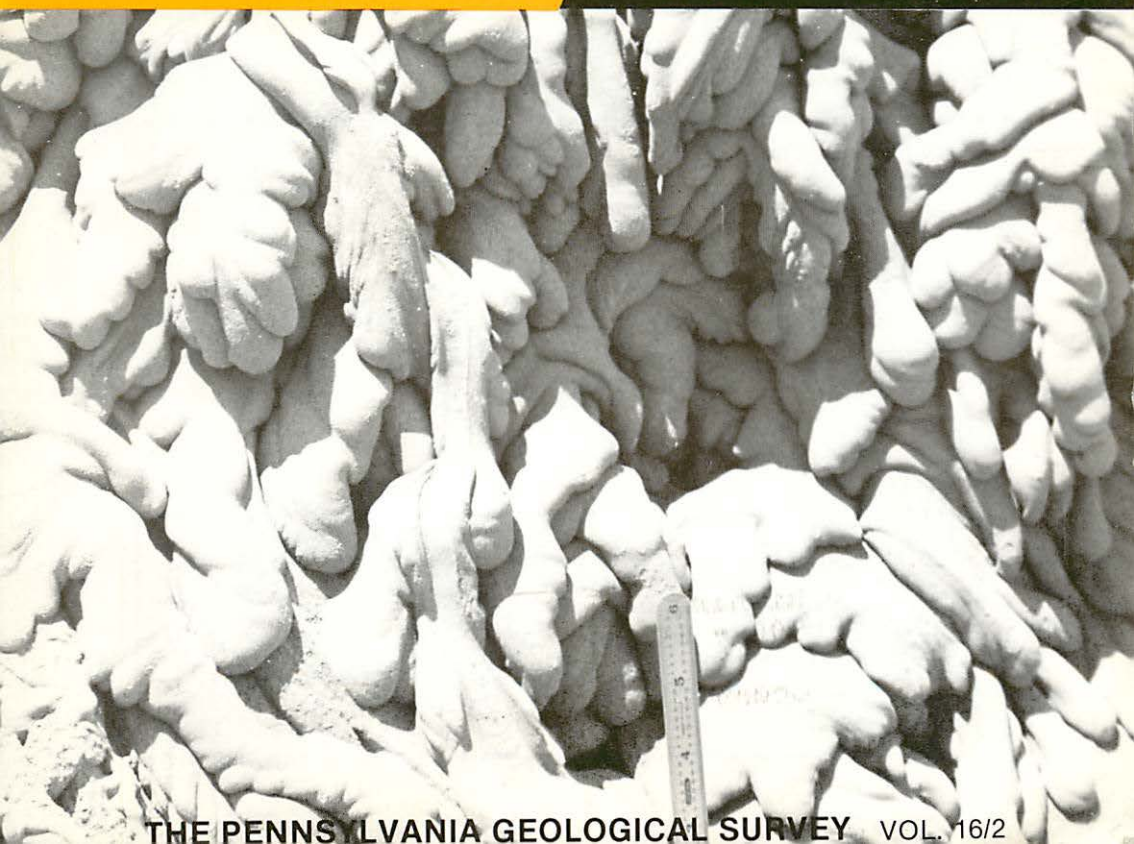


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COMMONWEALTH OF PENNSYLVANIA

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DEPARTMENT OF ENVIRONMENTAL RESOURCES

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OFFICE OF RESOURCES MANAGEMENT

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TOPOGRAPHIC AND GEOLOGIC SURVEY

Arthur A. Socolow, State Geologist

CONTENTS

New Greene County coal report.....	2
Pennsylvania Mineralogy.....	3
Medina Group Reservoir report issued.....	4
1985 Field Conference.....	5
Geology teachers meeting.....	5
Warner Company's Bellefonte operation.....	6
Franklin County Mineral Show.....	10
Elk County mapping starts.....	11
New oil and gas base maps.....	12
Fossil collecting—Columbia County.....	14

ON THE COVER: Nature's pattern; sandflows in cut-bank of glacial sand deposit, near Lake Wallenpaupack, central Pike County. Photo courtesy of Linda M. Crum.

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

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

Articles may be reprinted from this magazine if credit is given to the Topographic and Geologic Survey.

VOL. 16, NO. 2

APRIL, 1985

FROM THE DESK
OF THE
STATE GEOLOGIST



ACHES OF AN AILING MINERAL INDUSTRY

By all standards the national mining industry is depressed, particularly the metal mining industry. This in the face of a strong recuperating national economy which is traditionally a heavy consumer of metallic minerals. This has had repercussions in Pennsylvania which in recent years has seen the closing of its last two major metal mines, both with large ore reserves remaining in the ground. The depressed mining industry is also keeping exploration geologists from pursuing a variety of promising mineral prospects in our state.

Why the American mining depression? Largely because the mineral industry has turned to foreign sources which are providing high-grade ores at much lower operating costs than possible in the U.S. This dependence on foreign ores has a mixed impact on the U.S. On one hand the U.S. consumer has the benefit of lower cost mineral resources for its manufacturing needs. On the other hand American capital is going abroad while we have a truly depressed domestic mining community, with thousands of unemployed miners and related support workers.

