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ON THE COVER: The Susquehanna River Overlook, along the Appalachian Trail on Peters Mountain, Duncannon 7½-minute quadrangle, Dauphin County. The overlook affords an outstanding view to the north of the Susquehanna River valley (foreground) and the Juniata River valley (background). The site is one of many included in the new Survey publication Outstanding Scenic Geological Features of Pennsylvania (see article on page 6). Photograph by J. P. Wilshusen.
From Lakes to Seas—The Beauty and Wealth of Our Commonwealth

Some years past a bus line traversed our Commonwealth, the Edwards Lakes to Seas Bus Company, which traveled from Cleveland to Pittsburgh, thence to Williamsport via Clearfield, and finally to Philadelphia, crossing Pennsylvania's Anthracite region. This was an unusual route, not the direct routes of today's rapid transit, but indirect and winding. The advantage to the traveler of this circuitous route was that a varied and large amount of our Commonwealth's scenery was able to be viewed.

In a recent publication of our Bureau (described in this issue), we provide more information on Pennsylvania's scenic features, some of which may have been seen by a bus sojourner who traveled from northwestern Pennsylvania to the tidal waters of Philadelphia. Along this route near Homewood is Homewood Falls, an example of many scenic falls of western Pennsylvania. In Clarion County at Alum Rock is an overlook on the Clarion River, reputedly one of the best places to view our western plateau topography. Side trips from the bus route would have led you to many of the famous springs of central Pennsylvania, such as Big Spring, Blue Spring, and Beaver Spring in Centre and Clinton Counties, which produce copious quantities of our most valuable resource—water. Further east near Jim Thorpe are Onoko and Chameleon Falls in the Lehigh River Gorge State Park—a delight for hikers. Near tidewater is Devils Pool in Philadelphia.

All of these sites are described with photographs and maps in Part 2 of Outstanding Scenic Geological Features of Pennsylvania. To the 389 sites described in Part 1 are added the 125 newly described sites of Part 2. A sojourner's trip along the old Lakes to Seas route accompanied by Parts 1 and 2 of this report will show you the true beauty of our Commonwealth.

Should you arrive at Erie, lake port of our Great Lake, perhaps you can get a glimpse of the dredge ship which sails from Erie and produces valuable mineral resources as described in this issue's mineral resources contribution.

Donald M. Hoellini
State Geologist
ERIE SAND AND GRAVEL COMPANY
Suction Hopper Dredging on Lake Erie

by Samuel W. Berkheiser, Jr.
Pennsylvania Geological Survey

Erie Sand and Gravel Company, Erie, Pennsylvania, has been providing valuable fine aggregates to northwestern Pennsylvania for nearly a century. In 1888, wheelbarrows, shovels, and perspiration supplied aggregate mined from the peninsula, Presque Isle, to the local market. This quickly led to hydraulic dredging around the harbor area by small, 100-ton boats. Company records contain dredging permits dating back to 1910. Today, about 1,100 cubic yards of quality (Type A) fine aggregate is dredged from Lake Erie about 8 to 15 miles northwest of Presque Isle in two shifts per day. At the end of the company's pier is moored the dredge Niagara (not to be confused with Admiral Perry's flagship Niagara), which was commissioned in 1897 and is reported to be the oldest vessel under certification by the U.S. Coast Guard.

