The Pennsylvania Geologic Survey, officially known today as the Bureau of Topographic and Geologic Survey, and one of the bureaus of the Department of Environmental Resources, is one of only a very few of the Commonwealth's executive branch agencies whose history can be traced to the first half of the nineteenth century. Created in 1836, the survey spawned three subsequent geologic and topographic surveys during the last century and a half. Despite its rather bureaucratic nomenclature, Pennsylvania's first survey, borne of enthusiasm and excitement, was hallmarked not only by astonishing new findings, but by intrigue and fraud -- perfect elements for real drama!

Pennsylvania in the 1830s fermented with activity. Population rapidly increased, industry expanded, and anthracite was proving useful in the manufacture of iron. Internal developments -- the building of turnpikes, canals and railroads -- and the creation of a system of Common Schools were the concerns of the governors and legislators of Pennsylvania. They assiduously believed that internal developments and public education were necessary if the resources of the Commonwealth were to be successfully developed.

On March 30, 1836, the General Assembly of Pennsylvania received notice from Gov. Joseph Ritner that he had signed its bill establishing "a geological and mineralogical survey of the state with a view to determine the order, succession, arrangement, relative position ... of the several strata or geological formations within the state, and to discover and examine all beds and deposits of ores, coals, clays, marls ... as may be necessary to make a full and complete geological and mineralogical survey of the state." The bill became Act 73 of 1836.

Pennsylvania was the ninth state to enact legislation for a geologic survey and in 1836 joined Georgia, Maine and New York, whose legislative bodies also created geologic surveys that year. Maryland and New Jersey had established geologic surveys in 1833 and 1835, and Pennsylvania's legislative action was not unusual for 1836. The emphasis on internal improvements in Pennsylvania and the desire to discover usable mineral resources were all related to the period's concept of mercantilism, which held that each state should be broadly involved in the field of economics.
Since 1836 Pennsylvania has created four Geologic Survey. The First Geologic Survey began field work in May 1836 and field campaigns were conducted each year until the summer of 1842. Work on the final report was temporarily suspended in 1842 due to lack of legislative appropriations, purportedly because of the state’s "financial embarrassments." Field work was resumed in 1851 and eventually resulted in the beautifully illustrated, two volume, quarto-sized report and maps, which were published in 1858. The Second Geological Survey, conducted between 1874 and 1895, produced eighty-one quarto volumes with accompanying atlases. The third survey, authorized from 1899 to 1814, emphasized cooperative topographic and geologic mapping with the U.S. Geological Survey which had been created in 1879. The current, Fourth Geologic Survey has conducted geologic investigations since 1919 and has produced more than six hundred reports dealing with all aspects of the geology and topography of Pennsylvania.

The beginnings of the First Pennsylvania Geologic Survey can be traced to a meeting held September 30, 1826, in the hall of the Franklin Institute, Philadelphia. At this meeting Peter A. Browne, attorney and business promoter, disclosed a plan wherein he would "make a geological and mineralogical survey of Pennsylvania and make a set of geological maps of the state, twenty-six in number, upon a comprehensive scale." Although a committee of Philadelphia citizens was formed during the meeting, no further action took place until late February 1832, when the Geologic Survey of Pennsylvania was established. Society members were to "use their influence to have the state geologically surveyed." Memorials prepared by the Society urging the support of a topographic, geologic and mineralogic survey of Pennsylvania were sent to the legislature of Pennsylvania in December 1832. A legislative committee report was read March 23, 1833, but no action was taken. Additional memorials were dispatched by the Geologic Society of Pennsylvania in December 1834.

In response to Gov. George Wolf’s 1835 Message to the Legislature, a committee of the House of Representatives, chaired by Charles B. Trego, read a report espousing the need to conduct a geological and mineralogical survey and reported a bill for consideration. (Trego was to become one of the survey assistant geologists in 1837; he remained with the first survey until 1842.) The bill was signed by Governor Ritner on March 29, 1836, with other substantive legislation calling for a state constitutional convention that convened in 1838.

Thus began the First Geologic Survey of Pennsylvania whose investigations and discoveries, when finally published in 1858, after considerable difficulties, were destined to set the geologic framework for all subsequent geologic mapping in the states along the Appalachian Mountains. In addition, the discoveries of the First Geologic Survey of Pennsylvania prompted a major branch of the science of geology. The new field, structural geology, was concerned with the form and arrangement of rocks, their internal structures and, particularly, with their description and analysis.