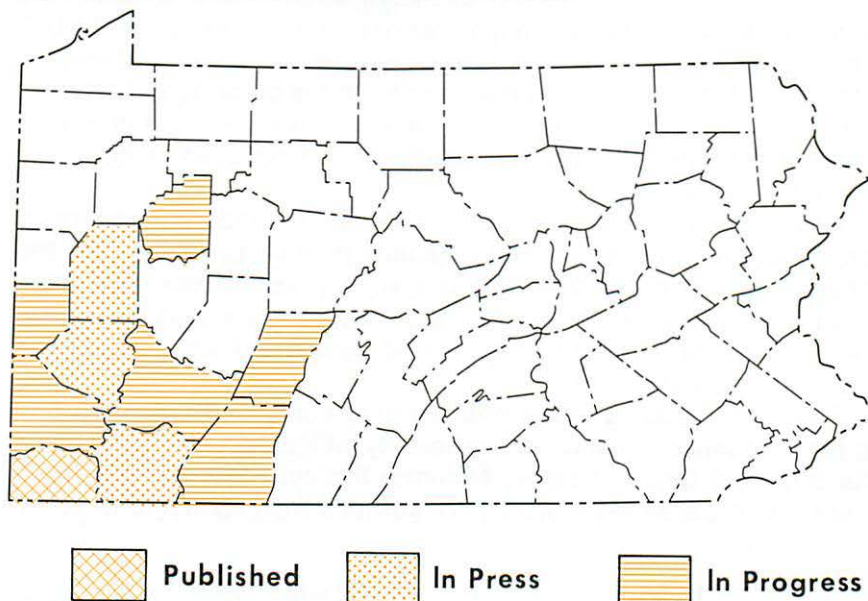
Of particular concern is our dependence on resources in foreign countries whose stability and reliability may be subject to sudden change. Unlike manufactured items (such as autos) which we could readily replace if cut off from foreign sources, it would take many years to "crank up" our own mineral deposits if we were denied critical foreign sources.

Thus, for the sake of national security our country needs a program of planned mineral self-sufficiency, at least on a standby basis for potential times of crisis. Assuring the domestic availability of essential mineral needs would constitute a truly strategic weapon.

Arthur G. Socolow

Greene County Publication kicks off New Series of Coal Resource Reports

The Bureau of Topographic and Geologic Survey has unveiled a new series of coal-resource reports with the recent publication of *Coal Resources of Greene County, Pennsylvania—Part 1. Coal Crop Lines, Mined Out Areas, and Structure Contours*. The report, compiled by staff geologists Clifford H. Dodge and Albert D. Glover, is one of many that will be published over the next few years for the major bituminous-coal-producing counties in western Pennsylvania. Coal-resource reports will be issued in several parts for each of these counties. Part 1 for each county will contain maps showing coal crop lines, surface and deep mined-out areas, and structure contours; other parts will contain tabular information on the coal resources of the counties and computer-generated thickness and quality maps of the principal (principally mined) coals. The maps will show sulfur trends, heat value, ash content, and trace-element trends for each coal.



Part 1 of the Greene County report contains two kinds of coal maps. First, for each of the principal coal seams in each 7½-minute

topographic quadrangle in the county, there is a map showing (1) the coal outcrop (crop line); (2) areas where the coal is known to be absent because of seam discontinuities; and (3) the extent of all known strip and deep mining up to the time of compilation. Second, for each quadrangle, there is a composite coal-crop map that includes structure contours and fold axes. If none of the principal coals has been mined or crops out in a particular quadrangle, only the second kind of map is presented. The two-color maps contain information on sources of published and unpublished data, map reliability, map symbols, map scale (approximately 1:62,500), structure contour intervals and datums, and names of fold axes. This report is published as a package of 8½-by 11-inch, pre-punched sheets that will fit standard three-ring binders for convenient use in the office and field.

Anyone involved in planning coal-exploration programs, land acquisition, land use planning, and environmental protection should find this report to be of considerable use. Comments on this new series of publications are invited.

This 67-page publication is designated as Mineral Resource Report 86, Part 1, and is available from the State Book Store, P. O. Box 1365, Harrisburg, PA 17105. The price is \$5.75 by mail and \$5.00 over the counter (plus 6% sales tax for Pennsylvania residents). A check made payable to *Commonwealth of Pennsylvania* must accompany the order.

Similar reports on Allegheny and Butler County will be published this summer and will be announced in a forthcoming issue of *Pennsylvania Geology*.

New Pennsylvania Mineralogy Book

The Mineralogical Society of Pennsylvania has announced publication of a new book, *Highlights on the Life of Charles M. Wheatley*, by F. Harold Evans. This is a 48-page volume of the "famous Chester County, Pennsylvania, mine operator, mineralogist, palaeontologist, naturalist, conchologist, and copper metallurgist" with *Forward* and *Appendix* by geologist Dr. Allen V. Heyl. In addition to the biographical story, there are portraits of Wheatley, sketches of old mines as well as maps and cross-sections, extensive references (both historical and geological), and data on several mines, including up-to-date mineral lists. The cover of the 8½-by 11-inch paperback is the blue-green associated with many copper minerals.

