hunterdon Co	41
42	......	99.00	-13.00	112.00	51.16	73.97	55.35	......	Jan., 1840	Feb., 1881	16	2	Dr. F. A. Ewing, E. R. Cook	Trenton, Mercer Co	42
43	51.88	......	......	......	50.55	73.03	53.82	30.12	Jan., 1790	Dec., 1859	67	10	—— Pierce and E. Hance	Morrisville, Bucks Co., Pa	43
44	51.54	103.00	-14.00	117.00	48.98	71.72	54.29	31.19	Jan., 1860	Oct., 1887	17	6	E. Hance and Milnor Gillingham	Fallsington, Bucks Co., Pa	44
45	51.94	101.00	-5.00	106.00	47.29	71.52	56.38	32.58	Jan., 1874	Nov., 1886	14	...	U. S. Signal Station	Sandy Hook, Monmouth Co	45
46	......	......	......	......	47.63	68.98	......	......	Jan., 1861	Aug., 1861	...	8	Prof. G. L. Harper	Riceville, Monmouth Co	46
47	53.50	......	......	......	52.13	70.33	56.50	35.03	June, 1831	March, 1849	3	2	Colb & Jenkins	Middletown, Monmouth Co	47
48	......	101.00	......	......	48.33	70.00	53.90	......	Feb., 1887	Dec., 1887	...	11	Rev. S. W. Knipe	Oceanic, Monmouth Co	48
49	50.92	94.00	-5.00	99.00	45.33	70.07	54.00	34.28	Jan., 1874	June, 1876	2	6	......	Long Branch, Monmouth Co	49
50	......	......	......	......	......	......	......	......	Aug., 1874	March, 1876	...	...	H. B. Beegle	Ocean Grove, Monmouth Co	50
51	......	......	......	......	......	......	......	......	Feb., 1887	Nov., 1887	...	6	Dr. W. C. Stone	Lakewood, Ocean Co	51
52	......	......	......	......	......	......	......	......	Sept., 1887	Dec., 1887	...	4	J. P. Haines	Toms River, Ocean Co	52
53	48.80	95.00	-10.00	105.00	43.30	68.60	51.90	31.30	Jan., 1874	Jan., 1876	2	1	U. S. Signal Station	Squan Beach, Ocean Co	53
54	50.81	102.00	8.00	94.00	46.87	70.83	52.77	32.77	Jan., 1887	Dec., 1887	1	...	J. C. Rice	Matawan, Monmouth Co	54
55	50.80	102.00	-11.00	113.00	47.64	71.32	53.25	30.99	Jan., 1857	Oct., 1883	14	7	T. Richardson	Freehold, Monmouth Co	55
56	51.14	98.00	3.00	95.00	48.13	71.37	51.60	33.47	Jan., 1887	Dec., 1887	1	...	Dr. H. G. Norton	Imlaystown, Monmouth Co	56
57	......	......	......	......	49.40	......	......	......	Jan., 1876	Nov., 1876	...	8	Peddie Institute	Hightstown, Mercer Co	57
58	49.38	99.50	3.00	96.50	47.08	70.38	49.65	30.43	Jan., 1883	Dec., 1887	1	5	M. S. Simpson, M.D	Bordentown, Burlington Co	58
59	......	......	......	......	......	......	......	......	Jan., 1876	Jan., 1876	...	1	J. Kennedy Barton	Florence, Burlington Co	59
60	51.94	......	......	......	49.71	72.01	54.81	31.22	March, 1849	March, 1868	13	6	Rev. A. Frost, Dr. E. R. Schmidt, J. C. Deacon	Burlington, Burlington Co	60
61	51.44	97.00	-4.00	101.00	49.13	72.06	54.46	30.13	Jan., 1886	Dec., 1887	2	...	C. F. Richardson	Beverly, Burlington Co	61
62	......	......	......	......	......	......	......	......	March, 1877	Oct., 1877	...	9	J. M. Vanhekle	Camden, Camden Co	62
63	52.45	101.50	-9.00	110.50	50.58	73.56	54.57	32.71	Feb., 1831	Dec., 1887	56	10	J. A. Kirkpatrick, A. D. Bache and others, and U. S. Signal Station	Philadelphia, Pa	63
64	53.46	96.00	6.00	90.00	50.73	76.27	54.13	32.70	Jan., 1887	Dec., 1887	1	...	Joseph H. Preston	Billingsport Lighthouse, Gloucester Co	64
65	......	......	......	......	......	......	......	......	Jan., 1880	June, 1880	...	6	Eayre Oliphant	New Lisbon, Burlington Co	65
66	52.22	98.00	0.00	98.00	50.33	71.24	54.76	32.56	Jan., 1861	June, 1876	8	9	Dr. M. J. Rhees, Dr. F. Ashhurst	Mount Holly, Burlington Co	66
67	51.57	103.00	-16.00	119.00	49.21	72.67	53.59	30.80	March, 1861	Dec., 1887	25	...	T. J. Beans	Moorestown, Burlington Co	67
68	51.67	102.00	-12.00	114.00	49.42	72.30	53.56	31.38	Jan., 1864	Dec., 1870	6	9	J. S. Lippincott, S. Wood, J. Boadle	Haddonfield, Camden Co	68
69	52.48	104.00	-24.00	128.00	49.96	73.28	53.93	32.74	Nov., 1871	Sept., 1882	10	11	......	Atco, Camden Co	69
