PENNSYLVANIA GEOLOGY

THE PENNSYLVANIA GEOLOGICAL SURVEY VOL. 15/2

COMMONWEALTH OF PENNSYLVANIA
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OFFICE OF RESOURCES MANAGEMENT
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TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

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ON THE COVER: View into 15 foot deep excavated sinkhole in Conestoga limestone, Millersville Borough, Lancaster County. Open "throat" which caused the surface collapse is shown in center of photo. Story page 15-16. Photo courtesy of J. P. Wilshusen.

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Editor, Arthur A. Socolow; Associate Editor, Donald M. Hoskins.

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VOL. 15, NO. 2 **APRIL, 1984**

FROM THE DESK OF THE STATE GEOLOGIST

ENVIRONMENTAL IMPACTS — NOT ALWAYS BAD

It is commonly assumed these days that when man modifies the environment it is harmful, while nature's treatment of the environment is generally presumed to be proper and beneficial. But is that really always the case?

Strip-mining laws in many states require the land surface to be restored to original, natural slope or contour. Yet the original slope in many instances was one that was fairly steep and subject to rapid erosion and gullying action. Long ago the Far East learned that terraced slopes resulted in less erosion and more arable, workable lands than natural, inclined slopes. Thus man, when permitted, can create less wasteful and more usable slopes than nature.

Eastern Pennsylvania has had two lessons in recent years of major streams that had benefited from man's activities. These streams had acquired year-round, uniform flow characteristics as they received fresh, pumped water from nearby mining operations, a quarry in one case and a deep mine in the other instance. A stable fish population had developed in the streams, capable of supporting sport fishing. Then, as the mines closed down for economic reasons and the pumping to the streams ceased, the streams have reverted back to their extreme seasonal flow variations, too low in the summer to support a significant fish population, or even to maintain a water quality sufficient for the human consumption which had developed during the augmented flow era.

And even as it becomes more and more difficult to build any major dams along our nation's rivers for fear of adverse environmental impact, we are losing the flood control and recreational benefits from the impoundments provided by dams. As many of us know from personal experience, floods are devastating natural phenomena. If man is capable of mitigating the destruction of floods, including the vast tonnages of soil and farmland which are washed away by such natural events, then it should be recognized that man's dam construction efforts may merit favorable consideration, rather than "knee-jerk" negative responses.

Before I am inundated by shrieks of horror and examples of man's inexcusable mayhem upon nature, permit me to stress that I do not support nor encourage an unrestrained assault upon nature's wonderlands and processes. I simply wish to note that nature is not always kind nor the best engineer. There are times when man can improve on nature. In the biological field we see it in man's attempts to deal with pestilence and deformities. In the meteorological world we try to cope with hurricanes, blizzards, droughts, and heat waves. And in the world of geology and hydrology, we should try to mitigate the affects of erosion, flooding, earthquakes, landslides, etc. We may not be able to stop those phenomena, but when permitted to do so, we can design procedures and structures that will limit the costly and harmful impacts of some of nature's processes. It is well to keep in mind that not all of man's impacts on the environment are harmful.

Arthur A. Socolow

What Does It Take To Make A Brick? The Watsontown Story

by S. W. Berkheiser, Jr. and J. D. Inners
Pennsylvania Geological Survey

For more than 75 years, the community of Watsontown on the West Branch of the Susquehanna River in Northumberland County has been involved in brickmaking. At the present time two companies, Watsontown Brick Co. and Glen-Gery Corp., operate brick plants and complementary shale pits in the area (Fig. 1). Watsontown Brick Co. is a family-owned business established by Charles E. Fisher, Sr., in 1908, one mile south of town. Glen-Gery Corp., one of the largest brick manufacturers in Pennsylvania, acquired their plant and quarries from Keystone Brick Company in the mid 1940's, and has operated continuously at the north edge of Watsontown since that time. Combined, these two businesses employ approximately 125 people and are capable of producing more than 150,000 bricks per day.

Watsontown owes much of its importance as a brick-manufacturing center to its favorable geologic location. Several Silurian age shale formations in the area provide good raw materials for making brick, and folds in the area cause repetition and broadening of the outcrop belts of these formations (Fig. 1).