The co-sponsoring Mineralogical Society is distributing the book. Write the Society c/o Dr. Arnold Fainberg, 598 N. Prince Frederick St., King of Prussia, PA 19406 (\$2.50 ppd. for members and \$4.50 ppd. for others).

PETROLOGY AND RESERVOIR CHARACTERISTICS OF THE LOWER SILURIAN MEDINA GROUP SAND- STONES

Exploration and development of the Lower Silurian Medina Group clastics presently dominates deep drilling activity along the northwestern flank of the central Appalachian basin. In Pennsylvania, Medina production is from very fine- to medium-grained sandstones that form low-permeability and low-pressure reservoirs across five counties in the northwest corner of the state. Aggressive development programs in the Athens and Geneva gas fields of Crawford County, Pennsylvania, have provided substantial amounts of geological and engineering data in the way of cores, samples and geochemical and geophysical logs. This information is integrated and interpreted in a new report published by the Pennsylvania Geological Survey entitled *Petrology and Reservoir Characteristics of the Lower Silurian Medina Group Sandstones, Athens and Geneva Fields, Crawford County, Pennsylvania*.

This investigation of the Medina Group reservoir sandstones in the Athens and Geneva gas fields was conducted for four specific purposes. The first was to describe the vertical and lateral distribution of depositional environments in the subsurface and define the relationship between these environments and the porosity and permeability of the sandstones. The second was to outline the diagenetic history of the sandstones with an emphasis on the postdepositional occlusion and enhancement of porosity. The third was to determine the various effects that detrital and diagenetic minerals have on reservoir quality and geophysical-log response, and the fourth was to describe the sensitivity of the Medina Group sandstones to drilling, completion, and stimulation fluids of different compositions.

This report is liberally illustrated with thin section and scanning electron microscope photomicrographs which clearly document the various kinds of grains, cements, clays and pores that make up the Medina reservoir rocks. Various aspects of geophysical log interpretation problems are portrayed graphically. The results of two core analyses and one hundred and fifty-six geophysical log analyses are listed. This report should be of extensive use to all who are engaged in hydrocarbon exploration, development, and research in Pennsylvania and adjacent states.

Petrology and Reservoir Characteristics of the Lower Silurian Medina Group Sandstones, Athens and Geneva Fields, Crawford County, Penn-

sylvania, Mineral Resource Report 85, was authored by C. D. Laughrey of the Pennsylvania Geological Survey. It is available at the State Book Store, P. O. Box 1365, Harrisburg, PA 17105. The price is \$5.65 (plus 6% tax for Pennsylvania residents). Enclose check payable to *Commonwealth of Pennsylvania*.



1985 Field Conference of Pennsylvania Geologists

The 1985 Field Conference of Pennsylvania Geologists will be the 50th conference conducted. To celebrate the golden jubilee of our conference, we plan special evening programs in addition to four one-day field trips which will be led by our hosts, The Pennsylvania State University, during the two-day period.

To prepare for one of these programs, we seek photographs and slides of prior Field Conferences, particularly with identified people. Anyone who has any photographs and slides that they would care to share with us will receive our thanks. If you would send them to us, we will have them duplicated and the originals will be returned to you.

Help us make this a celebration worthy of the 50 field trips which have greatly furthered our understanding of the geology of Pennsylvania.

And plan now to attend the 50th Field Conference October 3, 4, and 5, 1985. If you have not attended either of our last two field conferences and wish to receive notice of the meeting and registration information, write to Field Conference of Pennsylvania Geologists, c/o The Pennsylvania Geological Survey, P.O. Box 2357, Harrisburg, Pennsylvania 17120.

GEOLOGY TEACHERS TO MEET

The Eastern Section of the National Association of Geology Teachers will meet May 24–26 in Toronto, Canada. For details contact Robert Lord, Geography and Geology Department, Bramalea Secondary School, 510 Balmoral Drive, Brampton, Ontario, Canada L6T 1W4.

WARNER COMPANY'S BELLEFONTE OPERATION

by S. W. Berkheiser, Jr.

Pennsylvania Geological Survey

The Bellefonte area contains one of the purest high-calcium limestone deposits (Valentine Member of the Linden Hall Formation) in the Commonwealth and is an important lime-producing district. Since before the turn of the century, Warner Company and its predecessor, American Lime and Stone Co., have produced high-calcium products from quarries and later (1920's) from underground mines in this area (Figure 1). Warner Company was the first to use a rotary-kiln for calcining limestone in the Nittany Valley. Starting in the 1920's they were pioneers in developing this technology, which greatly increased production rates compared to the more common shaft kilns of that time.

