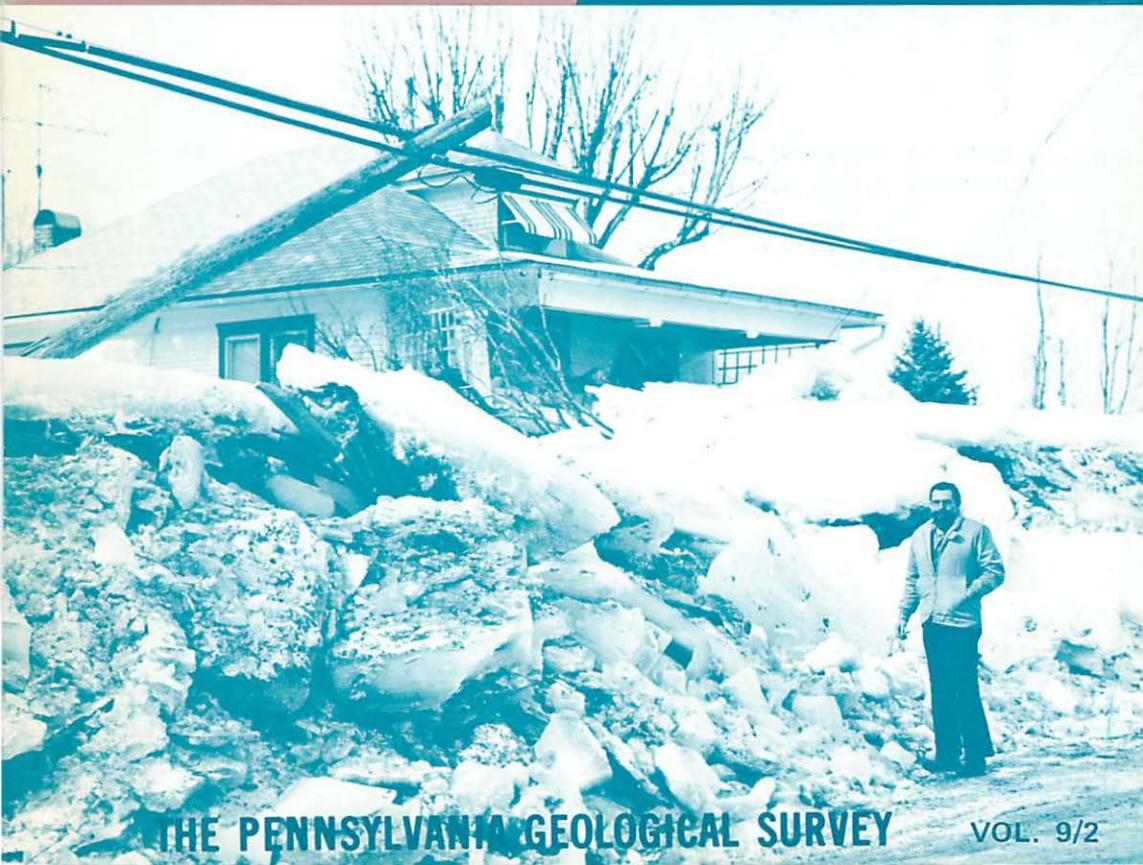
GEOLOGY PENNSYLVANIA



THE PENNSYLVANIA GEOLOGICAL SURVEY VOL. 9/2

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Ice Age of 1978. View of ice jam pushed up along west shore of Susquehanna River, damaging homes and utilities at Long Level, south of Wrightsville, Pa. Photo courtesy of Peter Wilshusen.

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Dept. of Environmental Resources, Harrisburg, Pennsylvania, 17120.

APRIL 1978

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

ENERGY PROGRESS

In the midst of headlines on oil spills, coal strikes, nuclear protests, and increasing imports, it is comforting to find that some progress is being made here in Pennsylvania towards easing the energy situation.

Preliminary data for 1977 indicates that there has been a marked increase in drilling for natural gas in western and central Pennsylvania. This includes deep drilling by the major utilities, as well as shallow drilling by small industries seeking to establish an independent gas supply on their own company properties.

From southwestern Pennsylvania, particularly Greene County, comes news of advancing plans for some twelve major, new coal mines which will "tap" large "blocks" of previously untouched deep coal.

In central Pennsylvania the second unit of the Three Mile Island nuclear power plant on the Susquehanna River has been completed and is ready for operation. Further east, in Montgomery County, construction of the Limerick nuclear power plant is proceeding well, as is the Berwick nuclear power plant in Columbia County.

Noteworthy also are the reports that there are several investigations underway to see if some of the existing damned lakes in Pennsylvania can be adapted to also serve for hydropower electric generation.

Each of the above-mentioned new energy sources in Pennsylvania has utilized various aspects of our accumulated geologic data, such as coal bed structures and reserve calculations, oil and gas reservoir bed characteristics, and rock structure conditions of the various power plant and dam sites. We are pleased to note Pennsylvania's energy progress and the Pennsylvania Geological Survey is proud to be making its contribution to the effort.

Arthur A. Socolow

Exploratory Drilling in Pennsylvania Indicates Substantial Reserves of Natural Gas*

Karen Shumac[1]
Robert Piotrowski[2]

Amoco Production Company and UGI Development Corporation, whose gas utility division serves customers in eastern Pennsylvania, have begun an extensive exploratory drilling program in Pennsylvania. Seventeen to nineteen wells were programmed to be drilled over a 2-year period on an area of approximately 1,100,000 acres in 11 central and southwestern counties. UGI reportedly will invest up to $6 million in the program and get a 40% working interest in all wells to be drilled, plus the option to buy all natural gas found. Amoco is the operator of the program using outside turnkey contractors. Under the agreement, UGI also has the right to purchase gas from Amoco from production in the Shanksville field in Somerset County, discovered by Amoco in 1973; reserves are unofficially estimated at up to 27 billion cubic feet of gas.