GEOLOGY. Lake Erie, straddling Pennsylvania's international border with Canada, is the shallowest of the Great Lakes. Three ridges cross the lake bottom in a general northwest-southeast trend, one between Lorain, Ohio, and Pelee Point, Ontario, another between Cleveland, Ohio, and Erieau, Ontario, and a third between Erie, Pennsylvania, and Long Point, Ontario. These late Pleistocene end moraines formed during glacial advances into the Erie basin (Pope and Gorecki, 1982). The Erie-Long Point moraine is generally composed of clay-sized till overlain by sand and/or gravel and is an important economic resource for Pennsylvania. Lewis (1966) attributed it to the Port Huron advance, 12,900 years B.P. (before present), which raised the lake to a level about 160 feet higher than the present level, forming Lake Whittlesey. The overlying sand and gravel of the moraine is believed to be a lag deposit formed when the ice retreated to the point that water could drain through the Niagara River, resulting in the formation of Early Lake Erie (12,370 to 12,790 years B.P.), about 100 feet lower than the present level (Lewis, 1966; Lewis and others, 1966). This sand and gravel averages about 7.5 feet in thickness (Pope and Gorecki, 1982) and may contain between one-half billion and 1 billion tons of valuable resource. In contrast, most of the commercial land-based sand and gravel deposits in northwestern Pennsylvania are much smaller and contain older (20,000 years B.P.) glacial material related to the Kent advance. A natural trench or breach in the Erie-Long Point moraine about 4 miles off-
shore physically separates it from the changing and dynamic Presque Isle Peninsula.

**MINING.** Erie Sand and Gravel Company operates the *J. S. St. John*, a suction hopper (sand sucker or hydraulic) dredge out of Erie Harbor. Commissioned as a U.S. Navy tanker in 1949, it was converted during the 1960's to a dredge. Maximum dredging capacity per shift is about 550 cubic yards, or 750 tons, which requires about 4 to 6 hours of pumping time to collect. Approximately 200,000 tons of sand is mined annually.

The dredging machinery itself is rather simple in concept (Figure 1). A 16-inch-diameter pump powered by a 200-horsepower diesel engine sucks material from the lake bottom end moraine through a hood that limits the maximum size of the material to about 3 inches in diameter. The pumpman's duty is to regulate a smooth flow of the material that is less than 3 inches in diameter over the screening trough by adjusting the vacuum (which regulates the water content) and the height of the hood above the substrate. Sand passes through the screens in the trough and exits into the hold of the ship through adjustable gates located below each screen. The deckhand regulates the flow of sand over the screens and into the hold by adjusting the four gates on each of the eight identical screens. Oversized material is returned to the lake. The captain, through his expert eye and past

![Figure 1. Sketch of the J. S. St. John showing essential equipment of a suction hopper dredge.](image-url)
experience, finely tunes the whole system by monitoring the size of the material coming out of the gates (Figure 2) and making adjustments to speed and course. The captain's skill in knowing where the correct size of material can be found within the permit area is essential for efficient operation. A typical pass, when first initiating a dredging run, is an oval circuit about 1 mile long and one-fourth mile wide. Once production is steadied, the ship may sustain a consistent flow of sand by turning to port (left) in circles of small diameter. The ship's engineer is responsible for keeping the diesel engines running and serviced (every hour), and for adjusting ballast as required in the hold and in four main tanks located along the ship's longitudinal axis.

Figure 2. Captain Ostroski sampling dredged sand as it exits the gates below the screening trough. Insert shows a generalized location map of the region.

The mining season generally extends from May through November. Twenty-foot seas are not uncommon on Lake Erie; the St. John will not usually go out in seas greater than 6 feet. The St. John has a maximum speed of about 8 knots (10 miles per hour), and it generally takes about 5 miles to reach this speed when fully loaded.

The U.S. Army Corps of Engineers, the Bureau of Dams and Waterway Management within the Pennsylvania Department of En-
environmental Resources, and the Pennsylvania Fish Commission regulate the commercial exploitation of this resource. The “Erie Grounds,” or permit area, trends west-northwest to south-southeast and is an irregular zone about 6 miles long and about 2 miles wide, starting at a point about 8 miles northwest of Presque Isle. The St. John is equipped with radar and Loran C navigation devices which give reasonable location accuracy (±50 feet). The captain is required to log in his position in Loran C or radar coordinates every half hour, and there is little chance of straying outside the permit area. The Fish Commission collects a royalty of 10 cents per ton or 15 cents per cubic yard.

MARKETING. Upon returning to port, the screening trough on the St. John is pushed aside and the 3-hour-long process of off-loading sand by crane and clamshell-bucket to stockpiles begins. The crane operator is responsible for assuring a proper blend of material in the stockpiles, depending on the final end-use.