Appointed geologist of the First Geologic Survey was Henry Darwin Rogers, a twenty-six year old professor at the University of Pennsylvania, employed during 1835 as State Geologist of New Jersey. Joining him as assistants were James C. Booth, twenty-four years old, and John F. Frazer, twenty-six years old, both of whom had studied at the University of Pennsylvania. Rogers’ brother, Robert, was appointed chemist for the survey.

Work for the survey would not be easy. Life in the field was rigorous, difficult and lonely, as the members of the first survey would discover. Philadelphian Richard C. Taylor, a founder of the Pennsylvania Geological Society, conducted an independent field investigation beginning in April 1834 and continued through the following winter when bitter temperatures -- at times thirteen degrees below zero -- halted the exploration. Taylor and his party collected and described the geology and fauna of the Allegheny Plateau area of present-day Lycoming and Tioga counties. His reflections on the survey, published in the Magazine of Natural History in 1835,
chronicled the hardships which would later be faced by members of the Commonwealth's first survey teams:

*Explorations of this kind are not performed without many privations, much fatigue, exposure and the customary inconveniences attending our peregrinations amongst woods and rocks, far from human dwellings, where our bed is the hemlock boughs, our awning the 'greenwood tree.' Yet have this rude forest life, these wild scenes, and even these temporary privations, their share of interest, and of not unpleasing novelty. After the heat of and burden of the day have been borne and its toils creased; -- after all hands have been busy about 'the camp' each to his individual task, some in erecting the temporary sleeping place, ... bringing in a substantial stock of fuel for the night, another barking trees for our roof; one making up a fire large enough to roast an ox, and preparing the evening meal, while another catches trout, which about in all these mountain streams; -- after all these preliminary duties have been dispatched, as well as the meal, the refreshed geologist, or naturalist, as he reclines on his fragrant couch of hemlock, basks before a cheerful fire...*

The young geologists proceeded to the field in May 1836. Henry D. Rogers and his assistants made a rapid trip across the state to Erie. Starting at Chester on the Delaware River they journeyed to Columbia, Lancaster County, and north on the Juniata River. They followed the Juniata to Lewistown and then traversed across country to Bellefonte and to Karthaus over the Allegheny Mountain. From Philipsburg they traveled northwest through Clearfield, Brookville and Clarion on their way to Erie. Upon their return they added a traverse from near Beccaria, down the Little Juniata River, and through Huntingdon to Newton Hamilton where the river turns northeast.

The initial investigation enabled Rogers to subdivide Pennsylvania into three geologically distinct sections. The Appalachian Section, bounded by the Blue Mountain on the southeast and the Allegheny Mountain on the northwest, was chosen for the first summer's campaign of field work.

Frazer went to Bedford County and, starting at Hopewell, where coal was being mined, examined the rocks exposed in the gap of Terrace Mountain and then along the course of Yellow Creek through the gap in Tussey Mountain into the limestone valley of Morrison's Cove. (A geologist's description of such rocks in their correct sequence is referred to as a "section." Such a section is frequently sketched in a geologist's notebook in which the geologist will draw a picture of the rocks to show each layer in proper relationship to each other.) Frazer's section began with the youngest rocks, and as he progressed, the section descended through geologic time to reveal that, along Yellow Creek, more than twenty-five thousand feet of rock layers of varying character were tilted such that they were vertical, or nearly so, over the whole section. He was able to demonstrate that the resistant sandstone layers underlying Tussey and Terrace mountains were, in fact, not the same, as had been thought by geologists who had previously examined the area. The sandstone and conglomerate layers supporting these mountains were, in reality, separated by many thousands of feet of intervening rock layers. Until this time geologists thought that all of the ridges which make up the mountains of central Pennsylvania were supported by rocks of the same age.

Rogers, Frazer and Booth convened in Huntingdon on a Sunday in the summer of 1836 and compared their field notes. Frazer's Yellow Creek section was disbelieved until confirmed by Rogers later that week in a visit to the area. Booth also verified the same sequence of rocks in a traverse along the Potomac River. The examination of the Bedford County geology in the first year of the survey resulted in the conclusion that the coals of the Broad Top Mountain were of the same geologic position and geologic age as were the bituminous coals known to exist in Clearfield and Lycoming Counties.