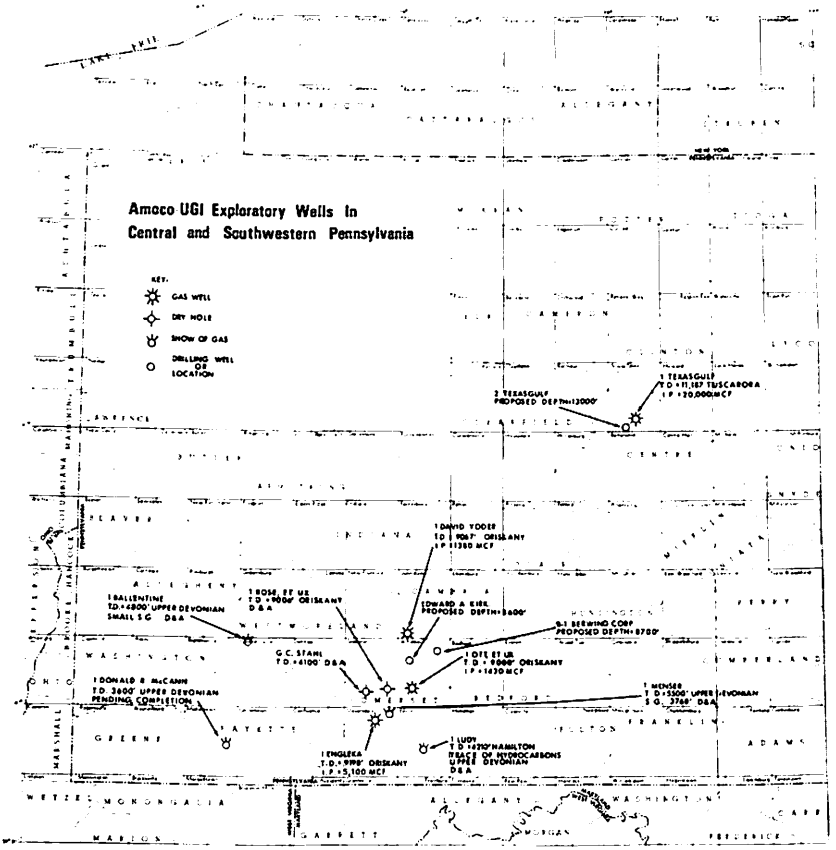
Most of the wells were originally scheduled to be drilled in Somerset, Fayette, Westmoreland, and Centre Counties at depths ranging from 3,000 feet to 12,000 feet. These wells were to include tests of the Tuscarora (Silurian), the Oriskany (Lower Devonian), and Upper Devonian strata. The program began in May, 1977 and has, as of December, 1977,resulted in the drilling of 10 of the originally proposed wells with 2 additional 1977 locations postponed for drilling until 1978.

Of the Upper Devonian tests planned for the project, 5 are now completed. The first well of the program, #1 Ludy, located 8 miles southeast of the town of Berlin, Northampton Township, Berlin quadrangle, Somerset County, was started on May 4, 1977 and drilled to a depth of 4,210 feet to the top of the Hamilton Formation. A trace of hydrocarbons was found but not in commercial quantities, the #1 Ludy well was abandoned on May 19, 1977.

The George C. Stahl well, Somerset quadrangle, Somerset Township, Somerset County, was in operation from June 7, 1977 to

*(Adapted from February 20, 1978 Issue of Oil and Gas Journal)

[1]Student Intern, PA Geological Survey, Mercyhurst College, Erie, Pa.
[2]Staff Geologist, PA Geological Survey, Pittsburgh, Pa.



June 19, 1977. It was drilled to a depth of 4,100 feet and abandoned with no show of gas to this depth.

The Menser #1 well, located 3-½ miles southeast of Somerset, Somerset Township, Meyersdale quadrangle, Somerset County, started drilling operations on June 9, 1977. There was a show of gas at 3,768 feet, but the well was abandoned as a dry hole at 5,500 feet on July 11, 1977.

The Ballentine #1, located 2 miles northeast of Hutchison, Connellsville quadrangle, Sewickley Township, Westmoreland County, was plugged and abandoned at 4,000 feet in August, 1977 after various well developed Upper Devonian reservoir zones were found to be predominantly water bearing; only small gas shows were encountered.

The Donald R. McCall #1 well, located 2 miles northwest of Smithfield, Masontown quadrangle, Nicholson Township, Fayette

County, was drilled to a total depth of 3,600 feet and is temporarily shut in, pending completion. Shows of gas were encountered from the Balltown, Speechley, and shallow Upper Devonian zones. During the year, Amoco and UGI initiated an Upper Devonian farmout program to increase exploration for economic Upper Devonian gas reserves.

Four Oriskany tests have been drilled and 2 more have scheduled locations. The #1 David Yoder well, Johnstown quadrangle, Conemaugh Township, Somerset County, started on July 16, 1977 was successfully completed October 19, 1977. The initial potential of this discovery is reported to be calculated absolute open flow of 1,380,000 cubic feet per day. The #1 Yoder is drilled to a depth of 9,067 feet with pipe set at 9,055 feet. The Yoder discovery, opening Heckman Hollow field, is 2 miles southwest of the city of Johnstown.