Geology and Mining

The Valentine Member of the Linden Hall Formation, which is equivalent to the Benner Formation, is characterized as a high-calcium

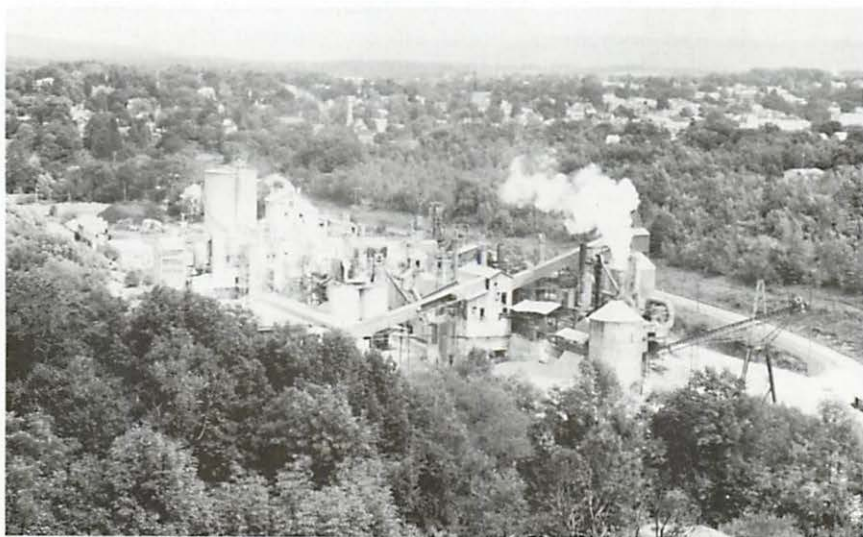


Figure 1. Overview of Warner Company's Bellefonte operation looking to the southeast with Bellefonte in the background.

(> 96% CaCO_3), medium-dark-gray, fine-grained, thick-bedded limestone commonly containing 1- to 2-mm sized calcite crystals. At the Bell-Mine, the ore deposit consists of almost pure calcite (CaCO_3) present as the Valentine limestone. It is exposed on both the north and south sides of Nittany Valley, forming an asymmetrical, breached anticline with bedding dips on the limbs of about 80°NW and 25°SE respectively (Berg and others, 1980, and Miller, 1934). Thicknesses of this high-calcium interval are variable, but best developed in the Bellefonte area where the steeply dipping north limb ranges from about 45 feet to 60 feet and the more gently dipping south limb commonly varies in thickness from between about 60 feet to 90 feet. Presently the kiln feed (plus 1/4"-sized limestone) for this operation comes from two sources.

The first source, the Bell-Mine, has been a traditional underground source for the purest end-products produced and is located on the steeply north dipping north limb. The shaft is located about 1 mile due west of Bellefonte (Figure 2). Here a "two-sub-level open stope" mining method developed to the 960-foot level extracts about 80% of the

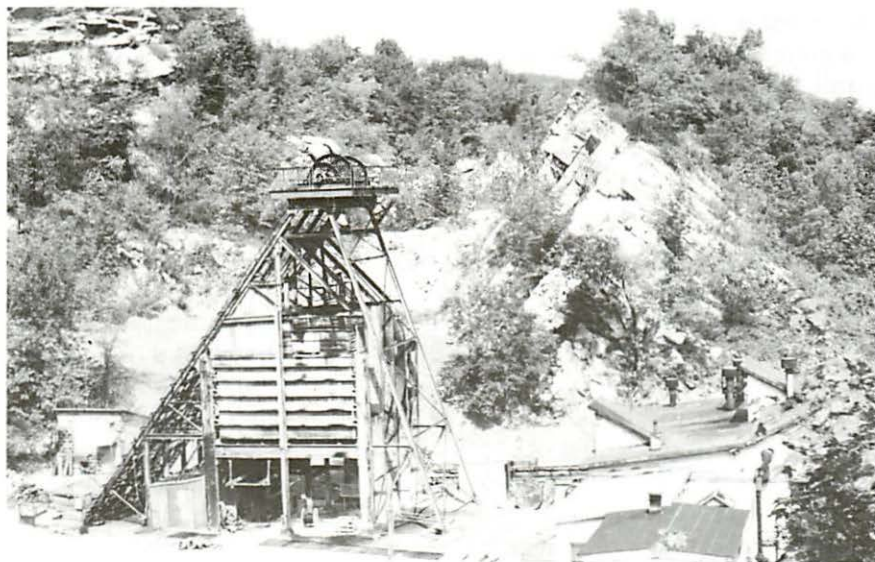


Figure 2. Main service shaft and headframe of the Bell-Mine. Notice evidence of surface mining the Valentine Member of the Linden Hall Formation (Benner Formation) in the background. Shaft is sited on the less pure Valley View Member of the Linden Hall Formation.

available Valentine ore (Figure 3). The main service shaft is nearly vertical and was sunk in the underlying, less pure Valley View limestone member near the footwall of the steeply dipping ore body. The main haulage of this lower level is developed near the hanging wall in Valentine ore. These lower workings have been developed along strike to the northeast for about 1 mile and to the southwest for almost 2 miles.

Individual stopes are about 300 feet high, containing an undercut and two sublevels. These stopes are about 335 feet in length (excluding 50-foot-thick end pillars) with three raises driven to the second sublevel. A 60-foot-thick crown pillar is left at the top of each stope. Mining progresses by making an undercut near the haulage level, which leaves a block of ore to protect the main haulage and direct subsequent stoped ore into 4 loading alcoves (Figure 4). Stopping is accomplished by radially drilling and blasting ore from the two sublevels. Primary crushing is completed underground. Haulage to the crusher is by rail. Drilling and blasting are carried out on the day shift, whereas hauling and crushing are accomplished on the second shift and "grave yard" shift; this produces about 1440 tons per day kiln feed to a surface surge pile.

