

## NEW JERSEY

New Jersey Geological Survey Element, Water Resources Division of Department of Environmental Protection, Box CN-029, Trenton, NJ 08625. Phone 609-292-1185.

### HISTORICAL SEQUENCE OF ORGANIZATIONAL NAME:

Rogers Survey, 1835-40  
 Kitchell Survey, 1854-56  
 Geological Survey of New Jersey, 1864-1915  
 Division of Geology and Waters, Department of Conservation and Development, 1915-25  
 Division of Geology and Topography, Department of Conservation and Development, 1925-47  
 Bureau of Geology and Topography, Division of Planning and Development, Department of Conservation and Economic Development, 1947-61  
 Bureau of Geology and Topography, Division of Resource Development, Department of Conservation and Economic Development, 1961-71  
 Bureau of Geology and Topography, Division of Water Resources, Department of Environmental Protection, 1971-74  
 Bureau of Geology and Topography, Commissioner's Office, Department of Environmental Protection, 1974-79  
 Bureau of Geology and Topography, Division of Water Resources, Department of Environmental Protection, 1979-81  
 Geological Survey Element, Division of Water Resources, Department of Environmental Protection, 1983-present  
 New Jersey Geological Survey is still used informally.

### NAMES AND TITLES OF ORGANIZATIONAL DIRECTORS AND DATES SERVED:

Henry D. Rogers, State Geologist, 1835-40  
 William Kitchell, State Geologist, 1854-56  
 George H. Cook, State Geologist, 1864-89  
 John C. Smock, State Geologist, 1889-1901  
 Henry B. Kummel, State Geologist, 1901-37  
 Meredith E. Johnson,<sup>1,2</sup> State Geologist, 1937-58  
 Kemble Widmer,<sup>2</sup> State Geologist, 1958-80  
 Frank Markewicz,<sup>2</sup> Acting State Geologist, 1981-83  
 Haig F. Kasabach,<sup>2</sup> Acting State Geologist, 1984-86: State Geologist, 1986-present

<sup>1</sup>and Chief, of Division of Geology and Topography, 1937-47.

<sup>2</sup>and Chief, Bureau of Geology and Topography.

### HISTORY OF THE NEW JERSEY GEOLOGICAL SURVEY

By I. G. Grossman

New Jersey, one of the first states to join the Union, was also one of the first to have a Geological Survey. It is

believed to be the second oldest state survey in terms of continuous operation. In 1835, following enabling State legislation, the Governor appointed Henry Darwin Rogers State Geologist. His office was, like most of the early state and federal Surveys, a temporary

one; his task was "to provide a geological and mineralogical survey of the State of New Jersey." Professor Rogers was one of four brothers who distinguished themselves in science, two of them in geology.



Henry D. Rogers  
1835-40

Rogers laid out five traverses covering the State in an east-west direction, although the pioneering map of the eastern United States by Maclure, published in 1809, had shown that the regional strike was northeast. Rogers' first annual report appeared in 1836. His field work extended several miles on both sides of his five traverses and was completed in 1839. He drew geologic sections to illustrate the distribution of formations. His final report, published in 1840, had 300 pages and included a colored geologic map. The report divided the State into northern and southern regions along a line extending northeastward from the Delaware River, near Trenton, to the Raritan River, near New Brunswick. This line, which he was among the first to recognize, roughly coincides with much of what came to be called the "Fall Line." Northwest of this line he

identified three formations he called the "Middle Secondary Strata" in what is now called the Piedmont Province. Northwest of these lay the "Primary Rocks" in what is now dubbed the New Jersey Highlands. Northwest of these lay "Older Secondary or Appalachian Rocks" in what is now known as the Valley and Ridge. In the "Appalachian" rocks, he identified six strata. Most of the strata in the southern half of the State he assigned to the latest period of the Secondary formations. These, with the exception of a few shallow local deposits of "later Tertiary date" were subdivided into five strata. He recognized that these dipped southeastward toward the Atlantic Ocean. Despite subsequent changes in stratigraphic nomenclature, Rogers' studies built a secure foundation for all later work in the State.