The #1 Ott well, Windber quadrangle, Paint Township, Somerset County, flowed gas at an estimated rate of 275,000 cubic feet per day while drilling the Oriskany; total depth is 8,895 feet. The #1 Ott well was completed on November 16, 1977, and is 4-½ miles southwest of the town of Windber. The initial potential of this discovery is reported to be 1,430,000 cubic feet of gas per day after hydraulic fracturing.

A flow of 5,100,000 cubic feet of gas per day after drilling was reported at #1 Engleka, Jr., Meyersdale quadrangle, Somerset Township, Somerset County. The drilling was started on September 11, 1977 and continued until reaching a total depth of 9,198 feet.

A completed Oriskany test at #1 Rose, 9 miles southwest of the city of Johnstown, Somerset quadrangle, Jenners Township, Somerset County showed no signs of production. Drilling of the Rose well started on October 13, 1977 and reached a total depth of 9,006 feet.

Other scheduled Oriskany tests include two in Somerset County, the B-1 Berwind Corp. and the Edward A. Kirk. The Berwind B-1 well, Windber quandrangle, Shade Township, is scheduled for a depth of 8,700 feet, and the Kirk #1 well, Windber quadrangle, Stoneycreek Township, for a depth of 8,600 feet.

The most successful well in the program started July 17, 1977 in Centre County and has gained much attention. The Texasgulf, Inc. Tract 1, Snowshoe quadrangle, Boggs Township, encountered a visually estimated flow of 20,000,000 cubic feet of gas per day in an open hole test at 10,760 feet in the Tuscarora Formation. The apparent discovery is 8 miles northwest of the town of Bellefonte and 27 miles south of the Leidy gas storage field where production was from the Oriskany. The nearest production from Silurian is 110

miles to the west-northwest in Venango County's Irwin gas pool, where the Clinton Formation is producing. Futher details have not been released by the operators. Amoco and UGI have staked a second well 1/2 mile southwest of the first. The #2 Texasgulf is scheduled to Tuscarora at about 13,000 feet.

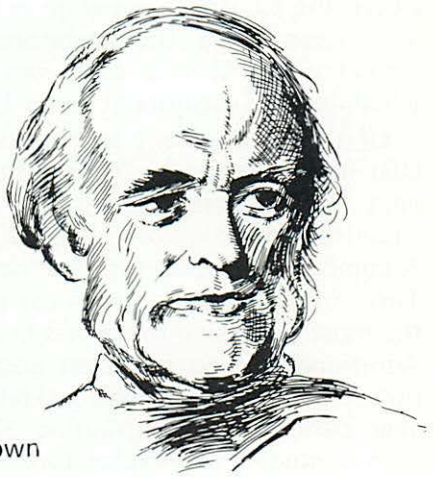
Of the 19 originally scheduled wells to be drilled by Amoco and UGI in Pennsylvania, 10 have been drilled. Four of these 10 wells have been successful with flow rates ranging between 1,380,000 cubic feet per day to 20,000,000 cubic feet per day of natural gas. A completion decision is pending for a fifth, Upper Devonian, well. Three of the 4 producers in the project are in Somerset County, but the most promising so far has been #1 Texasgulf in Centre County. Additional testing has been postponed until 1978, and after this time UGI has the option to extend the program for 3 separate one-year periods by contributing $2 million per year for additional seismic studies and exploratory drilling. The success of the Amoco-UGI program thus far, in particular the promise of the Texasgulf well, has shown that Pennsylvania has excellent gas production potential. Due to the demand and rising price of natural gas, exploratory drilling in Pennsylvania is expected to increase.

The U. S. Geological Survey has developed a "tote board" which compares past material consumption in the U. S. with anticipated future mineral consumption. The comparative figures for several major commodities were given as follows:

	Total U.S. Consumption over the past 200 yrs. (1776-1977)	Anticipated U. S. Consumption during the next 45 yrs. (1978-2023)
Iron	3.2 billion tons	5.5 trillion cubic meters
Copper	77 million tons	186 million tons
Sand & gravel	30.7 billion tons	91 billion tons
Mineral fuels (oil, gas, coal)	450 billion barrels	1083 billion barrels
Water	19.7 trillion cubic meters	36 trillion cubic meters

In every case the anticipated consumption for the next 45 years far exceeds the combined use over the past 200 years. Thus, geologists and the mineral industry have their work cut out for them if they are to meet the challenge of the anticipated needs of our society.

Charles Lyell and Pennsylvania



by William R. Brice
Associate Professor
Earth & Planetary Sciences
University of Pittsburgh at Johnstown

Charles Lyell (1799-1875), the great British geologist, mentor and friend of Charles Darwin, is well known to most geologists in this country for his book, *Principles of Geology* which helped turn geology into a unified science. However, it is not well known that Lyell made four visits to our continent; the first lasting from July 1841 till August 1842, and the second from September 1845 to June 1846 were the longest of his visits. The third was a short visit from August through November, 1852, and his last trip to these shores was for two months in 1853 when Lyell represented the British government at the New York Industrial Exhibition (Bailey, 1963).

After each of the first two extended visits Lyell published his observations and experiences, both geological and personal; *Travels in North America in the Years 1841-2* (1845) and *A Second Visit to the United States of North America* (1849). In both of these are to be found delightful, thought provoking, and amusing descriptions of life in these United States as Lyell found it in the middle of the 19th century.