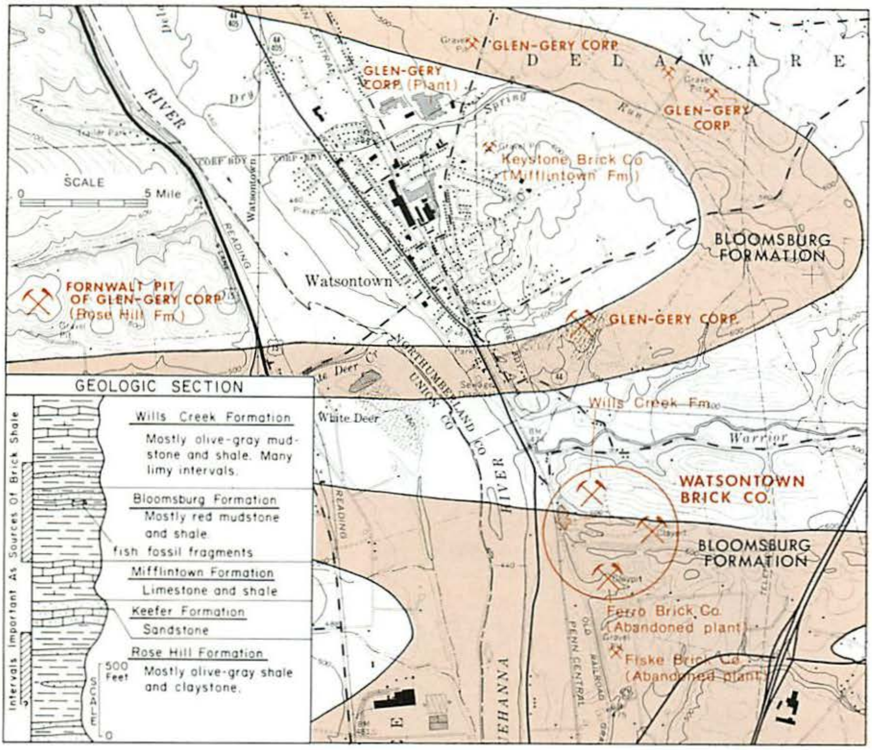

Figure 1. Simplified geologic map and section of Watsontown area, showing outcrop of Bloomsburg Formation, active (large symbols) and abandoned (small symbols) shale quarries and location of old and current brick works. (Geology from Inners, in preparation)

The Bloomsburg Formation, the principal source of brickmaking material, originated as a fine-grained, red mud that was rapidly deposited in a shallow, brackish water embayment or lagoon approximately 410 million years ago (Hoskins, 1961). In marked contrast to most red-bed sequences in the state, the Bloomsburg of central Pennsylvania contains abundant vertebrate and invertebrate fossil remains, including fragments of head shields of extinct cyathaspid fish, which were recently discovered in the Watsontown Brick Co. quarry (Hoskins, 1983). Less important sources of brick shale, but still extensively quarried, are the Rose Hill and Wills Creek Formations. Olive-colored shales from these two formations are blended as needed with the red Bloomsburg mudstones to improve plasticity. Watsontown Brick Co. presently mines shale (principally the Bloomsburg) at the rate of about 150 tons per day to feed a new kiln, which has a capacity of 70,000 to 80,000 bricks per day. A cored, standard-size brick (2¼″ by 3½″ by 8″) requires about four pounds of raw material.

In order to better understand the process of brick manufacture, let us follow a brick through the Watsontown Brick Co. plant (Fig. 2) from its origin as a "block" of newly quarried Bloomsburg mudstone to the point that it emerges as a finished product, stacked and ready to be transported to the consumer (Fig. 3).

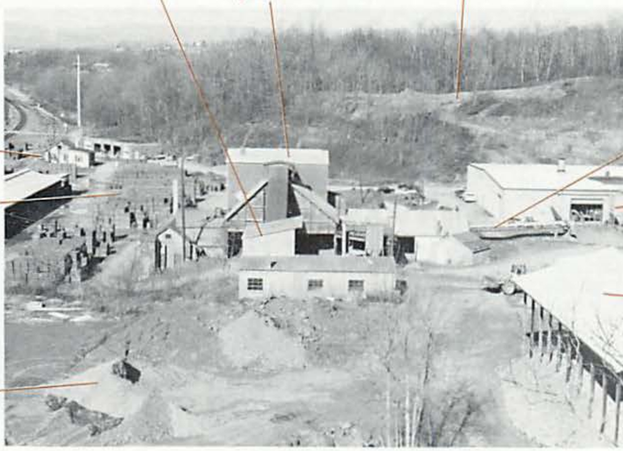

Figure 2. View of Watsontown Brick Company operation from the ridge south of the plant looking north.

After excavation and haulage to the plant, the mudstone is stockpiled. From the stockpile it goes to the first stop in its transformation from mudstone to brick, the primary roller crusher. The material is further reduced to about -25 mesh (0.028 inches) in a series of dry pans (roller-type crushers). This is followed by screening to obtain the proper gradation for ease of manufacturing and producing a sound product.