The second source, the Gentzel Quarry located about 3 miles southwest of Bellefonte, was recently developed on the south limb of this anticlinal structure, where dips are less and the Valentine is slightly thicker. This quarry provides supplemental kiln feed and products.

Manufacturing

High-calcium pebble and ground lime (CaO) are the principal products manufactured. Two bituminous, coal-fired, rotary-kilns can produce about 900 tons of quicklime per day. This is a significant contrast in both production and labor to the older vertical-batch and draw-type kilns (Berkheiser and Hoff, 1983). The ratio of limestone to coal to make lime in the rotary kilns is about 3:1, whereas the older batch type kilns commonly required a ratio of about 5:1. Warner's Bellefonte operation requires about 275 to 300 tons of coal per day, which is pulverized on site.

Other high-quality products include hydrated lime (Ca(OH)_2), glass-stone (provides chemical durability to glass), and pulverized limestone. The quicklime typically contains about 95% CaO , <1% MgO , and <2% SiO_2 , plus insolubles. Typical analyses of the limestone products contain about 98% CaCO_3 , 1% MgCO_3 , 0.1 to 0.2% Fe_2O_3 and generally <2% SiO_2 , plus insolubles. About 500,000 tons of limestone are mined each year.

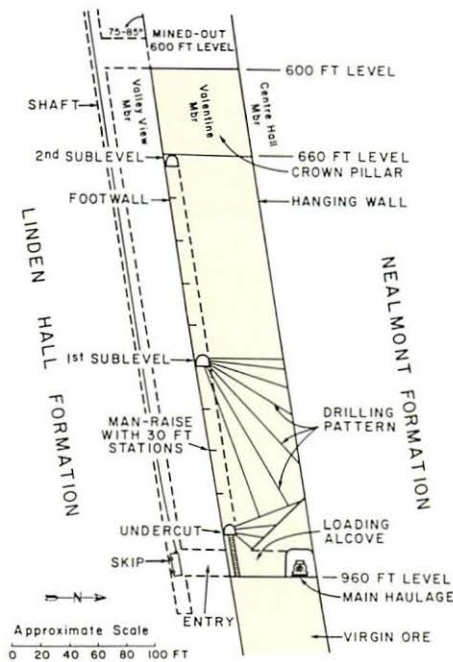


Figure 3. Generalized cross-section and sketch illustrating the "two-sublevel open-slope" mining method. Modified from company illustrations.

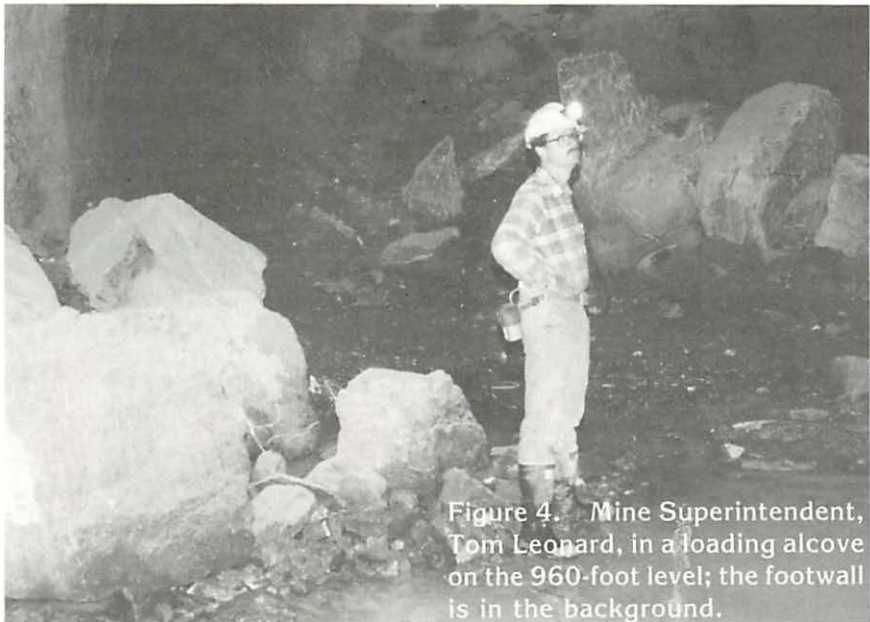


Figure 4. Mine Superintendent, Tom Leonard, in a loading alcove on the 960-foot level; the footwall is in the background.

Marketing

Greater than 40% of the lime produced is consumed by the steel industry. Environmental uses such as sewage treatment, stack gas scrubbers (reduces acid emissions), and water treatment are other major markets which have been steadily increasing. Agricultural products, fluxstone, and coal mine rock dust (suppresses coal dust explosions) are other rock products produced at this plant.

The majority of these products are transported to their respective markets by truck. In general, a 200-mile radius encompasses most of their customers; however, they do service clients as far away as Illinois and California.

Summary

Warner Company holds additional high-calcium reserves and resources in the Nittany Valley which insure a future supply of quality lime and limestone products in Pennsylvania. Furthermore, a real concern for mitigating this industry's impact on the surrounding environment is shown by the numerous steps they have taken, such as sophisticated dust-suppression loading facilities, wet scrubbing of the kiln gases, and developing settling ponds where acidic solutions are added to lower the pH before discharge. Warner's pioneering spirit continues, which helps make Pennsylvania a leading high-quality lime producing state in the U.S.