Although his travels carried him and his wife from Nova Scotia to the Mississippi delta, it is his contact with the state of Pennsylvania that is of importance here. His first trip here was via Corning, New York. Lyell had been traveling in New York State with James Hall who took his leave at Geneseo. From there Lyell travelled by coach in which ". . .our coachman seemed to take pleasure in driving rapidly over deep ruts and the roughest grounds. . .," (Lyell, 1845, v. I, p. 46). On September 7 he reached the coal fields of Blossburg

(which Lyell spelled Blossberg). Here he was conducted through the area by the president of the local mine, Dr. Saynisch, who told him of shooting wolves from his bedroom window, and of a panther killed on the outskirts of Blossburg. However, Dr. Saynisch suggested Lyell shouldn't worry too much for ". . .the bears have not been seen in years." (Lyell, 1849, v. I, p. 51).

After Lyell had examined the coals and related rocks he was struck by the similarity which existed between coal measures in Pennsylvania and their European counterparts. Also, he was able to find the plant fossil *Stigmaria* in growth position in the underclay associated with the coal seams, which suggested to him that coal originated from plants growing on the spot. The same relationship of coal and *Stigmaria* had been noted in Wales as well.

After this short excursion into Pennsylvania, Lyell returned to New York and went to Albany. From Albany, after several side trips with James Hall, Lyell travelled by steamer on the Hudson to New York City, and then by railway to Philadelphia. There he found "the streets of Philadelphia rival the finest Dutch towns in cleanliness. . . ." (Lyell, 1845, v. I, p. 61). His stay in this fair city was not altogether a restful one, however, for every night for the five day stay ". . .there was an alarm of fire, usually a false one;. . ." (op. cit. p. 61). It all caused Lyell to comment, "they manage these matters as effectively at Boston without turmoil." (op. cit. p. 61).

From Philadelphia Lyell spent several days travelling in New Jersey with T. A. Conrad. Professor H. D. Rogers, of the first Pennsylvania Geologic Survey, met Lyell on October 3rd for a trip into the anthracite region. The party travelled up the Schuylkill River for a while over the gneissic rocks, then on up to Reading, and eventually to the town of Pottsville, ". . .a flourishing manufacturing town with the tall chimneys of numerous furnaces, burning night and day, yet quite free of smoke." (op. cit. p. 67).

In the neighborhood of Pottsville, Lyell found 13 seams of anthracite, ". . .several of which are more than two yards thick." (op cit. p. 67) He was also quite taken with what we refer to today as the Pottsville conglomerate, "a conglomerate of coarser texture than I had ever seen in any productive coal-measures, some pebbles of quartz being of the size of a hen's egg." (op. cit. p. 68) He found the *Stigmaria* associated with the coal here as well, together with what he refers to as the "British species" of *Pecopteris lonchitica* and *Neuropteris cordata.* At the Lehigh Summit Mine, he discovered that several of the coal seams ran together to form a single unit about 50 feet thick. At "Mauch Chunk, or the Bear Mountain" he found an

early strip mine, ". . .this remarkable bed of anthracite is quarried in the open air,. . ., the summit of the hill being 'scalped' as one of the miners expressed it." (op. cit. p. 69).

Apparently Sir Charles (as he was to become in 1848) was more than slightly skeptical as to the suggested thicknesses for some of the rock units in Pennsylvania. "I at first supposed that some deception might have arisen respecting the alleged thickness of the older fossiliferous rocks of the Appalachians,. . ." (op. cit. p. 70). But he was soon convinced ". . .that those Silurian and Devonian strata, which do not exceed in their aggregate thickness a mile and half in the State of New York, acquire more than three times that thickness in the Pennsylvania Alleghanies." (op. cit. p. 70).

Comparison of the fossils associated with the anthracite coal in the Pottsville area with what he had seen associated with the bituminous at Blossburg also convinced Lyell that the coal measures were indeed of the same age. In this he supported the idea put forth in 1831 by G. W. Featherstonhaugh. Lyell was quick to grasp the connection between the existence of the anthracite and the association of disturbed strata.

After leaving Pennsylvania in October of 1841, Lyell travelled from Boston to Charleston before returning to the state in January 1842. He was then to remain in Philadelphia until March of that year. This time his major problem was one of currency rather than geology. His dollar notes were not as sound as he had hoped. Paper money then was backed by banks, not the federal government, and if the bank folded, so did the value of the paper. Fortunately Lyell converted his paper money to gold less than four weeks before the four banks on which his money had been issued failed.

Even the Governor of Pennsylvania had his problems with the paper money of the day. He had come to Philadelphia because state funds being held for a debt payment were in a bank which failed a few days before payment was to be made. To make matters worse, no other bank in Philadelphia would advance the state the money to pay its bond debt.

Lyell spent the next few months in New England, and then came back to Pennsylvania from Frostburg, Maryland, passing General Braddock's grave, and following the roads of his disastrous march to Fort Duquesne and Pittsburgh, which Lyell spelled "Pittsburg." Along this route he travelled over ". . .Laurel Hill, so called from its rhododendrons. . ." (Lyell, 1845, v. II, p. 20) near the town of Union, ". . .its site being marked by a thin cloud of smoke,. . ." (op. cit. p. 20). Lyell was struck by being able to cross a great natural barrier, and find people on the other side speaking the same

language, with the same customs and political institutions. This was unlike what he had experienced in Europe.

From Union(town) the party went to Brownsville on the Monongahela River. The one thing that greatly impressed Lyell now that he was on the plateau was ". . .the richness of the seams of coal. . ." (op. cit. p. 22.) At Brownsville he describes an outcropping of the "Pittsburg" seam ten feet thick. Mines and mine openings dotted the river banks; thus taking advantage of the natural exposure. Lyell was able to follow this seam ". . .the whole way to Pittsburg, fifty miles distant." (op. cit. p. 25). He quotes the brothers Rogers as saying the coal fields on the plateau (including Virginia and Ohio) as covering ". . .fourteen thousand square miles."