Rogers' report dealt with the economic geology of each region. For example, he mapped the greensand marl extending northeastward from the Delaware River near Salem to Raritan Bay and stressed its use as a fertilizer. Most of his report dealt with the identification and location of the minerals and rocks that had been found in the State. He also included some theoretical speculations on the origin of some of the formations and deposits. In some instances, his catastrophism led him astray; it led him to believe, for example, that the trap dikes had burst through the sandstone and shale. His ad hoc survey ended with his final report.

In 1854, a special committee of the New Jersey legislature authorized a new survey and William Kitchell, a teacher at Newark Institute was appointed Director. He was a nonpracticing medical doctor who had studied natural science in Germany. Kitchell opted to do his work in the northern half of the State and appointed George H. Cook, the newly hired Professor of Chemistry and Natural Science at Rutgers College, to be his

## Summary of the Nine State Geologists of New Jersey

Name	Life Span	Remarks
Henry D. Rogers	1808-66	Appointed State Geologist of Pennsylvania in 1836.
William Kitchell	1827-61	Worked without salary when appropriations were suspended by legislature in 1860. Died of pneumonia in 1861.
George H. Cook	1818-89	Also worked without salary from 1863 to 1864, after which legislature restored funding.
John C. Smock	1842-1926	Worked for the Survey for 33 years; the last 12 as State Geologist.
Henry B. Kummel	1867-1945	First President of the Association of American State Geologists. Served the longest as State Geologist; 36 years.
Meredith E. Johnson	1898-1975	Worked for the Pennsylvania Geological Survey for 6 years before coming to New Jersey.
Kemble Widmer	1913 - living	Has lectured extensively on American Revolutionary history following his retirement.
Frank Markewicz	1921 - living	Actively engaged in consulting and volunteer work following his retirement.
Haig F. Kasabach	1935 - living	Present incumbent; started work with the New Jersey Geological Survey in 1960.



William Kitchell  
1854-56

assistant and to survey the southern half. Kitchell also hired Lieutenant Egbert L. Viele, a topographical engineer who was a recent graduate of West Point, and Dr. Henry Wurtz a chemist-mineralogist. It is noteworthy that Kitchell organized the first state-sponsored topographic survey in the

United States. The topography **and** the geology of the State were to be mapped on a county basis, starting with Cape May County in the extreme southern part of Cook's area. Meanwhile, Kitchell pursued his field work in the northern part of the State. He substituted the terms "Azoic" for Rogers' "Primary Rocks" and "Paleozoic" for his predecessor's "Older Secondary Strata." He took advantage of the careful work done by the New York Survey and traced their contacts and formations southwestward into New Jersey. However, economic considerations clearly needed emphasis, so Kitchell updated Rogers' descriptions of the iron, copper and zinc deposits, and described numerous active iron mines. Despite the pressures of field work, Kitchell managed to complete three annual reports. His contributions to pure science were meager, probably because of his short tenure, though he was the first to point out the importance of the alga, Chara, in precipitating calcium carbonate and forming fresh-water marls. Most of the Survey's stratigraphic work was done by Cook, who, among other things, updated

Rogers' marl studies. He also investigated the apparent gradual encroachment of the sea in Cape May County and estimated that the coast was subsiding at the rate of about 2 feet a century. His complete report on Cape May County was published in 1857, accompanied by Viele's topographic map. Kitchell's plan to map the geology and topography of the State on a county-by-county basis was far too ambitious, given the resources available at the time. In 1856, appropriations were abruptly suspended by the legislature so that the office of State Geologist was abolished. However, in 1860 Kitchell obtained approval from the legislature to continue work on the survey, at his own expense, under the auspices of the State Agricultural Society. He was allowed the use of the apparatus and materials belonging to the State survey. Kitchell died suddenly in 1861.