A pug mill (bladed screw-type machine used for mixing water and clay) is automatically fed with the shale-mix, water, and an additive to enhance green strength (strength of unfired brick) and workability. From the pug mill, the shale-mix is extruded like toothpaste onto a conveyer belt. The die through which the shale-mix is extruded controls the size and surface texture of the brick being manufactured. Additional surface coatings, such as sand, can be added before the extruded column is cut into slugs by a guillotine cutter. The slugs are then conveyed to the computerized setting machine which automatically cuts, stacks, and loads the green brick onto the kiln cars. Each kiln car contains 6,000 standard-size bricks stacked 12 high. The computerized journey through the dryer takes

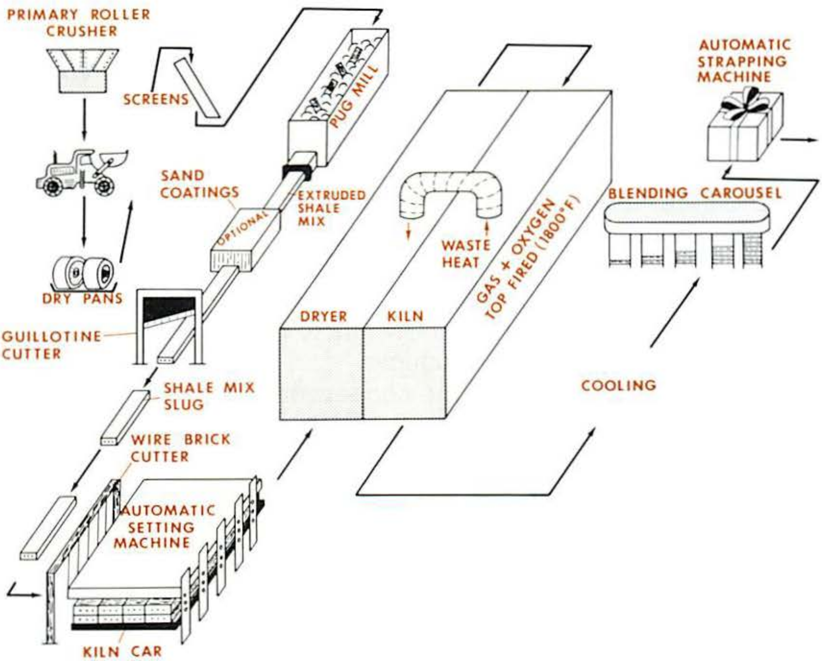

Figure 3. Simplified flow chart of the brick making process at Watsontown Brick Co., Watsontown, Pennsylvania.

about 1½ days. The dryer uses waste heat from the adjacent tunnel kiln to dry the bricks prior to firing (each brick loses about 14 oz. of water). Firing in the kiln is accomplished at a temperature of about 1800°F and takes about two days. The kiln is presently fueled by a mixture of natural gas and oxygen. Oil is a standby fuel, and provisions for coal use were incorporated into the design. Flashing (coloring of the brick in an oxygen-poor atmosphere) is done in the tunnel kiln and is generally restricted to one side of the kiln and to one or two rows of cubes on a kiln-car. A cube equals 500 standard size bricks. Kiln-cars are moved automatically through the dryer, tunnel kiln, and unloading stations. Mixing of the flashed bricks with the more abundant unflashed bricks is semi-automatic with men unloading the bricks from the kiln-car to a monorail carousel which feeds an automatic strapping machine.

In the early 1950's, Watsontown Brick produced about 70,000 to 80,000 bricks per day in 12 coal-fired periodic kilns (4 beehives, 8 rectangulars), and employed 112 people. Today the same production is achieved using 1 tunnel kiln and 30 people. The operation is also much more energy efficient. Watsontown Brick's efficiency is readily apparent from the size of their market which includes such places as Detroit, Chicago, Baltimore, Washington, D.C., Virginia, North Carolina (a major U.S. producer of bricks) and Canada, as well as the entire northeastern United States.

Initially, paving bricks were the main product made at Watsontown, and these helped surrounding communities keep their streets free of mud. Present products are for home and commercial construction. Adjusting to changing end-uses, manufacturing techniques, energy sources, and economic cycles, has helped the community of Watsontown and Pennsylvania to remain a major supplier of quality industrial mineral products.

We gratefully acknowledge the cooperation and information provided by Charles E. Fisher, Watsontown Brick Company and Jon R. Moyer, Glen-Gery Corporation.