On May 15, 1842, Lyell and his wife embarked at Brownsville for "Pittsburg." Their means of conveyance was a long, narrow, single-paddle steamer. From a bend in the river, ". . .we had a fine view of Pittsburg, partially concealed by the smoke of its numerous factories." (op. cit. p. 27). He described the city as ". . .a most flourishing town, and we counted twenty-two large steamboats anchored off the wharfs." (op. cit. p. 27). The same large coal seam was exposed in the hillsides, and also down near the river's edge was a small seam over which he found layers of shale and limestone with *Bellerophon, Leptaena* and *Spirifer,* just as he had seen a few days earlier at Frostburg, Maryland.

Not all trips run smoothly, and Lyell's was no exception. "The steamboats on the Ohio cannot be depended upon for punctual departure at the appointed hour like those of the Hudson or Delaware." (op. cit. p. 28). Because of this, he went by public coach to Wheeling where he hoped for better luck with the boats. Travelling towards Wheeling, Lyell noted the absence of "drift and boulders" which he had seen in great abundance in the north. However, what started unpleasantly was destined to become vexatious.

"On reaching one of those ennumerable towns to which, as if for the sake of confusion, the name of Washington has been given, I received the agreeable intelligence that, instead of travelling to Wheeling before sunset, I must wait till another mail came up in the middle of the night." (op. cit. p. 28). Thus with that somewhat sour note, on May 15, 1842, Charles Lyell and his wife took their leave of Pennsylvania.

During his second trip to the United States about three years later, Lyell did not spend much time in Pennsylvania. He stopped at Philadelphia in December of 1845 on his way to the south. The major topic of the day then was politics and not geology; the Oregon question, the state income tax which was ". . .weighing heavily on

Pennsylvania. . . ." (Lyell, 1849, v. I, p. 193). He found many Philadelphians had taken houses in New Jersey to escape the tax, but ". . .resorting in the winter season to Philadelphia for the sake of society." (op. cit. p. 193).

After a trip through the south, up the Mississippi and the Ohio, the Lyells arrived in "Pittsburg" (still with no "h") from Cincinnati; noting that the punctuality of the steamers was better this time than in 1842. On April 16, 1846, they approached Pittsburgh, in what appears to have been a typical Pennsylvania spring. "There had been so hard a frost in the night, that the roof of our steamer's cabin was glazed with a thin sheet of ice. . ." (Lyell, 1849, v. II, p. 225). He notes how well the city has recovered from a great fire between his visits. Lyell claims that Pittsburgh ". . .has every advantage save that of an atmosphere free from coal smoke." (op. cit. p. 225). Labor strikes and unrest were common then. "I learnt that there had recently been a strike of the factory girls here for ten instead of 12 hours of daily labor." (op. cit. p. 225).

The stay in Pittsburgh was brief, for the object of his visit was to see a set of fossil footprints at Greensburg. Through East Liberty, Wilkinsburg, and Adamsburg they travelled, stopping occasionally to look at coal outcrops. Greensburg was a town of about 1000 inhabitants, with five churches and three newspapers. A Dr. King conducted him to the quarry in Union township, six miles southeast of Greensburg, on the farm of Mr. Gallagher. Unfortunately, the original slab had crumbled, but Dr. King had made a set of casts which Lyell examined. The footprints had been found in a sandstone approximately one hundred feet below the Pittsburgh coal. They were associated with *Lepidodendron, Sigillaria* and *Stigmaria* both above and below. Lyell identified the prints as that of a reptile similar to the European cheirotherium. He calculated that other footprints found in the area had been sculptured by the local Indians.

On April 10, 1846, Lyell and his wife left Greensburg by stagecoach for Philadelphia. It seems that misfortune and Pennsylvania were synonymous for Lyell. On this journey, by night, two different coaches broke wheels due to the poor condition of parts of the road. (Too many potholes perhaps.) No journey would be complete without some misplaced luggage, and one of three bags was left behind after a night transfer to a new coach. After writing to three places to claim it, five days later the bag rather mysteriously appeared in his hotel room in Philadelphia and no one knew who brought it, or how it got there. Despite broken wheels and late

departures, Lyell had high praise for public conveyances in the U. S. Not once did he ever loose a package, even including some 30 boxes of geological specimens which were shipped, for all of them sooner or later were delivered to his door in London.

The first dawn of his journey from Greensburg came as the coach topped Laurel Ridge where the dense morning fog hung like lakes in the small valleys below. The coach travelled along the Juniata River for a while; eventually it reached Chambersburg where the Lyells, after a night's rest, transferred to a train and continued the journey at the "rate of fourteen miles per hour." This cross-state journey was to be Lyell's last direct contact with Pennsylvania. Although he did return to the U. S. on two other occasions, these were short visits and he had little time for geological activity.

References

Bailey, Sir Edward (1963). *Charles Lyell,* Doubleday & Company, Inc. Garden City, New York.

Lyell, Charles (1845). *Travels in North America, in the Years 1841-2; with Geological Observations on the United States, Canada, and Nova Scotia.* V. I and II, Wiley & Putnam, New York.

_____ (1849). *A Second Visit to the United States of North America,* V. I and II., Harper and Brothers, Publishers, New York.