About 40 percent of the product mined from Lake Erie is sold as PennDOT-approved, Type A concrete sand. “Block grit,” used for the manufacture of concrete building blocks, mason sand, used as mortar mixes, and “snuff sand,” used as a mineral filler by GAF Corporation, round out the product line for the dredged material. The material dredged 8 to 15 miles offshore is in no way affecting the dynamic processes that are causing Presque Isle beaches to migrate eastward. In fact, sand and gravel from the Erie-Long Point moraine should work well in beach replenishment projects because of the very low clay content and natural gradation. Through other corporate endeavors, Erie Sand and Gravel Company also transports and markets annually about 200,000 tons of limestone from the same pier. This includes fine and coarse aggregate shipped in its own vessels from Marblehead, Ohio, and Drumond, Michigan.

Thanks is extended to the day crew of the J. S. St. John, Captain John Ostroski, Chief Engineer Richard Dudek, Pumpman William Straub, and Deckhand Glen Weist, for their cooperation and patience in gathering data for this article. Thanks is also given to Sidney E. Smith, Jr., President, and Sandy E. Smith III, Marketing Manager, of Erie Sand and Gravel Company for their time and cooperation in preparing this article.

REFERENCES
NEW SURVEY PUBLICATION

OUTSTANDING SCENIC GEOLOGICAL FEATURES OF PENNSYLVANIA
PART 2

A second volume of Outstanding Scenic Geological Features of Pennsylvania has been released. It is Pennsylvania Geological Survey Environmental Geology Report 7, Part 2, 1987. Written by Alan R. Geyer and William H. Bolles, both of whom authored the first volume, this new publication contains the location and a brief description of 125 additional sites throughout the state. Parts 1 and 2 together of Outstanding Scenic Geological Features of Pennsylvania now provide a comprehensive listing and description of 514 of the best known geological sites, arranged by physiographic province.

Also included are two appendices of named springs and waterfalls in the state. In addition to location, yield and data source are given for springs and the height is given for waterfalls.

Both of these publications are available from the State Book Store, P. O. Box 1365, Harrisburg, PA 17105. The price of EG 7, Part 1 is $6.05 (plus 36¢ tax for Pennsylvania residents), and the price of EG 7, Part 2 is $3.95 (plus 24¢ tax for Pennsylvania residents).

⇒ Indian Chief Rock, Blair County, one of many sites described in Environmental Geology Report 7, Part 2.
THE GEOGRAPHIC NAMES
INFORMATION SYSTEM

The Geographic Names Information System (GNIS) is an automated data system, comprising five separate data bases, that has been developed by the U.S. Geological Survey to compile, standardize, and disseminate information on geographic names in the United States and its territories. All known places, features, and geographic areas that have been identified by a proper name are included in GNIS.

The primary data base in GNIS, called the National Geographic Names Data Base, contains more than 2 million names of places and features in the United States. The information is filed by state, and the compilation of data for each state is divided into two phases. During Phase I, all geographic names from U.S. Geological Survey topographic maps are entered into the system. In Phase II, historical and variant geographic names as well as names and features from sources other than U.S. Geological Survey topographic maps are added. After both phases have been completed for a state, the results are published as a separate volume of Professional Paper 1200, The National Gazetteer of the United States of America. Presently, state volumes are available for New Jersey, Delaware, and Kansas; the remaining states are scheduled for completion in the next 8 years.

Phase I data are currently available for Pennsylvania as bound computer lists priced at $34.00 or as magnetic tape priced at $50.00. An example of the descriptive elements contained in the computer listing for each geographic name is shown below. Special searches of the system for specific descriptive elements may be requested, and the results are available as computer printouts or magnetic tapes.

The data base may be accessed in the regional information offices of the National Mapping Division of the U.S. Geological Survey. For further information, contact GNIS Manager, 523 National Center, Reston, VA 22092 (telephone 703-860-626).