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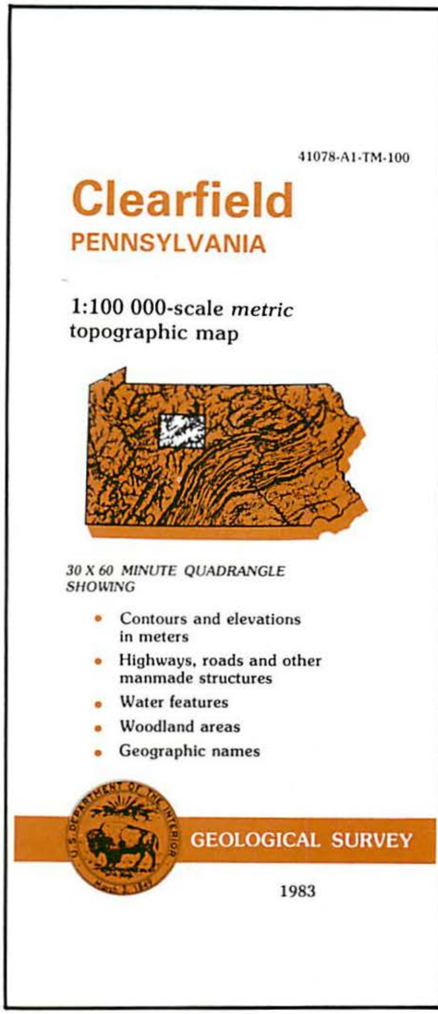
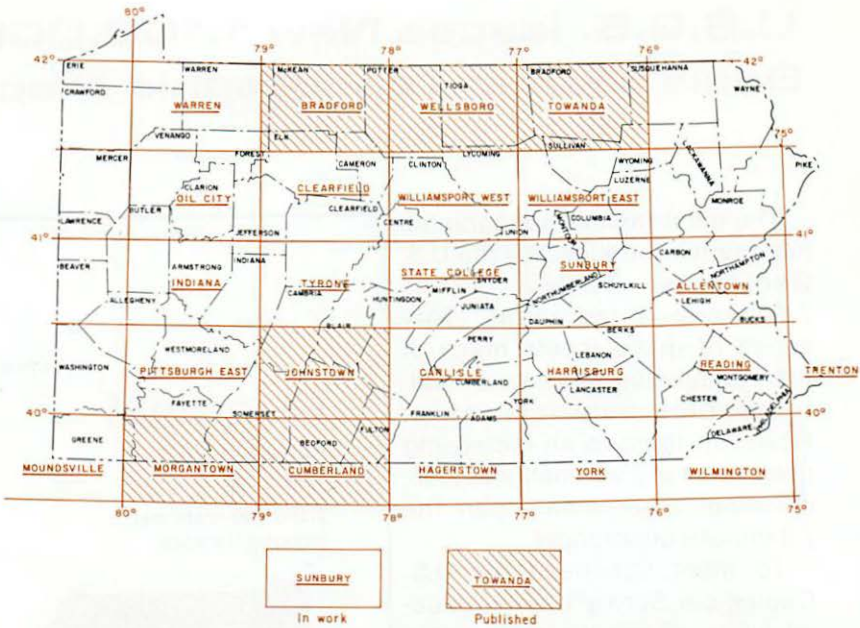
U.S.G.S. Issues New 1:100,000 Scale Metric Topographic Maps



The most familiar topographic map series produced by the U.S. Geological Survey is the 7.5-minute quadrangle. This series of maps meets many of the requirements users of cartographic materials have. However, there is an increasing need for maps at smaller scales, covering larger areas than the 7.5-minute quadrangle.

To meet this need the U.S. Geological Survey has introduced a 30 x 60-minute topographic quadrangle map series which is derived from the 7.5-minute maps. The scale of these maps is 1:100,000. (1 centimeter on the map equals 1 kilometer on the ground or about 1.6 miles) The elevation contours are produced in metric units with contour intervals of 20 meters. The maps are multicolored, show political boundaries, highways, manmade structures, and topographic and cultural features. Another feature of this series of maps is a full fine-line Universal Transverse Mercator grid. The map legend includes a conversion table for the metric system, declination diagrams for grid convergence, and a chart of topographic map symbols. The 1:100,000 scale quadrangle maps provide much of the detail shown on larger scale maps yet cover enough geographic area to be useful as base maps for regional studies.

Six maps in this series are completed for Pennsylvania. They include: Bradford, Wellsboro, and Towanda in the north, and Johnstown, Morgantown, and Cumberland in the south.



Published maps are available at $3.60 each from Washington Distribution Section, U.S. Geological Survey, 1200 South Eads Street, Arlington, Virginia 22202.

GEOLOGY TEACHERS TO MEET

The Eastern Section of the National Association of Geology Teachers will hold its annual spring conference April 26-29, 1984, at Lewes, Delaware at the Virden Center of the University of Delaware Marine Science Center. Registration will begin at 4 p.m. on April 26; workshops are scheduled April 27; field trips and banquet April 28. For fees and options contact Ellis Underkoffler, Talley Jr. High, 1110 Cypress Rd., Wilmington, DE 19810; phone, office: 302-792-3978. home: 302-762-5837.

FRANKLIN COUNTY MINERAL SHOW

The Franklin County Rock and Mineral Club is sponsoring their seventh annual show, May 12 and 13, 1984, at the Chambersburg Middle School, McKinley Street and Stouffer Avenue, Chambersburg, Pennsylvania. The times for Saturday are 10:00 a.m. to 7:00 p.m. and on Sunday 11:00 a.m. to 5:00 p.m. For more information contact Pat Hoyer, 8810 Rowe Run Road, Shippensburg, Pennsylvania 17257; phone 717-532-6058.