Water Resource Film Available

A color sound motion picture on water resource investigations has been produced for the U. S. Geological Survey and is now available for public viewing. The 28-minute film explains how the USGS appraises the quantity, quality, distribution, and occurrence of surface and ground water.

The film focuses on how the USGS monitors and evaluates water resources through a nationwide hydrologic network, and how such data and research are used by local, state, and federal agencies to help solve a wide range of complex water problems. The subjects discussed include techniques for monitoring and analyzing water supplies, droughts, floodmapping, underground waste disposal problems, water use and consumption, and the need for water to meet a variety of industrial, domestic, and agricultural demands.

The film, titled "The Subject is Water," may be obtained on loan for viewing by contacting the U. S. Geological Survey's Branch of Visual Services, 303 National Center, Reston, Va. 22092.

Triassic-Jurassic Diabase Dike At Hellam, York County, Pennsylvania

by Jon D. Inners and J. Peter Wilshusen

Recent field investigations for an environmental geology study of the York metropolitan area have resulted in the discovery of a small Triassic-Jurassic diabase dike at Hellam, York County, Pennsylvania. The dike trends north-northeast and crosscuts lower Paleozoic rocks in the York Valley synclinorium of the Piedmont Province. Because of its narrow width, short length, and lack of topographic expression, the dike had not been detected by the geologists who had previously mapped the area (Stose and Jonas, 1933; 1939). Local landowners, however, have long recognized it as a band of "ironstone" crossing their properties.

The Hellam dike has an exposed length of about 2.25 miles and trends mainly N20E, changing toward NOE at the apparent north end (Figure 1). The southern limit of the dike is well defined about 1.0 mile west of Valley View Park and 1.1 miles south of Hellam Borough, but the north end is concealed by colluvium and dense woods on the south edge of the Hellam Hills. Rock formations intruded by the dike range from the Lower Cambrian Antietam quartzite to the Middle (?) Ordovician Conestoga limestone.

The best exposure of the Hellam dike is at Clayton Ely Emig Park on the north bank of Kreutz Creek (40°00'02"N/76°36'13"W, Columbia West 7 1/2-minute quadrangle) (Figure 2). There the dike is about 25 feet thick (as determined by a magnetometer traverse), although only 15 feet in the center of the dike are exposed. It dips about 75° toward N70W and intrudes basal limestone conglomerate of the Conestoga Formation. A small amount of float from the dike is present at the east end of a road cut in the Vintage dolomite on U. S. Route 30, about 0.25 mile north of Hellam Borough (40° 00'40"N/76°35'56"W, Columbia West 7 1/2-minute quadrangle). The thickness and orientation of the dike at this locality cannot be accurately determined.

The dike rock is a very tough, dark-gray, fine to medium grained, equigranular diabase of the York-Haven type (Smith and others, 1975). At Emig Park, the outcropping ledges are moderately jointed, with individual joints spaced mostly 6 inches to 1 foot apart; the most prominent joint set strikes N73W and dips 75° northeast. On weathering, diabase joint blocks develop a distinctive orangish-

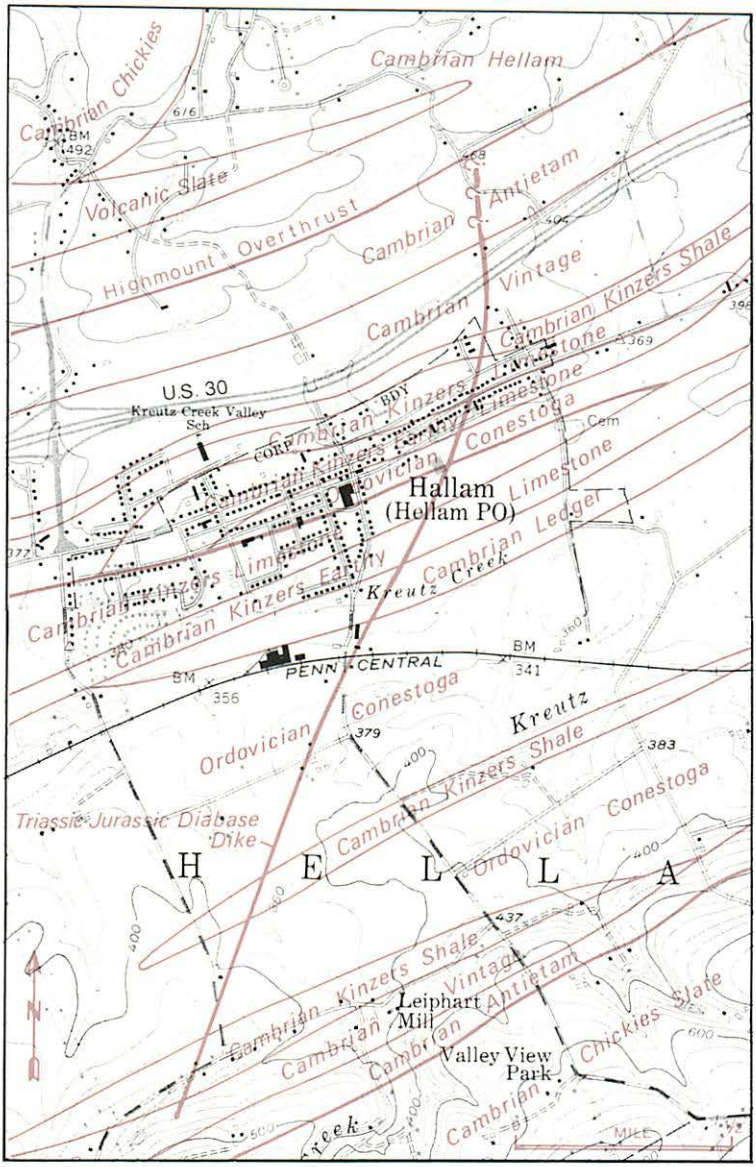


Figure 1. Geologic map of portions of Columbia West and Red Lion 7 1/2-minute quadrangles, York County, showing outcrop trace of Hellam dike. (Contacts of Paleozoic formations from Stose and Jonas, 1939, Plate 1).

brown rind, 1 to 2 mm thick, and exfoliate in thin sheets. Soil formed from the dike rock is stony, orange-brown, and clay-rich;

subrounded to subangular cobble- and pebble-size fragments of partially weathered diabase are common. These "stony patches" along the trace of the dike are minor annoyances to local farmers.