Example of printout showing Phase I data for a geographic feature in Pennsylvania.
"JAWS" IN PENNSYLVANIA:

Physonemus and Other Vertebrate Fossils from the Vanport Limestone of Lawrence County, Pennsylvania

by William Marks, Pennsylvania Department of Environmental Resources, Ebensburg, Pa., and Maryjo Peluso-Marks, Consulting Geologist, Loretto, Pa.

The Middle Pennsylvanian Vanport Limestone is widely exposed in quarries, highway and railroad cuts, and stream gullies throughout Lawrence County. Many of these outcrops contain a rich and varied marine fauna, including brachiopods, gastropods, bryozoans, cephalopods, corals, and crinoids. Where the limestone layers have been open to the atmosphere for a number of years, countless invertebrate fossils retaining great detail can be found weathered out of the rock matrix.

Much rarer, however, are the vertebrate fossils noted at three localities in the central part of the county (Figure 1). These fossils consist of detached teeth and spines of extinct sharklike creatures (Class Chondrichthyes) that prowled the Vanport sea in search of prey to satisfy their ravenous appetites.

Teeth of the ancient shark Petalodus (pictured in Lesley, 1890) were found at all three outcrops. When reconstructed, these teeth are triangular in shape, approximately 2.5 cm in length and width, and convex on one side and concave on the other (Figures 2 and 3). Specimens are clearly visible in the matrix because of their

Figure 1. Location map. Collecting localities are marked by X's.
characteristic “robin’s egg” blue color. *Petalodus* was apparently a pavement-toothed shark of the ?Order Bradyodonti (Romer, 1966).

Figure 2. *Petalodus*, convex side of tooth, McConnells Mills.  
Figure 3. *Petalodus*, concave side of tooth, McConnells Mills.

Several teeth of another type of shark were also found at the same localities. The teeth have a lobe shape and are approximately 2.5 cm in width. One side is minutely porous (Figure 4), and the other exhibits a network of canals. The collected specimens fit the description of the teeth of *Deltodus*, an ancestor of the modern Chimaera.

Figure 4. *Deltodus*, showing porous surface, McConnells Mills.
or ratfish. These teeth were apparently used for grinding and crushing the hard-shelled invertebrates that were the basic diet of the ancient Chimaerans (Lund, 1970).

The most unusual fossil found in the Vanport at the Lawrence County localities is a large fish spine from the McConnells Mill outcrop (Figure 5). The spine is conical and flattened and approximately 5 cm long. Except for a smooth proximal end, it has a scaly, "beadlike" covering over most of its length. The spine is nearly identical to the curved specimen of Xystracanthus illustrated in Lesley (1890, p. 1283). Romer (1966) assigns such spines to the hybodontoid shark Physonemus. To the best of our knowledge, this is the first documented occurrence of this genus in the Vanport Limestone. Physonemus has been previously reported from Carboniferous rocks in the mid-continent region.

**Figure 5.** *Physonemus*, showing "beadlike" covering on spine, McConnells Mills.

The authors thank Dr. Robert Hinds, Slippery Rock University, and Dr. Steve Bill, formerly at Slippery Rock, for supervising the original research. Drs. John Harper and Jon Inners of the Pennsylvania Geological Survey, and Ms. Kathleen Abel, formerly with the Survey, assisted in preparing the article.

**REFERENCES**

magnetic susceptibility of precambrian basement rocks in northwestern pennsylvania

The Oil and Gas Geology Division of the Pennsylvania Geological Survey has obtained measurements of the magnetic susceptibilities of selected samples of Precambrian basement rocks from northwestern Pennsylvania (Figure 1). Samples for which susceptibility measurements were obtained were collected from the Survey's core and sample libraries in Pittsburgh. Susceptibility measurements were made by Dr. Hallan C. Noltimier, Professor of Geology at Ohio State University, at the request of Donis Snellenberger, geophysicist with the Mitchell Energy Corporation, Columbus, Ohio.