Spiral feeding-organ supports preserved in the brachiopod Athyris spiriferoides (Eaton), Rockville, Dauphin County, Pennsylvania

by Jon D. Inners
Pennsylvania Geological Survey

An unexpected result of recent fieldwork aimed at up-dating General Geology Report 40, *Fossil Collecting in Pennsylvania,* was the detection of previously unrecognized paleontologic details at some "old" localities. One of the most interesting of these occurrences is at the well-known Middle Devonian fossil collecting locality at Rockville, just north of Harrisburg. What started out as a routine field check of an oft-described locality (Willard, 1939; Ellison, 1965; and Hoskins, 1969) livened considerably when the author discovered numerous specimens of the spiriferid brachiopod **Athyris spiriferoides** (Eaton) in which the spiral feeding-organ supports are preserved. These delicate internal structures are generally broken before burial or otherwise lost during diagenesis of the enclosing sediment.

The **Athyris** specimens with preserved feeding organ supports occur in an abandoned sandstone quarry in Little Mountain on the east side of the Susquehanna River at Rockville, approximately 3 miles north of Harrisburg in Dauphin County (40°20′21″N/76°54′14″W, Harrisburg West quadrangle; Figure 1). The quarry lies at the north end of a deep rock cut on U.S. Routes 22-322 and exposes vertical to slightly overturned beds belonging to the upper part of the Montebello Member of the Mahantango Formation. Most of the rock that crops out in the quarry walls is thick bedded, medium- to light-gray, medium- grained to conglomeratic quartz sandstone in which molds of large, thick-shelled brachiopods are moderately common. **Athyris** and other invertebrate fossils are very abundant in a 20-foot thick unit of medium-gray, calcareous sandy silt shale that occurs 160 feet stratigraphically below the youngest beds exposed in the quarry (Ellison, 1965). The fossiliferous bed juts out from the quarry wall at the south end of the right-of-way fence.

Athyris spiriferoides (Eaton) is a Middle Devonian articulate brachiopod characterized by a biconvex profile, a narrow hinge, and prominent, laminated growth lines on otherwise smooth valves (Figure 2). **Athyris** possessed spiral, calcareous supports (spiralia,) for the complex internal feeding organ (lophophore) (Figure 3).

Athyris in the Rockville quarry typically occurs as articulated in-

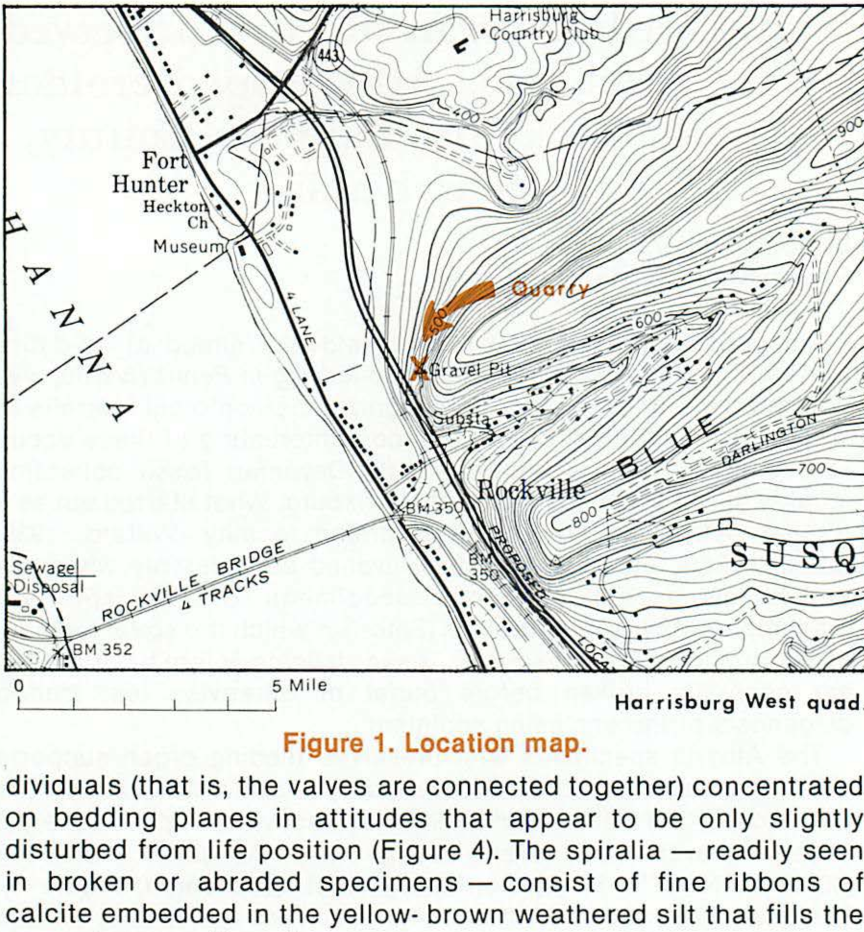


Figure 1. Location map.

dividuals (that is, the valves are connected together) concentrated on bedding planes in attitudes that appear to be only slightly disturbed from life position (Figure 4). The spiralia — readily seen in broken or abraded specimens — consist of fine ribbons of calcite embedded in the yellow- brown weathered silt that fills the space between the valves.