70	......	......	......	......	47.27	71.93	51.60	......	Feb., 1887	Nov., 1887	...	10	J. W. Harris	Harrisville, Burlington Co	70
71	......	......	......	......	......	......	......	......	March, 1868	Nov., 1868	...	9	J. S. Fritts	Elwood, Atlantic Co	71
72	51.51	102.00	-2.00	104.00	49.57	72.23	53.67	30.57	Jan., 1886	Dec., 1887	2	...	W. T. Wilson	Clayton, Gloucester Co	72
73	52.64	101.00	-7.00	108.00	48.49	74.57	54.41	33.09	Oct., 1867	July, 1870	2	10	E. D. Couch	Newfield, Gloucester Co	73
74	53.34	106.00	-11.00	117.00	50.58	74.73	55.20	32.85	Jan., 1867	Dec., 1887	20	5	Dr. John Ingram, Dr. O. H. Adams	Vineland, Cumberland Co	74
75	51.48	96.00	-12.00	108.00	46.68	69.89	55.99	33.38	Jan., 1874	Dec., 1885	12	...	U. S. Signal Station	Barnegat, Ocean Co	75
76	......	98.00	-2.00	100.00	......	......	......	......	May, 1882	Dec., 1884	1	4	......	Little Egg Harbor, Burlington Co	76
77	51.78	99.00	-7.00	106.00	47.05	70.19	56.07	33.81	Jan., 1874	Dec., 1887	14	...	U. S. Signal Station	Atlantic City, Atlantic Co	77
78	......	......	......	......	......	......	......	......	Oct., 1863	Oct., 1863	...	1	Dr. Somers	Somers Point, Atlantic Co	78
79	53.96	97.00	1.00	96.00	48.27	73.00	57.27	37.30	Jan., 1887	Dec., 1887	1	...	William Lake	Ocean City, Cape May Co	79
80	50.48	94.00	-3.00	97.00	45.10	69.10	53.90	33.70	Jan., 1874	Jan., 1876	2	1	U. S. Signal Station	Pecks Beach, Cape May Co	80
81	52.21	......	......	......	48.24	74.06	55.90	30.66	Jan., 1865	April, 1868	2	...	B. Cole	Seaville, Cape May Co	81
82	52.49	......	......	......	48.18	73.60	54.67	33.50	April, 1868	Nov., 1875	4	1	Mrs. J. R. Palmer	Rio Grande, Cape May Co	82
83	53.14	89.00	4.00	85.00	47.96	71.68	57.50	35.92	Sept., 1871	Oct., 1885	13	3	U. S. Signal Station	Cape May, Cape May Co	83
84	......	......	......	......	......	......	......	......	Oct., 1859	Dec., 1859	...	3	G. Watson	Woodstown, Salem Co	84
85	......	101.00	-4.00	105.00	50.50	74.56	......	33.86	Jan., 1877	Dec., 1887	3	1	W. B. Matlock, S. L. Richmond	Salem, Salem Co	85
86	50.94	103.00	-6.00	109.00	47.49	74.14	53.00	29.12	Nov., 1871	Nov., 1873	2	1	H. C. Perry	Allowaystown, Salem Co	86
87	54.69	101.00	-5.00	106.00	51.70	75.23	57.61	34.23	Feb., 1825	Sept., 1870	18	10	Ass't Surgeon U. S. Army	Fort Delaware, Del	87
88	53.05	95.00	-9.00	104.00	51.00	73.65	54.73	32.83	Jan., 1864	Feb., 1873	9	2	Rebecca C. Sheppard	Greenwich, Cumberland Co	88
89	55.03	99.00	-6.00	105.00	52.79	75.59	56.18	35.55	Aug., 1870	Dec., 1880	9	8	J. H. Bateman	Dover, Kent Co., Del	89
90	54.10	101.80	-15.00	116.80	52.68	72.15	56.81	34.77	1831	Dec., 1887	52	4	U. S. Signal Station	Baltimore, Baltimore Co., Md	90


NEW JERSEY
From Original Surveys based on the
Triangulation of the U. S. Coast and Geodetic Survey
Scale: 5 miles to an inch
MILES
KILOMETERS
GEORGE H. COOK, State Geologist. C. C. VERMEULE, Topographer.
1888
NOTES.
The contour lines or lines of equal elevation are shown for each 50 feet south of the Raritan and Millstone rivers and for the first 50 feet and then for each hundred feet north of said rivers. The lines at 500, 1,000 and 1,500 feet elevation are drawn heavy. The datum is mean sea-level.
By reference to the State Map on the same scale which shows all villages, highways etc., any locality may be readily identified.
LEGEND.
Railroad Stations
Tide Marsh
Fresh Marsh and Swamp
SCALE OF TINTS
Elevation above 1,500 feet
1,000 to 1,500
700 to 1,000
500 to 700
300 to 500
200 to 300
100 to 200
50 to 100
0 to 50
NEW YORK
PENNSYLVANIA
DELAWARE
ATLANTIC OCEAN
DELAWARE BAY
DELAWARE RIVER
Port Jervis
EASTON
TRENTON
PHILADELPHIA
CHESTER
WILMINGTON
YONKERS
BROOKLYN
LONG ISLAND CITY
NEW YORK BAY
STATEN ISLAND
RARITAN BAY
SANDY HOOK BAY
BRIDGETON
MILLVILLE
ATLANTIC CITY
JULIUS BIEN & CO. LITH.