We thank Warner Company, and in particular Mr. Robert Woodring and Tom Leonard, for their time and cooperation.

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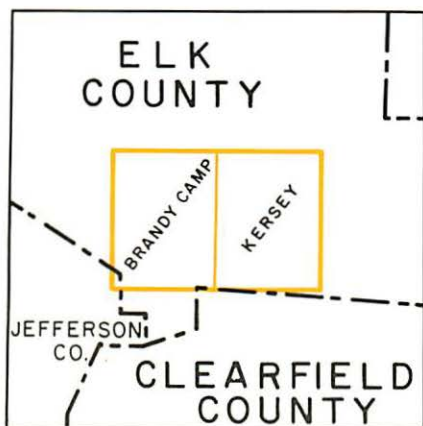
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FRANKLIN COUNTY ROCK & MINERAL CLUB

The Franklin County Rock and Mineral Club will hold its Eighth Annual Jewelry and Mineral Show at the Chambersburg Middle School, McKinley Street and Stouffer Avenue, Chambersburg, PA. Hours: May 4—10:00 a.m. to 7:00 p.m. and May 5—11:00 a.m. to 5:00 p.m. For further information contact Show Chairwoman Pat Hoyer, 8810 Rowe Run Road, Shippensburg, PA 17257. Phone 717-532-6058.

GEOLOGIC MAPPING BEGINS IN SOUTHERN ELK COUNTY

The Bureau of Topographic and Geologic Survey has recently initiated a detailed geologic mapping project of the Brandy Camp and Kersey 7½-minute quadrangles in southern Elk County, north-central Pennsylvania. Little geologic mapping has been done in Elk County since the 1880's, and detailed information is needed for efficient mineral-resource development, land use planning, and environmental protection. Elk County is rich in natural resources including bituminous coal, oil and gas, high-calcium limestone, sandstone, clay and clay shale, and sand and gravel.



The results of this study will be published as an Atlas Report consisting of a detailed (scale 1:24,000), full-color geologic map of the bedrock (which encompasses sedimentary rocks of Late Devonian to Pennsylvanian age) and unconsolidated surficial deposits of the two quadrangles. Included with the geologic maps will be a columnar section, a cross-section, a triple-column legend denoting the mineral-resource, groundwater, and engineering characteristics of the various geologic formations, and a table of resource calculations of the major coal seams. A short text will also be included.

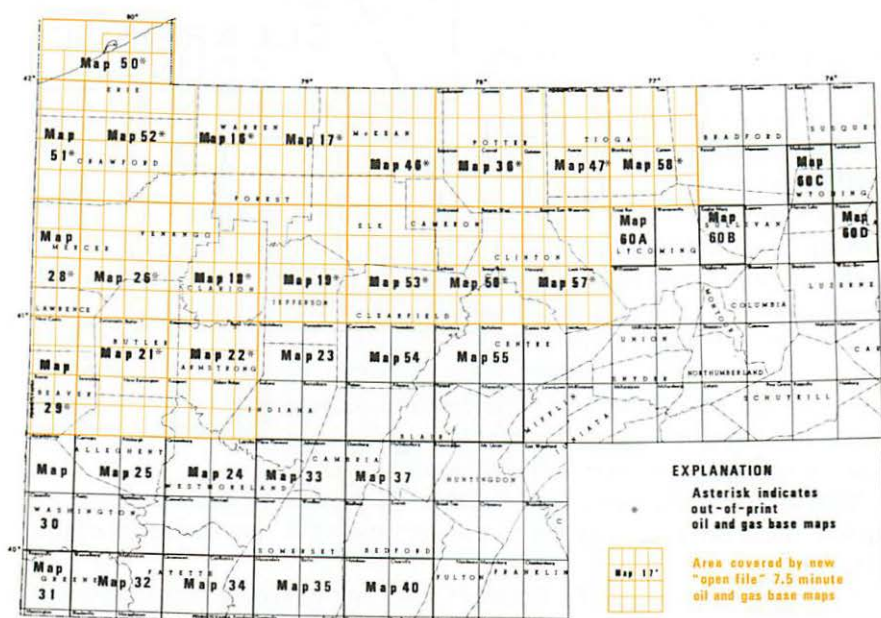
This atlas should be of considerable interest and use to the coal industry, local officials, engineers, conservationists, and residents of the area.

Geologic mapping of the Brandy Camp and Kersey quadrangles will be carried out by staff geologist Clifford H. Dodge. Field work will begin this spring, and the project will be completed in the autumn of 1987.

New Oil and Gas Base Maps

The Pennsylvania Geological Survey, Oil and Gas Geology Division, is making available to the public a new series of oil and gas base maps through our "open file" procedure. Each new base map is a "blue-line" reproduction of a standard U.S. Geological Survey 7.5-minute (1 inch equals 2,000 feet) topographic map on which is shown the locations and identifying numbers of oil, gas, and service wells in the represented area (see the accompanying index map). The topographic portion of each map is subdued to let the well symbols stand out, but is still legible on a blue-line reproduction.