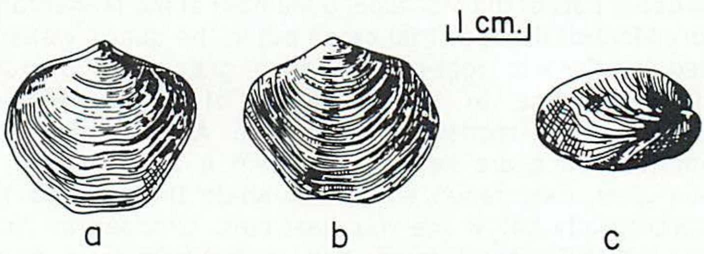


Figure 2. *Athyris spiriferoides* (Eaton). Views are (a) dorsal (top), (b) ventral (bottom), and (c) side.

Although no direct trace of the freshly lophophore itself is retained in these 387 million-year-old fossils, it is probable that the feeding-organ supported by the spiralia of **Athyris** consisted, as in some modern brachiopods, of two spirally coiled arms that diverg-

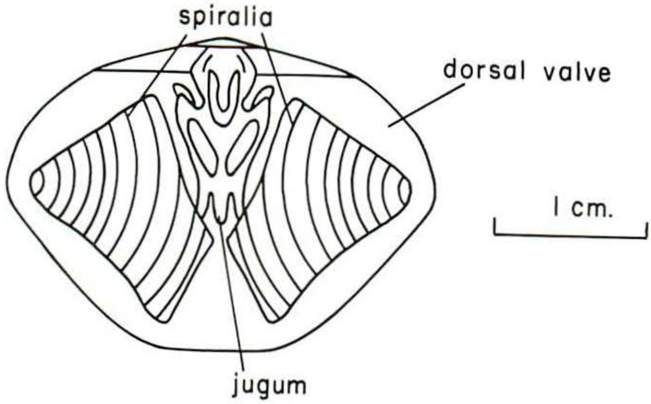


Figure 3. Interior of *Athyris*, showing structures that support the feeding organ.

ed from either side of the mouth. Each arm bore a single row of long, slender flexible filaments. On the sides of each filament were rows of hairlike-projections, or cilia. At the base of the filaments was a ciliated food groove that extended along the frontal side of each arm to the mouth.

Brachiopods are suspension-feeders; that is, they extract minute suspended food particles (microorganisms and finely divided organic material) from sea water. The basis of their feeding mechanism is the weak current stream set up by the lashing of cilia on the lophophoral filaments (Figure 5) (Rudwick, 1970). But in order to feed efficiently a brachiopod has to have some method of

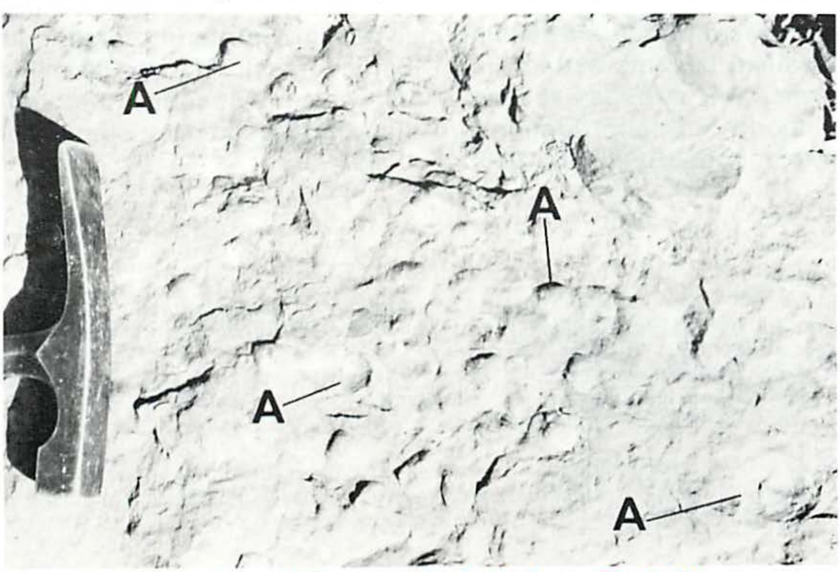


Figure 4. Slab of fossiliferous silt shale from Rockville quarry. Note abundance of *Athyris* (A).