Prior to Frazer's section, rocks which underlie the Broad Top and the surrounding
areas included in the Appalachian Mountains had been thought to consist of rocks which would include veins of quartz, volcanic rocks and their included metal ores, as well as coal. What they found allowed a profound new scientific understanding of Pennsylvania’s geology because it meant that exploration for coal in the rocks of the Appalachian Mountains, except in the Broad Top, was useless as no coal existed in these rocks.

Where Rogers and his assistants had expected to find in Bedford County ores of metals such as zinc and tin, they found, instead, a profusion of iron ores of the "brown" ore type.

Rogers and his assistants were also able to subdivide Bedford County’s great thickness of rocks into twelve distinct sets of rocks which were easily distinguishable from each other. This subdivision, with but few modifications, was used by all geological assistants of the first survey and by all subsequent Pennsylvania geological surveys, as well as other geological surveys of the Appalachian states.

Booth and Frazer did not return in 1837 to continue further field work and were replaced by new assistants, one of whom was Charles Trego, the former legislator. Rogers wrote to his brother, William, State Geologist of Virginia, that "...our great and pressing dilemma is for competent geological assistants. The country does not afford them: they are to be made by us..." Between 1838 and 1840 a maximum of nine assistants were employed each year; most were trained by Rogers and were dispatched to various districts in Pennsylvania. Greatest attention was paid to the anthracite and bituminous coal regions, as well as areas in southeastern Pennsylvania, where metallic ores were being mined, and in the valleys of the Appalachian Mountains where the brown iron ores were found.

Major geologic discoveries made in the subsequent years of the first survey, concluded that the anthracite coals were of the same age and origin as the bituminous coals, even though of markedly different chemical and physical characteristics. The use of topography in determining the underlying geology was discovered in 1838, as was the origin of brown iron ores. Dr. Robert Jackson, a physician and later chief surgeon of the Army of the Cumberland, served as a geological assistant from 1838 to 1841. He studied the brown iron ores of the many limestone valleys in central Pennsylvania and determined that they originated from accumulation of the undissolvable iron resulting from solution of limestones in which the iron naturally occurred. From his and the other assistants’ observations in 1838 came the first understanding of the effect of erosion on the earth’s surface. Their conclusions were later acknowledged and accepted by European geologists.

In 1840 and 1851 Rogers employed George Lehman and Augustus Dalson as artist-draftsmen who traveled throughout Pennsylvania sketching scenes of the topography and geology. Field work ended with the 1841 season, and when the Pennsylvania General Assembly did not appropriate funds in 1842, Rogers was unable to publish field notes, sketches, section descriptions and maps. The Commonwealth cited "financial embarrassment" but, perhaps, some of the answer for the lack of support could be found in a legislator’s comment in 1840. Rogers, in a letter to his brother in Virginia, reported that a legislator uttered: "Mr. Speaker, I shall vote against this appropriation, on the ground of its unfairness to other sciences of like nature with this geology. The bill, sir, makes no provision for phrenology, physiognomy, animal magnetism, and the highly important science of water-smelling..."

A small appropriation in 1843 was apparently used by Rogers to employ one of the former geological assistants, J. Peter Lesley (later appointed chief geologist of the Second Geological Survey), in the preparation of the final maps and reports. They were delivered to the Secretary of the Commonwealth in 1847 for publication. However, they lay neglected until 1851 when citizens, particularly in the anthracite regions, clamored for the publication of the report and maps. Upon their urgings the legislature appropriated thirty-two thousand dollars, of which half was to be used
for publication by "an eminent publishing firm" of Philadelphia and the balance to further the work of Rogers, geological assistants and miners in bringing the work up to date.

Additional field work was conducted in 1851 and 1852, particularly in the anthracite fields. Rogers continued work on iron ores, notably the "fossil" iron ores near Danville. He was also engaged in arranging the voluminous individual area reports and illustrations, prepared by each geological assistant, into a form suitable for publication. He wrote the summarizations and scientific interpretations for which the final report would become famous throughout the geologic world -- both in the United States and throughout Europe.