George H. Cook  
1864-89

In 1863, the legislature authorized George H. Cook to continue Kitchell's project. Cook also worked without a salary and at his own expense, until 1864. In that year, he presented his

report "Upon the Geological Survey of New Jersey and its progress during the year 1863." This so impressed the legislature that it restored funding for the Survey, reimbursed Cook for his 1863 expenses, and appointed him State Geologist. Cook submitted annual reports each year from 1864 to 1867 and followed up with a final report "The Geology of New Jersey" in 1868. This major work, which was published the same year, was divided into three parts: (1) a geologic description of the State, (2) economic geology, and (3) "historic" geology. The economic geology part included many pages on the flourishing iron and zinc mines and also included information on water supply. The report was accompanied by a portfolio of eight maps. Cook had studied the marl formations and the economic geology section contained chemical analyses of marls from about 100 sites together with 9 illustrated sections of marls. He rejected the previously assigned Cretaceous age for the upper marls and reassigned them to the Eocene or earliest Tertiary series, based on their fossil content. He recognized the fine quality of Cretaceous clay extending across the state and pointed out that it was just as good as the expensive foreign clays that were being imported by manufacturers of crucibles and glass pots. Cook's strong emphasis on economic geology so impressed the legislature that a much more extensive work was authorized. However, Cook by no means confined himself to practical economic work. His "Geology of New Jersey" contained detailed descriptions of the Precambrian, Paleozoic and Triassic Formations. He rejected Lyell's attribution of the drift to marine deposition and agreed with Louis Agassiz that it had been deposited by a continental ice sheet. Cook, assisted by John Smock, began mapping the terminal moraine in New Jersey in 1877. Cook also mapped the moraine westward into eastern Pennsylvania

and eastward across Staten Island and Long Island, New York. In the 1880 report of the Geological Survey, he also described glacial Lake Pequest and glacial Lake Passaic.

In the 1870's Cook made a water-supply study of the Passaic River basin upstream from Little Falls and showed that enough lakes and reservoir sites were available to provide ample supplies of potable water. Water supplies were also needed by communities near the coast and this required a knowledge of ground water. Cook knew that the marl beds at Kirkwood were 70 feet above sea level and dipped gently seaward at a rate of 25 feet per mile. Based on a southeastward projection of 45 miles to Atlantic City, he estimated that the marl should occur at a depth of about 1,055 feet below tide level and fresh groundwater should be found at a depth of 1,055 to 1,125 feet. Subsequent drilling successfully encountered fresh water and made possible the development of seaside communities. Cook was able to continue his important contributions because the legislature renewed his mandate several times. In effect, the survey became a permanent part of the state government after 1864.

Cook, like his predecessor, recognized the importance of topographic mapping in the state, both as an aid in geologic mapping, and as a spur to economic development. By 1875, he was ready to abandon piecemeal mapping of small areas and initiate topographic mapping of the entire state. He placed the mapping under the direction of Cornelius C. Vermeule, topographic engineer. He also took advantage of a federal law passed in 1871 providing triangulations by the U.S. Coast Survey for states that were conducting their own surveys. Thereupon, the Coast and Geodetic survey proceeded to work in New Jersey at Cook's direction and utilizing his staff. Under this fiscal arrangement, the federal government

paid for the triangulations and the state financed the topographic survey. In 1884, the U.S. Geological Survey began a program of topographic mapping of the entire country. The federal survey agreed to fund all of the remaining work in the state in return for copies of the maps that New Jersey had already completed, covering about half the state. Finally, in 1887, the state was completely covered by 17 overlapping topographic maps on the scale of 1 inch to the mile. New Jersey thus has the distinction of being the first state to have had a topographic map of a quadrangle and also the first to have had complete topographic map coverage of the entire State.

Cook continued to pursue a vigorous program for the more extensive publication authorized by the state although he was busy in his dual position as State Geologist and Vice President and Professor of Chemistry, Natural History and Agriculture at Rutgers College. A first volume, *Topography, Magnetism and Climate* appeared in 1889. That same year, Cook, laden with honors, died. He had served as State Geologist for 25 years. The last volume of the eight-volume *Final Report of the State Geologist* series entitled *Surface Deposits* did not appear until 1916.

John Conover Smock, a graduate of Rutgers College, succeeded Cook as State Geologist and Director of the Geological Survey in 1889. Smock had been Cook's assistant for 21 years, from 1864 to 1885, and had helped him map the terminal moraine in New Jersey. During this period, Smock was also on the staff of Rutgers College. He and Cook were the first to recognize that the glacial deposits in New Jersey represented the effects of more than one ice sheet. They also collaborated in tracing the extent of Glacial Lake Pequest and Glacial Lake Passaic. Smock was especially interested in the thickness of the ice and studied its

effects elsewhere, in the Catskills of New York State. He concluded that the great ice sheet that had occupied the Hudson River valley had had a thickness of 3,000 feet and that it had thinned to the south, to a maximum thickness in northern New Jersey of about 1,200 to 1,300 feet.