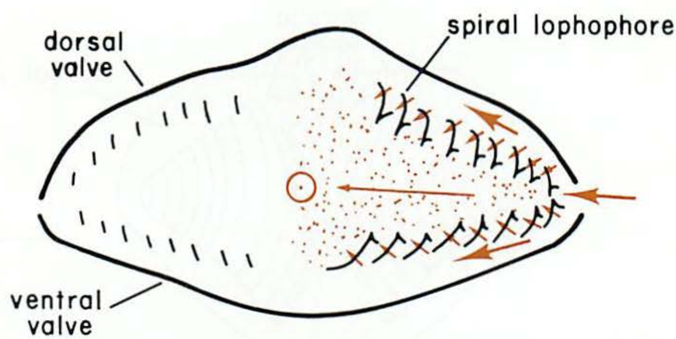


Figure 5. Generalized cross-sectional diagram of feeding mechanism of *Athyris*. (Thick arrows = inhalant currents; thin arrows = exhalant currents; strippled area = exhalant chamber; bull's eye = exhalant current issuing from medial part of gape.) (Modified from Rudwick, 1970, p. 138).

separating incoming (or inhalant) nutrient-rich currents from outgoing (or exhalant) currents containing inorganic particles and body wastes. In the spiriferid brachiopods, this separation of inhalant and exhalant currents was accomplished by the twisting and coiling of the lophophore arms around the spiralia.

The 570-million-year history of brachiopods from Cambrian time down to the present day clearly shows the overall survival efficiency of the lophophoral feeding mechanism. Spiriferid brachiopods, however, became extinct in the Early Jurassic (about 190 million years ago), perhaps because spiralia were a less robust method of supporting a spiral lophophore than that adopted by some other brachiopods (Rudwick, 1970).

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SURVEY ANNOUNCEMENTS

WATER WELL COMPUTER PRINTOUTS—A COUNTY ANALYSIS

In a previous article in "Pennsylvania Geology" (v 14/5, p. 6-7), we discussed the current status of our water well computer file. In addition to the information in that article, we have compiled the following table which gives the total number of printout sheets, the approximate number of wells contained on the printout, and the total cost of the printout per county:

	Approx. No. of Wells	Number of Printout Sheets	Total Cost In Dollars		Approx. No. of Wells	Number of Printout Sheets	Total Cost In Dollars
Adams	44	297	11	Lackawanna	84	567	21
Allegheny	52	351	13	Lancaster	532	3591	133
Armstrong	60	405	15	Lawrence	76	513	19
Beaver	136	918	34	Lebanon	376	2538	94
Bedford	224	1512	56	Lehigh	272	1836	68
Berks	316	2133	79	Luzerne	44	297	11
Blair	84	567	21	Lycoming	88	594	22
Bradford	116	783	29	McKean	48	324	12
Bucks	488	3294	122	Mercer	68	459	17
Butler	180	1215	45	Mifflin	84	567	21
Cambria	132	891	33	Monroe	352	2376	88
Cameron	20	135	5	Montgomery	380	2565	95
Carbon	168	1134	42	Montour	32	216	8
Centre	40	270	10	Northampton	248	1674	62
Chester	584	3942	146	Northumberland	64	432	16
Clarion	12	81	3	Perry	68	459	17
Clearfield	12	81	3	Philadelphia	—	—	—
Clinton	32	216	8	Pike	124	837	31
Columbia	44	297	11	Potter	48	324	12
Crawford	100	675	25	Schuylkill	100	675	25
Cumberland	188	1269	47	Snyder	40	270	10
Dauphin	384	2592	96	Somerset	88	594	22
Delaware	24	162	6	Sullivan	40	270	10
Elk	16	108	4	Susquehanna	44	297	11
Erie	196	1323	49	Tioga	108	729	27
Fayette	36	243	9	Union	100	675	25
Forest	20	135	5	Venango	164	1107	41
Franklin	96	648	24	Warren	28	189	7
Fulton	24	162	6	Washington	116	783	29
Greene	16	108	4	Wayne	88	594	22
Huntingdon	68	459	17	Westmoreland	128	864	32
Indiana	104	702	26	Wyoming	36	243	9
Jefferson	68	459	17	York	244	1647	61
Juniata	36	243	9				

Requests can be made for partial county printouts on a township by township basis. The cost would then be figured at: 10 or fewer sheets-no charge; more than 10 sheets-25 cents per sheet including the first 10 sheets. In addition, a $7.50 per hour charge would be added to the 25 cents per page charge for staff time spent searching and assembling data.

The printouts are available from the Pennsylvania Geological Survey - WWI, P. O. Box 2357, Harrisburg, PA 17120; telephone: 717-787-5828.

REPORT ISSUED ON OIL AND GAS DEVELOPMENTS

Pennsylvania's oil production, considered by many to be a thing of the past, reached a total of 4,282,354 barrels in 1982 with a value in excess of $120 million before refining. Comprehensive information on oil and gas production, exploration, and drilling activities in the Commonwealth is contained in the newly released **Oil and Gas Developments in Pennsylvania in 1982,** issued by DER's Bureau of Topographic and Geologic Survey.