The new 7.5-minute base maps are designed to replace, rather than supplement, the 15-minute series of oil and gas base maps sold through the State Book Store. The maps of the now out-of-print, 15-minute series were generally some of the State Book Store's better selling items, but the scale of the maps, the lack of topographic and cultural information, and the crowding of symbols from postings of new information led to our decision to replace them with a more useful and appropriate series. Because the new maps are the same scale as the Division's work maps, the 7.5-minute series will be easier to update on a regular basis.



Old base maps now declared out-of-print are Maps 16, 17, 18, 19, 21, 22, 26, 28, 29, 36, 46, 47, 50, 51, 52, 53, 56, 57, and 58.

With the change in mapping scales come certain inevitable changes in the types of information shown by the maps. The now out-of-print 15-minute base maps were essentially blank of all geographic information other than a 5-minute grid, the quadrangle names, county boundaries, and some major rivers and towns as background. The 7.5-minute maps, being reproductions of standard U.S. Geological Survey topographic maps, show all of the geographic information including grids, topography, streams, roads, etc. The now out-of-print 15-minute map series showed well symbols, Survey file numbers, availability of geophysical log and sample data on open file, and the outlines of fields and pools. The new 7.5-minute map series show only the well symbols and identifying numbers (typically the permit or project numbers). Other information, such as total depths, elevations, log and sample symbols, and field outlines are not put on the new maps because of anticipated lack of space and the need to protect the original from constant erasure with addition of new information; this information may henceforth be obtained by contacting the Oil and Gas Geology Division at the Bureau's Pittsburgh Office.

The index map accompanying this announcement indicates the locations of all newly available maps and the now out-of-print 15-minute base maps they replace. Announcements concerning the availability of additional 7.5-minute maps (and the subsequent out-of-print status of the corresponding 15-minute base maps they replace) will be made in future issues of "Pennsylvania Geology" and in the Survey's annual report of oil and gas developments in Pennsylvania.

When requesting maps please provide the 7.5-minute topographic map name of each map desired. To determine map names refer to the "Pennsylvania Index to Topographic and Other Map Coverage" published by the U.S. Geological Survey and available free of charge by writing to our Bureau offices or from Branch of Distribution, U.S.G.S., 1200 S. Eads St., Arlington, VA 22202.

For any further information, you may contact the Pennsylvania Geological Survey, Oil and Gas Geology Division, 7th Floor Highland Building, 121 S. Highland Avenue, Pittsburgh, PA 15206, (412) 665-2155.



New Fossil Collecting Locality in Columbia County

by John E. Ryan

Delaware Valley Paleontological Society

Superb Middle Devonian fossils may be collected at a road cut on the northwest side of Pa. Route 254, just west of the center of Millville in Columbia County (Figure 1). The road cut is the second of three cuts which occur along Route 254 between 0.3 and 0.65 mile southwest of its intersection with Pa. Route 42 ($41^{\circ}06'58''\text{N}/76^{\circ}32'17''\text{W}$, Millville quadrangle). By far the best and most numerous fossils occur at this second exposure, although a few fossils may be found in the other two road cuts.

Fossils are abundant and accessible at this exposure. There is ample parking for several vehicles just beyond the southwest end of the cut. Because the outcrop is only 6 feet from the edge of a 3-lane highway, this site is not suitable for large groups. **EXTREME CAUTION MUST BE EXERCISED AT ALL TIMES.** Collectors should take special pains not to disturb adjacent private property or to damage the exposure. Courteous behavior by collectors should ensure that this locality remains open to the public.

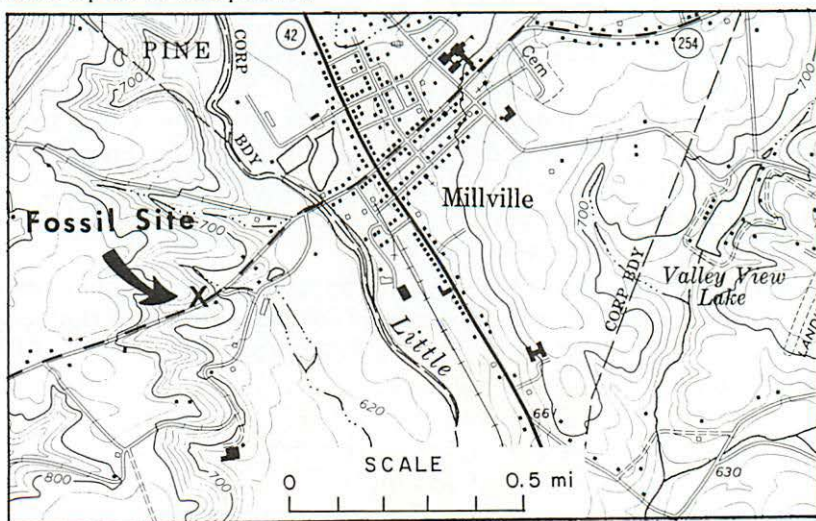


Figure 1. Location map.



Figure 2. Fossiliferous Mahantango shale exposed at Millville fossil site. (Photo by John H. Way.)