John C. Smock  
1889-1901

In 1885, Smock resigned to accept an appointment as Assistant State Geologist of New York under James Hall. As such, he was in charge of the New York State Museum. He returned to New Jersey in 1889, when Cook died, to become State Geologist. Smock moved the Survey and the "State Mineral Cabinet" or museum of the Geological Survey to Trenton; thus, for the first time separating the Survey from Rutgers. The Geologic Museum became the State Museum in 1895. He arranged a division of labor with the U.S. Geological Survey; the federal survey mapped the bedrock formations of New Jersey and the state survey mapped the surficial deposits. He collaborated with Professor R. D. Salisbury in completing his glacial mapping. Smock hired Lewis Woolman

to study the burgeoning number of wells on the New Jersey Coastal Plain. Woolman identified most of the aquifers of the Coastal Plain and mapped their extent in New Jersey during the 1890's. Smock also hired Dr. Henry B. Kummel as Assistant State Geologist. Under Smock's administration, C. C. Vermeule completed and published a major work on the Water Supply and Water Power of New Jersey. In 1892 Smock was sent to Holland to study the reclamation of drowned land as a prelude to improving New Jersey's Hackensack Meadows. In 1890 he hired Gifford Pinchot to study the forest resources of the State. Indeed, from 1894 to 1906, the Survey assumed most of the responsibilities of a forestry service.

Only about 10 scientific articles or reports on the geology of New Jersey bear Smock's name. This underrepresentation of his major contributions is due, in large part, to the subsumption of his earlier work in the "Annual Reports" under Cook's authorship. This obscured the fact that the early geologic maps were based on much of his work. Whether he smarted under this arrangement is not known. However, when he later became State Geologist, he was scrupulous in granting credit, in print, to work done by others.

Smock retired in 1901. After retirement, he grew interested in classical studies, especially the influence of Greek on the English language. He completed a work on the Greek roots of scientific words just before he died in 1926.

Henry B. Kummel, the fifth State Geologist, was from Wisconsin but he received early training in the geology of New Jersey when he mapped some of the state's glacial deposits in 1893 under the direction of Professor Rollin D. Salisbury, of the University of Chicago. In 1896 Kummel received his Ph.D. from that newly-built university, following acceptance of his dissertation

titled *Lake Passaic - an extinct glacial lake [in New Jersey]*. From 1896 to 1899 he was Assistant Professor of Physiography at Lewis Institute in Chicago, but he returned to New Jersey each summer for the field season. Kummel's mapping of the Triassic rocks of central and northern New Jersey at this time became his best-known professional work. In 1889, he became Assistant State Geologist and moved permanently to his adopted state.

When Smock retired in 1901, Kummel became State Geologist. Little more than a year later he had a premature brush with death. In 1903, he and his party were caught in a late autumn snowstorm in the Uinta Mountains of southern Wyoming. The party turned back and managed to reach civilization, thereby enabling Kummel, who had fallen ill with a



Henry B. Kummel  
1901-37



Henry Kummel doing field work on horseback in August 1902.  
Photo probably by Rollin D. Salisbury.

serious case of typhoid, to survive because he was able to get medical help quickly.

In 1922, Kummel received a second title and also added responsibility as Director of the New Jersey Department of Conservation and Development. His administrative duties as director of a large state agency were heavy, but he maintained his interest in geology and in the Survey. The Annual Reports had been discontinued in 1910 in favor of a program of publishing bulletins on specific subjects, a program he continued and one maintained to this day. Also, under Kummel, the Atlas Sheet series was finally completed. A Geodetic Monument System had been established for New Jersey in 1854 but it had deteriorated to near uselessness by 1900. The current geodetic system was established under the Works Progress Administration in 1935. The system was turned over to the New Jersey Geological Survey in 1935.