The 120-page annual report, compiled by Dr. John Harper, Chief of the Survey's Oil and Gas Geology Division, is replete with tables, maps, and descriptions of the oil and gas developments on a county by county basis.

Natural gas production for the year totalled over 121 billion cubic feet with a total value of over $300 million dollars. Complementing the gas production was 6 percent increase in natural gas reserves, a tribute to the aggressive exploration and development program being conducted by the industry.

During the year, 4,224 new wells were drilled, a 19 percent increase over the previous year. The most active counties for oil drilling were Venango, Forest, Warren, and McKean; the most active counties for gas drilling were Indiana, Erie, Crawford, Clearfield, Jefferson, and Westmoreland.

The new report also provides information on seismic exploration activities, secondary and tertiary oil recovery projects, and on oil and gas research projects in progress at the Survey.

Progress Report 196, **Oil and Gas Developments in Pennsylvania in 1982,** is available from the State Book Store, P.O. Box 1365, Harrisburg, PA 17105 for $1.90 (plus 12¢ tax for Pennsylvania residents). Check made payable to the Commonwealth of Pennsylvania must accompany the order.

A SERVICE RENDERED

Several hundred times a year we receive requests for geological advice and assistance. We are always pleased to respond, not only as part of our assigned mission, but also in a firm belief that geologists have an important contribution to make to our society.

Too often we don't hear how things worked out with the problems brought to our attention. In the case of this Lancaster County sinkhole problem, however, we have documentation of a happy ending to a serious situation. We are pleased to share with our readers the comments we have received.

MILLERSVILLE BOROUGH
10 COLONIAL AVENUE
MILLERSVILLE, PENNSYLVANIA 17551
(717) 872-4645

December 9, 1983

Director
Department of Topographical
& Geological Survey
Harrisburg, Pa. 17120

Dear Sir,

I would like to take this time to thank your department and specifically your Mr. Wilshusen for the prompt response to our request for help.

I contacted your department on Monday, November 28th seeking advise and remedy for a sink hole problem that was threatening to undermine the foundation of a home in our community. Mr. Wilshusen arrived the next day and set into motion the necessary equipment and materials that were needed to control the situation and did so in a very professional manner. I spent some time with Pete in determining the Borough's position in this matter and found him to be more than cooperative in all respects. The necessary work was completed on December 8th and the residents have now moved back into their home and feel relieved that the problem is now over. Again, I would like to thank Pete and your agency for the expertise that was offered to the occupant of 1907 Blue Ridge Drive and to the Borough of Millersville.

Respectfully,

Robert J. Battillo

Robert J. Battillo
Code Enforcement Officer
Borough of Millersville

(continued on page 16)

Dept. of Environmental Resources
Per. One J. Peter Wilshusen:
Engineering Geologist:

We wish to express our sincere thanks for the assistance we received with our sinkhole problem. Pete's professional attitude and concern for our problem was satisfying. He always explained what he planned to do and answered all our questions. He never left us in the dark he worked with us, Millersville Borough, U.G.I. and Funk Brothers Excavating Co. His follow-up and concern were commendible. We were very happy to have him work with us

Sincere thanks,
Verna and John Krady
1907 Blue Ridge Drive
Lancaster, PA, 17603

Load of coarse stone to be placed with concrete into large sinkhole visible in front of house.

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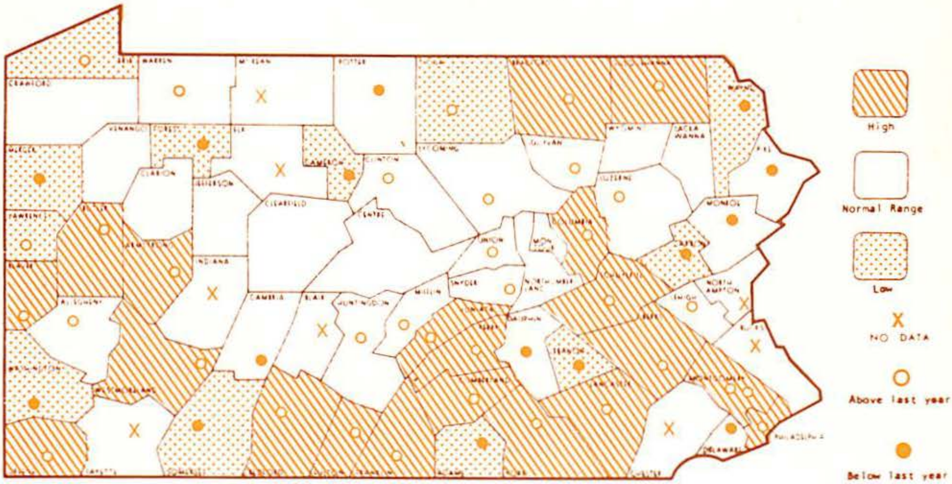

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