The rock layers at the center exposure are medium-dark-gray shales and siltstones belonging to the upper part of the lower member of the Mahantango Formation (Way, in preparation) (Figure 2). These layers incline slightly to the north and east, although the bedding cross-section at this exposure is fairly level. Fossils are most common in a zone of shales several feet thick that runs the length of the exposure. Embedded in the shales are calcareous nodules of various unusual shapes, the smaller of which also contain fossils. (While these nodules are inorganic, some may at first be confused with fossil remains, especially with fragments of straight cephalopods.) The fossils are preserved as molds and casts, mineralized remains, and occasional original shell material. Preservation surpasses the norm for the Mahantango, and many specimens retain the finest detail.

Spiriferid brachiopods, particularly the genus *Pustulatia*, are the most common fossils. This locality is most noteworthy, however, for the occasional complete specimens of the trilobites *Greenops* and *Phacops* which occur throughout the fossiliferous zone. These trilobite fossils show excellent preservation, and some specimens approach museum quality. Pelecypods and gastropods also are common, with the gastropod *Palaeozygopleura* occurring frequently in the upper part of the fossiliferous zone.

The following fossils have been identified from this locality:

CORALS	<i>Mediospirifer</i> (C)	CEPHALOPODS
<i>Heterophrentis</i> (P)	BIVALVES	<i>Michelinoceras</i> (P)
BRACHIOPODS	<i>Palaeoneilo</i> (C)	<i>Spyroceras</i> (P)
<i>Lingula</i> (P)	<i>Phestia</i> (P)	Unidentified ammonoid (R)
<i>Craniops</i> (R)	<i>Aviculopecten</i> (P)	TRILOBITES
<i>Orbiculoidea</i> (R)	<i>Modiomorpha</i> (P)	<i>Phacops</i> (C)
<i>Rhipidomella</i> (U)	<i>Cypricardella</i> (P)	<i>Greenops</i> (C)
<i>Tropidoleptus</i> (U)	BRYOZOANS	CRINOIDS
<i>Douvillina</i> (P)	<i>Sulcoretopora</i> (P)	Columnals (P)
<i>Longispina</i> (P)	GASTROPODS	FISH
<i>Athyris</i> (C)	<i>Bellerophon</i> (R)	Placoderm scales (R)
<i>Pustulatia</i> (A)	<i>Holopea</i> (P)	
<i>Mucrospirifer</i> (C)	<i>Palaeozygopleura</i> (C)	
<i>Spinocyrtia</i> (C)		

Letters denote the frequency with which the fossils are found. A = abundant; C = common; P = present; U = uncommon; R = rare.

Illustrations of these fossils can be found in Ellison (1965) and Hoskins and others (1983).

The shales and siltstones exposed along Route 254 were deposited in a warm, shallow sea some 387 million years ago, probably during a period of marine transgression. Both the fine grain size and the local traces of calcium carbonate suggest that the sediments were deposited at some distance from the shoreline. The occurrence of the brachiopod *Lingula* shows that the water depth was quite shallow, however, probably no greater than 60 feet (see Faill and Wells, 1974, p. 49).

The many articulated shells and the absence of fossils which exhibit breakage or wear due to transport indicate that the Millville fauna is a life assemblage, and that the organisms lived in a quiet-water environment. Although the presence of small amounts of pyrite (iron sulfide) suggests that the bottom waters tended to stagnate, many types of invertebrate organisms were able to proliferate on the sea floor despite the absence of strong circulating currents.

The author wishes to thank Jon D. Inners and John H. Way, of the Pennsylvania Geological Survey for their advice and assistance in the preparation of this article. Emily B. Giffin, formerly with the Pennsylvania Historical and Museum Commission, provided help during the initial field investigation.

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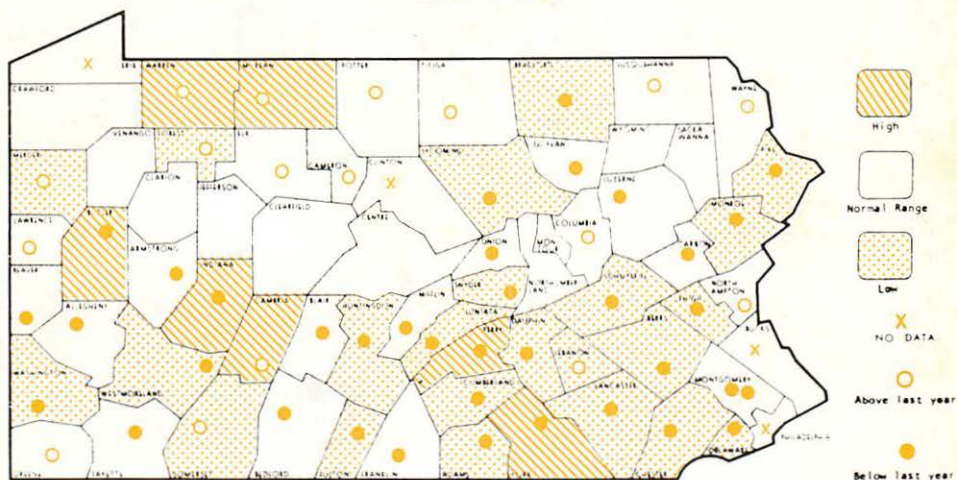
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