Kummel was a veteran photographer who took hundreds of photographs to illustrate the geology and physiography of his adopted state. Many of his older negatives, on 8- by 10-inch glass plates, are still on file at the Geological Survey. He retired in June 1937, having served in the lead position for 35 years, longer than anyone before or since. His bibliography lists 47 titles. Many of these were necessarily administrative or data reports, but at least 15, including his revision of "The Geology of New Jersey" were basically interpretive. He was a member of numerous civic and scientific organizations and served as officer or member in many local, state, and federal organizations. He died, greatly honored and esteemed, in 1945.

Meredith Johnson, the sixth State Geologist, was born in the mountains of eastern Tennessee where his father was manager of an iron company at Embreeville. He received an E.M. degree from Lehigh University and also



Meredith E. Johnson  
1937-58

studied at Harvard. He worked for the Pennsylvania Survey from 1921 to 1927 and became Assistant State Geologist of New Jersey in 1928. When Kummel retired in 1937 Johnson succeeded him. The Great Depression and resulting cutbacks in state expenditures soon reduced the entire State Geologic Survey to two people--Johnson and his secretary! He later rebuilt the staff to 11.

He continued the Survey's emphasis on economic geology and considered one of the major achievements of his administration the discovery of some workable ilmenite deposits in the state. Under Johnson's direction, the Survey also studied projected reservoir sites, such as those at Round Valley and Spruce Run. He also secured passage of a well-drilling law which provided invaluable data on subsurface conditions and ground water.

Despite administrative duties, he made it a point to get out into the field one day a week, if at all possible. This caused a narrow escape from death in July 1952 when he and an assistant, Henry Herpers, were inspecting an old

quarry north of the Delaware Water Gap. They inadvertently touched a low-dangling high-tension line concealed by brush. Johnson was knocked unconscious for about an hour and Herpers was killed. Johnson suffered third degree burns but recovered and continued to serve as State Geologist until he retired in 1958. His bibliography includes about 30 reports, of which about a dozen are data compilations of mineral and rock production in the state. He died in Greene, Rhode Island, in July 1975 at the age of 77.



Kemble Widmer  
1958-80

Kemble Widmer became State Geologist when Johnson retired. Widmer was born in New Rochelle, New York, in 1913. He graduated from Lehigh University (A.B. in Geology) in 1937 and did postgraduate work at Stanford University (1937-39). He entered the U.S. Army as a Second Lieutenant in 1941 and came out as a Lieutenant Colonel in 1945 at the end of World War II. He continued his geologic studies at Princeton and received an M.A. (1947) and Ph.D. (1950).

During his early professional years, his summers were spent working for the Newfoundland Geological Survey (1937-41, 1946, and 1947). He was Assistant Professor of Geology at Rutgers University (1949-51) and Associate Professor of Geology at Champlain College, State University of New York (1951-53). He became Principal Geologist with the New Jersey Geological Survey in 1953 and State Geologist in 1958.

Under his leadership, revision of all the mile-to-the-inch topographic maps of New Jersey was completed. Widmer believed in enforcing State laws requiring licenses for drillers and permits for drilling. He went out into the field, accompanied by State Troopers, to remedy lax enforcement. After a few summonses were handed out, word got around and compliance improved. Widmer also started a program of study on erosion of New Jersey's shoreline. A crew of four spent summers taking samples along the coast. Another innovation was the distribution of small sets of New Jersey rocks to schools in the State; these were sold at \$5.00 per set.

On a more technical level, he introduced the "Land Oriented Reference Data System" (LORDS) in 1974. This is a data bank of environmental information, which includes six semitransparent overlays for each state atlas map. The six overlays are (1) land use, (2) geology, (3) water service areas and public-water-supply wells, (4) sewer service areas, sewage treatment plants and sanitary landfills, (5) surface-water drainage, drainage-basin boundaries and flood-prone areas, and (6) population density and market roads.

Widmer retired on the last day of 1980. He had maintained his reserve officer status as a Colonel in the U.S. Army through the years and had become Adjunct Professor in the Department of Earth, Space, and Graphic Science at the U.S. Military Academy at West Point. In addition to

his numerous professional geologic and geographic affiliations, he is a Fellow of the Company of Military Historians. He did a little consulting work after retiring but his interest in American Revolutionary history won out. He has given over 50 speeches on the subject in his first six retirement years. His bibliography includes about a dozen papers on the geology of New Jersey. He has also authored a popular book *The Geology and Geography of New Jersey*.