Figure 2. Exposure of Hellam dike at Clayton Ely Emig Park, Hellam. Note well-developed joints along which diabase is broken into angular blocks. Looking north-northeast along strike of dike; dip is steeply to left (northwest). White ruler is 12 inches (30cm) long.

In thin section (Figure 3), diabase from the middle of the dike at Emig Park is composed predominantly of laths of plagioclase and subhedral grains of pyroxene that range in size from 0.1 to 1.0 mm, averaging 0.25 to 0.5 mm. Texture is subophitic, and primary alteration is moderate. Mineral percentages are as follows (determined by a point count of 200 grains):

Plagioclase (laboradorite $An_{56\pm4}$)	40 percent
Pyroxene (mostly augite)	41 percent
Opaque oxides (ilmenite and magnetite)	5 percent
Sericite (alteration product of plagioclase)	10 percent
Chlorite (alteration product of pyroxene	4 percent
Biotite	trace
Apatite (needles in plagioclase)	trace
	100 percent

The mineralogy of this sample reflects a late stage in the differentiation and crystallization of the dike; a sample from the chilled margin would be more representative of the chemical composition of the original magma.

Plagioclase grains commonly exhibit slight zoning; augite is often twinned, and a few grains have cores of an earlier, altered pyroxene. The presence of mica (biotite and sericite) and chlorite were confirmed by X-ray powder diffraction analysis (Smith, oral communication).

The Hellam dike is one of several thin diabase intrusions of Late Triassic or Early Jurassic age that cut across the York Valley and the

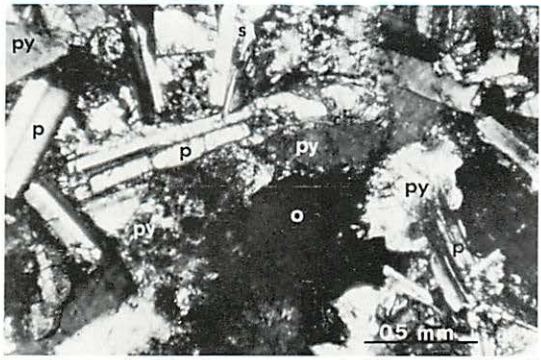


Figure 3. Photomicrograph of medium grained diabase from center of Hellam dike at Emig Park (p=plagioclase; s=sericite; py=pyroxene; cn=chlorite; o=opaque).

adjacent Lancaster Valley to the east. The two nearest dikes, both of which are roughly parallel to, but considerably longer than the Hellam dike, are the Stonybrook dike, located 2.0 miles to the west of Hellam, and the Safe Harbor dike, 14 miles to the east. The Stonybrook dike is Rossville-type diabase and the Safe Harbor is York Haven-type (Smith and others, 1975). The Hellam dike itself lies approximately on the same trend as a diabase dike of uncertain type that was mapped by Stose and Jonas (1933) on the north side of the Susquehanna River east of Maytown and Donegal Springs, Lancaster County. If the "Maytown" dike extends to the south bank of the Susquehanna, some diabase should be evident in the excellent exposures of Chickies quartzite near Wildcat Falls on the north side of the Hellam Hills, about 2.0 miles east of Accomac. The fact that neither Stose and Jonas (1933) nor Wilshusen found any trace of diabase at this locality indicates that the "Maytown" dike terminates on the north bank of the Susquehanna. Thus, even if the Hellam dike does continue for some distance north of the termination mapped on Figure 1, it is unlikely that it cuts completely across the Cambrian quartzites of the Hellam Hills and continues northward as the "Maytown" dike. A significant gap, or offset, between the two dikes is probable.

The writers thank Robert C. Smith II for assisting with the petrographic identification of minerals and for performing an X-ray diffraction scan of a powdered sample of diabase. Paul Ebersole led Inners to several float crops of the dike in cultivated fields near Hellam.

REFERENCES

Smith, R. C. II, Rose A. W., and Lanning, R. M. (1975), *Geology and geochemistry of Triassic diabase in Pennsylvania.* Geol Soc. America Bull., vol. 86, p. 943-955.

Stose, George W. and Jonas, Anna I. (1933), *Geology and mineral resources of the Middletown quadrangle, Pennsylvania,* U. S. Geol. Survey, Bull. 840.

Stose, George W., and Jonas, Anna I. (1939), *Geology and mineral resources of York County, Pennsylvania,* Pa. Geol. Survey, 4th ser., County Rept. 67.