Magnetic susceptibility is a measure of the degree to which a material is attracted to a magnet. The degree of magnetization of rocks is the product of their susceptibility and the strength of the earth's magnetizing field. Results of the susceptibility measurements reveal the relative magnetic strength of the Precambrian basement in northwestern Pennsylvania. When obtaining or interpreting magnetic data in that region, the data presented here can aid in determining if any observed anomalies are structural or compositional in nature. The magnetic susceptibility values presented here also compliment the data presented in Pennsylvania Geological Survey Information Circular 62, *The Precambrian in the Subsurface of Northwestern Pennsylvania and Adjoining States*, by T. E. Saylor.
## Lithology and Magnetic Susceptibility of Precambrian Basement Rocks from Northwestern Pennsylvania

<table>
<thead>
<tr>
<th>Well name</th>
<th>Location</th>
<th>Lithology</th>
<th>Susceptibility (gauss/oersted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hammermill No. 2</td>
<td>Erie Co.</td>
<td>Biotite gneiss intruded by microcline granite; magnetite content = 0–&lt;1%</td>
<td>$2.52 \times 10^{-5}$</td>
</tr>
<tr>
<td>Kardosh No. 1</td>
<td>Crawford Co.</td>
<td>Quartz-biotite gneiss; abundant hematite grain coats; magnetite content = 1%</td>
<td>$2.06 \times 10^{-3}$</td>
</tr>
<tr>
<td>Temple No. 1</td>
<td>Mercer Co.</td>
<td>Quartz-biotite gneiss; numerous lenses and veins of biotite granite; magnetite content = 1–2%</td>
<td>$1.46 \times 10^{-4}$</td>
</tr>
<tr>
<td>Fleck No. 1</td>
<td>Mercer Co.</td>
<td>Quartz-biotite gneiss; numerous lenses and veins of biotite granite; magnetite content = 1–2%</td>
<td>$1.21 \times 10^{-4}$</td>
</tr>
</tbody>
</table>

### Surplus Topographic Maps

The Survey has accumulated a quantity of outdated 7½-minute-quadrangle topographic maps for northern Pennsylvania. We are offering them, in limited numbers, to teachers and troop leaders.

If you are interested in receiving a limited quantity of these maps, write to the Department of Environmental Resources, Bureau of Topographic and Geologic Survey, P. O. Box 2357, Harrisburg, PA 17120. Maps will be supplied as long as they last on a first-come, first-served basis. Orders for specific quadrangles cannot be accepted.
Two significant new publications dealing with the mineral problems and outlook of the United States mining community have recently become available. *The Mineral Position of the United States: the past fifteen years* (U.S. Bureau of Mines, 1986) is the 1985 Annual Report of the Secretary of the Interior and contains a review of the changes that have taken place in the mineral position of the nation since the Mining and Minerals Policy Act was enacted by Congress in 1970. This 45-page report is available free while supplies last from the U.S. Bureau of Mines, Division of Publications, 4900 LaSalle Road, Avondale, MD 20782-3393. Some of the major conclusions in this report are listed below:

—the U.S. mineral industry is undergoing significant structural change,

—less of the basic metals are needed, although the need for construction materials to build new infrastructure and maintain roads, bridges, and buildings is expected to increase,

—the outlook for increased growth is better for the nonmetallic minerals than for the basic metals, but the growth in demand for advanced metals or rare-earth metals could be considerable,

—two countries that may change the pattern of worldwide demand for and supply of minerals are China (producer) and the U.S.S.R. (potential consumer),

—new technology will play an increasingly important role in the competition for world markets, and

—U.S. companies may have to become more multinational, especially as joint ventures with foreign partners, risk-sharing arrangements, and diversification become more common.