Frank J. Markewicz  
1981-83

Frank Markewicz became Acting State Geologist in 1981 following the retirement of Kemble Widmer. Markewicz was born in Newark, New Jersey, in 1921. During World War II, he served for 4 years in the U.S. Navy aboard aircraft carriers in the southwest Pacific. He graduated from Upsala College in 1950 with majors in geology and economics. While still a sophomore in college, he worked for the U.S. Geological Survey during the field season. He spent four summers with the USGS, chiefly mapping the geology of coal deposits on the Kenai Peninsula in Alaska.

His field work for the Survey resulted in several significant contributions. From 1957 to 1965, he discovered and, with the help of an assistant, mapped three major ilmenite deposits in the state, of which two were commercially exploited. During the late 1950's and early 1960's, he supervised engineering geology studies at reservoir sites on Spruce Run and Round Valley. After the State Division of Fish and Game had vainly searched for a large supply of water for a new fish hatchery, Markewicz discovered a major aquifer, supplying the requisite quantity, 6 to 7 million gallons per day, near the Pequest River. The subsurface supply proved to meet all the water quality requirements for this major hatchery. He also subdivided a complex sequence of dolomitic limestone, 4,000 feet thick, into formations and members. It is now known as the Kittatinny Supergroup. The subdivision made possible the drilling of high-capacity wells in targeted units. "Mark," as he was popularly known, was promoted to Acting State Geologist in 1981. He retired in 1983 and has since done consulting and volunteer work. He is the author of 12 publications.

After serving as Deputy State Geologist in 1983 and Acting State Geologist during 1984-86, Haig F. Kasabach was appointed State Geologist in 1986. He had completed Bachelor's and Master's degrees from the University of Michigan before he joined the New Jersey Geological Survey in 1960. He completed several ground-water reports and subsurface maps for the Survey before joining the Division of Water Policy and Supply in 1966 as the State's first hydrogeologist. He worked on several ground-water recharge and dam projects and provided hydrogeologic expertise to the State for allocation of ground water. In 1974 he organized a new ground-water investigation unit in the Division's Enforcement Element, which for the



Haig F. Kasabach  
1984-present

first time began prosecuting ground-water polluters and remediating ground-water contamination.

In 1977 he became Chief of the State Bureau of Water Quality Planning and Management which investigated ground-water contamination and pioneered the use of bioassays for regulatory purposes. In 1980 he organized the Bureau of Ground Water Management which issued the State's first permits to discharge to ground water and which provided support to the enforcement units. When the Governor declared a building moratorium to save New Jersey's 1.1-million-acre Pinelands in 1979, the Bureau controlled growth in the area by utilizing ground-water models and information on ambient water quality to effectively control development until the Pinelands Commission could implement a plan in 1981. In 1983 Kasabach rejoined the Geological Survey when it merged with his Bureau and all regulatory functions were transferred to other agencies. This merger tripled the size of the Geological Survey to about 50 and made it an

integral part of the Division of Water Resources.

Increased funding from a State Water Bond Act in 1984-85 enabled the Survey to expand its ground-water program and embark on several ground-water studies under a cooperative program with the U.S. Geological Survey. Concurrently, the Survey concluded a cooperative agreement with the USGS to revise the State Geologic map which had not had a major revision since 1906. Seven new geologists were recruited to work with USGS staff to complete the field work on the map in 5 years. Fledgling geophysics and drilling programs also were expanded at this time through the acquisition of new equipment and by recruitment of geophysicists and well drillers.

Major new Federal and State water-pollution laws caused a tremendous demand for hydrogeologists to assist in ground-water pollution investigations. To avoid duplicating the Survey's tremendous investment in equipment and specialized services, the Department of Environmental Protection decided to concentrate all groundwater pollution investigatory work within the Geological Survey. This centralization expanded the staff to 65 professionals and 20 support staff and has provided the Survey with new quarters, which include laboratories as well as maintenance facilities for three drill rigs.

In March 1988, all ground-water pollution work formerly performed for the Division of Water Resources and other DEP agencies was transferred to the regulatory arm of the Division along with the staff from the Bureau of Ground-Water Pollution Analysis. All ground-water and surface-water monitoring programs, including the Division's biological and shellfish laboratories, were transferred to the Geological Survey.