Publication of the survey findings was time-consuming; disheartening tribulations delayed the printing. The "eminent publishing firm," Hogan and Thompson of Philadelphia, selected by the legislature to publish the report and maps and to disburse all funds, including the salaries of Rogers and his staff, withdrew four thousand dollars from the State Treasury and the dissolved. To correct this impropriety and to pay the geological survey staff salaries, the legislature in 1852 authorized Rogers to send vouchers directly to the State Treasury.

Henry Rogers proposed in 1855, when both text and illustrations were ready, that he be given the copyright to the report and maps, as well as the contract for publication. He volunteered to forego his salary in the supervision of the publication process.

The legislature accepted Rogers' offer, restored the four thousand dollars lost to Hogan and Thompson, and authorized the Secretary of the Commonwealth to contract directly with him for the publication of the report. Rogers then left for Scotland, where he arranged with W. and A.L. Johnston of Edinburgh to engrave the illustrations and maps. William Blackwood and Sons of Edinburgh printed the quarto volumes and they were sold in the United States by Lippencott.

The final report is a magnificent example of the publication processes of the 1850s. It was printed in two quarto volumes totaling more than sixteen hundred pages. Included were eight hundred engraved woodcuts inserted in the text. Twenty-three engraved plates were painstakingly devoted to illustrations of fossil plants. Other plates included engravings of geological sections throughout the state and sketches of the scenery and geology along the rivers of Pennsylvania.

Still notable for their beauty are three full-color lithographs bound in the volumes. Even today the lithograph of Pulpit Rocks may be compared to their present-day appearance, and the two are identical. Even graffiti remains, although the names on the rocks are different today than they were in 1840, when the original water color was made. (Pulpit Rocks will be the site of a commemorative event in September 1986, when a plaque celebrating the beginning of the First Pennsylvania Geological Survey will be erected.) The two lithographs of the Baltimore Company mines near Wilkes-Barre were outstanding examples demonstrating geology and artistry. During the 1840s, this mine was a popular tourist attraction in the anthracite region because of the thickness of the coal seam. Presumably the three figures depicted in the lithograph near then entrance to the mine were curious tourists.

One of the greatest survivors of the first survey is an oil painting depicting a field party. The painting, now in the collections of The State Museum of Pennsylvania, is the only known illustration of the First Geological Survey geologists in their field station. Lesley, in his Report A of the Second Geological Survey, wrote that Lehman, "the talented artist of the Survey," was in the camp of James T. Hodge for a month during the summer of 1840. The geologists were investigating the bituminous coal fields of Cambria, Somerset, Fayette and Westmoreland counties. The two geologists doing field work in that district in 1840 were Hodge and Townsend Ward. They had "two tents, a wagon and three horses, with three brothers for working hands... In August Mr. Lesley joined the party, which had by
that time reached Loretto. The camp was then moved from station to station every week or ten days, down the Conemaugh and up the Sandy, down Castleman's river, and back through Ligonier valley. ..." Inasmuch as the painter William van Starkenborg made a notation which identified the painting as portraying a site in Somerset County originally sketched by Lehman, it can be assumed that the top-hatted figures are Hodge, Ward and Lesley and the other three are the working hands. Possibly van Starkenborg saw a water color of this same scene by George Lehman, rather than just one of the many uncolored sketches, and then reproduced it in oil. If so, this would identify four of the ten water colors Lehman is known to have painted for the First Geological Survey of Pennsylvania.

Publication of this extensive report formally ended the First Geological Survey of Pennsylvania. Soon, however, the demands of the mineral industries, the discovery of petroleum in northwest Pennsylvania and the need for accurate geologic maps resulted in the creation of the Second Geological Survey in 1874. Upon its completion in 1895 only four years elapsed before the Pennsylvania legislature again realized that geologic surveys and accurate topographic maps were needed. Similarly, with the close of the third survey in 1915, only four years transpired and a Fourth Geological Survey, which continues today, was instituted.

For more than a century and a half, the geologic surveys have provided accurate information which inevitably aided research undertaken by scholars and industries. The surveys, which had their beginnings with the often ill-fated first survey, have helped Pennsylvania develop what Governor Ritner and the 1836 legislature envisioned as resources for the future. The legacy bequeathed to Pennsylvania by that diligent first survey team is truly remarkable. Its heritage is a living legacy, continuing to provide -- each and every day -- new and useful information supporting the Commonwealth’s myriad industries and technologies.

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