Eugene N. Cameron, the author of *At the Crossroads—The Mineral Problems of the United States* (published by John Wiley and Sons, 1986), takes a somewhat contrasting position regarding the future of the mineral industry of the United States and elucidates both some familiar and some new mineral trends. By systematically examining the role of mineral resources (both fuel and nonfuel) in our economy,
including their nature, uses, reserves, and the outlook for future supplies, Cameron concludes that domestic policies must be modified to create an environment more favorable to the discovery and development of new mineral deposits. "Otherwise the remainder of the century will see a decline in the U.S.'s ability to supply its mineral needs from its own resources. Decline in industrial strength and diminished national security will inevitably follow."

From a supply-and-demand standpoint, the future of Pennsylvania's current annual $800 million nonfuel-mineral industry appears brighter than ever. However, a balanced approach to mineral development and environmental conservation will be needed if Pennsylvania is to continue as a major supplier of quality mineral commodities.

REFERENCES


New Price for Oil and Gas Base Maps

In 1985, the Pennsylvania Geological Survey made available to the public a series of 7½-minute oil and gas base maps. These maps, which are compiled on 1:24,000-scale topographic bases, replaced the 15-minute series of base maps that had been on sale since 1970. The 7½-minute maps cover the oil and gas fields of western Pennsylvania and the areas of central and eastern Pennsylvania where exploratory drilling has occurred.

The 7½-minute oil and gas base maps are available to the public as ozalid prints. Effective June 1, 1987, the price of the maps is $3.75 each plus shipping costs.

Details for purchasing the maps can be obtained by contacting the Pennsylvania Geological Survey, Oil and Gas Geology Division, 121 South Highland Avenue, Pittsburgh, PA 15206–3988, telephone 412–645–7057. When requesting copies of the maps, please provide the 7½-minute topographic map name of each map desired.
During 1986, twenty-two 7½-minute topographic maps were photorevised by the U.S. Geological Survey. This was accomplished as part of the U.S. Geological Survey-Pennsylvania Geological Survey cooperative program to prepare and maintain topographic map coverage for Pennsylvania.

The 7½-minute “topos” are used for areas where detailed base maps are needed. They are most often utilized by professionals for geologic mapping, engineering planning, water-quality research, and ecological studies, but they are also widely used by campers, hikers, hunters, and other persons engaged in outdoor activities.

There are 879 topographic quadrangle maps for Pennsylvania, each covering an area 7½ minutes square (a minute is one-sixtieth of a degree in latitude and longitude). The map scale is 1:24,000 (one inch equals about 2,000 feet), and each quadrangle represents an area of between 49 and 71 square miles.

Except for Blue Ridge Summit, Emmitsburg, and Philadelphia, the areas of photorevision are in north-central Pennsylvania.

The topographic maps can be obtained for $2.50 each by writing to U.S. Geological Survey, Map Distribution, Box 25286, Federal Center, Denver, CO 80225. Prepayment is required; checks should be made payable to U.S.G.S. For more information, contact the Pennsylvania Geological Survey library (NCIC Affiliate) at 717-783-8077.

New Staff of the Pennsylvania Geological Survey

Caron O’Neil

Caron O’Neil joined the Survey as Assistant Geological Editor in September 1986. Prior to this, she was a resident of Pittsburgh, where she attended the University of Pittsburgh. Caron started her post-high-school education as a chemical engineering major at Lehigh University. The jump to geology and the subsequent transfer to Pitt came 3 years later, after Caron took, and was taken by, her first geology course. She received a B.S. in geology (with a Math minor) in December 1981, and an M.S. in geology in December 1986.

Caron’s geologic employment history includes three years as a teaching assistant, and two short-term contracts with the Department of Energy. Her teaching duties consisted of preparing and conducting physical geology, historical geology, geomorphology, and structural geology labs. The contract work involved lineament studies with the Morgantown Energy Technology Center.

Loretta Rossum

Loretta Rossum joined the staff of the Survey in April 1987. She will work primarily with the Environmental Geology Division as a Clerk Typist with additional assignments in the Administrative Division when needs arise.

Loretta is a native of Harrisburg and has attended school here and business college in Detroit, Michigan. While she was a student at John Harris High School she received the Powelson Business Award for academic achievement.
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GROUNDWATER LEVELS
FOR
MAY 1987

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