SURVEY ANNOUNCEMENTS

GLACIAL BORDER MAPPING ON OPEN FILE

A report on the Late Wisconsinan glacial border in eastern Pennsylvania and its accompanying maps have been placed on open file at the Pennsylvania Geological Survey in Harrisburg. This report comprises maps at scale 1:100,000 on topographic base which show the trace of the Late Wisonsinan glacial border from the Delaware River, near Belvidere, north-westward to Bullis Mills on the New York border. Various types of glacial drift are mapped for about one mile north of the glacial border and older drift materials are noted in the area for about one mile south of the border. The report discusses the general nature, age and economic significance of the glacial materials and gives a detailed description of the length of the border. The original compilation sheets at scale 1:24,000 are also on open file. This report and maps, authored by G. H. Crowl and W. D. Sevon, provides new insight into the maximum extent of the last glaciation in Pennsylvania and some information about economically important sands and gravels. These materials may be examined in the offices of the Pennsylvania Geological Survey, Executive House, 101 S. Second Street, Harrisburg, Pennsylvania, 17101, but are not in a form suitable for reproduction.

MAP OF UNCONSOLIDATED SURFICIAL MATERIALS

A generalized surficial geology map of Pennsylvania has been compiled at a scale of 1:250,000 by W. D. Sevon and is now on open file at the Pennsylvania Geological Survey in Harrisburg. The several map sheets delineate 25 different surficial materials including spoil piles, rock ridges with colluvium slopes, Late Wisconsin till, Illinoian till and mixed sedimentary rocks, and mixed hard and soft sedimentary rocks with landslide deposits. The intent of the map is to indicate generally, what types of unconsolidated materials occur at the surface throughout Pennsylvania. An accompanying explanation presents a brief description of the nature of the mapped materials. These maps may be examined in the offices of the Pennsylvania Geological Survey, Executive House, 101 S. Second Street, Harrisburg, Pennsylvania 17101, but are not in a form suitable for reproduction.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

Arthur A. Socolow, *State Geologist*
Donald M. Hoskins, *Assistant State Geologist*

TECHNICAL SERVICES

Shirley J. Barner, *Stenographer*
Sandra Blust, *Librarian*
Jo Ann Bagshaw, *Typist*
John G. Kuchinski, *Draftsman*
Christine Miles, *Geological Editor*
Virginia Milewski, *Draftsman*
Mary A. Miller, *Stenographer*
Geary L. Sarno, *Draftsman*
Marjorie Steel, *Stenographer*
Albert Van Olden, *Draftsman*

ENVIRONMENTAL GEOLOGY DIVISION

Alan R. Geyer, *Division Chief*

Jesse Craft, *Geologist* (Pittsburgh Office)
Eugene D. Hess, *Geologist*
Donna M. Snyder, *Stenographer*
Larry E. Taylor, *Geologist*
Martha Walter, *Clerk*
John P. Wilshusen, *Geologist*

GEOLOGIC MAPPING DIVISION

Samuel I. Root, *Division Chief*

Thomas M. Berg, *Geologist*
Rodger T. Faill, *Geologist*
Albert D. Glover, *Geologist*
Jon D. Inners, *Geologist*
Joan Lenker, *Typist*
David B. MacLachlan, *Geologist*
Henry W. Schasse, *Geologist*
William D. Sevon, *Geologist*
Mark A. Sholes, *Geologist*
Viktoras W. Skema, *Geologist*
John H. Way, Jr., *Geologist*

MINERAL RESOURCES DIVISION

Bernard J. O'Neill, *Division Chief*

John H. Barnes, *Geologist*
John C. Benson, *Typist*
Leslie T. Chubb, *Laboratory Technician*
Robert C. Smith, *Geologist*

OIL AND GAS DIVISION

1201 Kossman Bldg.
100 Forbes Ave., Pittsburgh, Pa. 15222
Division Chief

Lajos Balogh, *Draftsman*
Cheryl Cozart, *Stenographer*
Elizabeth A. Eberst, *Typist*
Robert Fenton, *Laboratory Technician*
John A. Harper, *Geologist*
Louis Heyman, *Geologist*
John Petro, *Draftsman*
Robert G. Piotrowski, *Geologist*

TOPOGRAPHIC DIVISION

In Cooperation with The U.S. Geological Survey

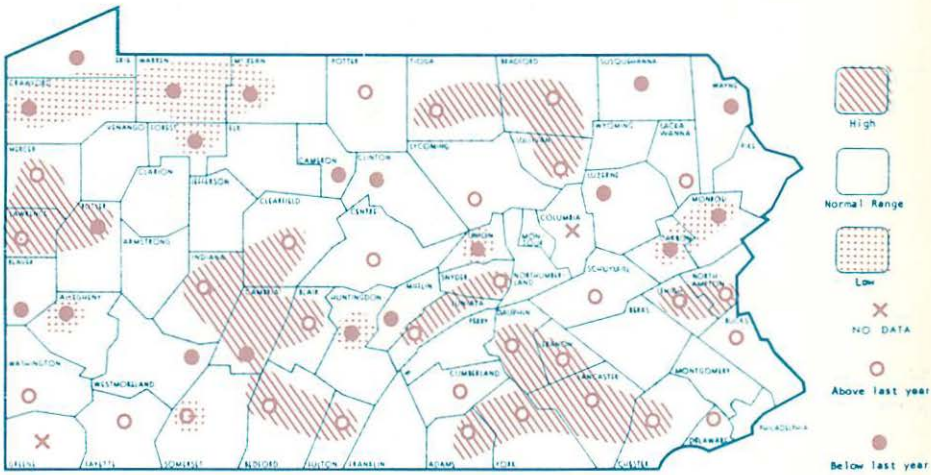
GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

GROUND-WATER LEVELS

FOR

MARCH 1978



BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY
DEPT. OF ENVIRONMENTAL RESOURCES
HARRISBURG, PA. 17120