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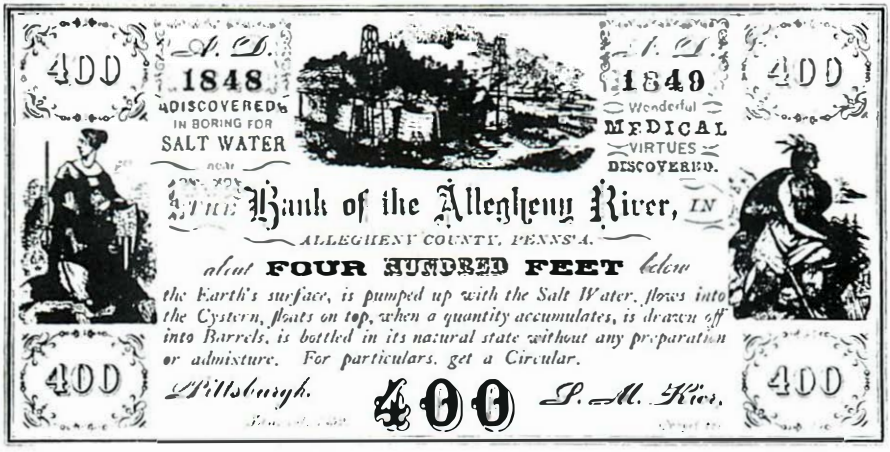
Pennsylvania GEOLOGY



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ON THE COVER

The front of one of Samuel M. Kier's advertising circulars, published to resemble a bank note, that promised his crude oil as nature's panacea (see article on page 9). Reproduced from Derrick Publishing Company, 1898, p. 948.

PENNSYLVANIA GEOLOGY

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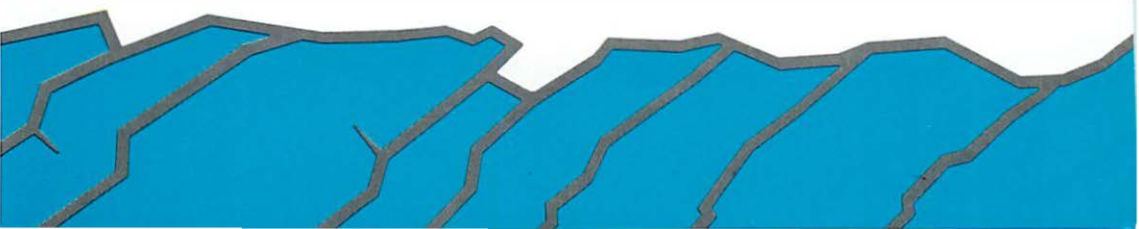


STATE GEOLOGIST'S EDITORIAL

Geology, Trespass, and Safety

From time to time, we publish in this journal the locations of outstanding sites where geologic features may be observed or where geologic materials may be collected. These sites may feature examples of local geology, abundant or unusual fossils or minerals, or they may be places where students and others can observe and learn about geology. *However, publication of locations in our journal does not grant permission to visit these sites!* All described sites are located on privately owned property or property that is managed for the public. It is the personal responsibility of anyone who wishes to visit these sites to obtain permission before entry. This is more than common courtesy; it is also a legal requirement.

Recently we were contacted by Pennsylvania officials of Conrail who are concerned about trespass on their property, in particular, along their transportation rights-of-way. These officials asked us to inform our readers of their concerns (see also fossil locality sidebar on page 14). Conrail estimates that during the past year, more than 1,000 people (50 in Pennsylvania) were killed or injured along its tracks in the United States, primarily while trespassing.

In Pennsylvania, Conrail officials report that they have encountered groups of geologists, principally from academic institutions, who have trespassed on their property and who have used the explanation that "the locality description was published in [X, Y, or Z] Journal." This explanation is patently not acceptable, and, if used further, will only result in total withdrawal from all persons of access to important teaching and learning sites.

It is, and has been, the policy of the Bureau of Topographic and Geologic Survey that all staff members should seek permission for entry onto private property for the purpose of geologic investigations. We strongly urge that all geologists, whether professional or amateur, follow the same policy. While at times this may be onerous and may even result in refusal of entry, the safety and legal integrity of all geologists is more important than is the possibility of physical harm or arrest if this recommendation is not followed. In particular, academic faculty should rigorously follow this policy, both as an example to students of proper legal behavior, and as a basic precautionary safety measure.

Donald M. Hoskins
State Geologist

THE "BANANA" MINE—Key to Understanding the Origin of the Thick Luthersburg Coal in Elk County

by Clifford H. Dodge
Pennsylvania Geological Survey

INTRODUCTION. "They once deep mined coal here, 10 feet thick, almost directly under our feet." Little did I realize the significance of this offhand remark by an old-timer back in 1984. When approached by this individual, I was measuring a section and sampling coal in an active strip mine in southeastern Elk County, as part of the Pennsylvania Geological Survey's continuing program of collecting basic data on the geology and coal quality of the bituminous coal fields of Pennsylvania (see back cover). Although naturally skeptical about unsubstantiated claims of occurrences of unusually thick coal (i.e., greater than about 6 feet in this part of the state), I felt that the old-timer was sincere. I smiled and nodded and recorded his comments in my notes. After thanking him for the information, I returned to my investigation of the strip mine. In time, I put the conversation out of my mind.

The following year, I began a comprehensive geologic mapping study of the coal measures of Elk County. Situated in rural north-central Pennsylvania, Elk County had historically received relatively little attention from government geologists, owing to limited staff and higher priorities elsewhere, and thus had been one of the least studied coal-producing regions in the Main Bituminous coal field (see back cover). However, as part of an ongoing series of county coal-resource investigations, my recent work has yielded much new information on the coal geology of the region. As expected, the geology of Elk County is full of surprises. Particularly noteworthy are aspects of an unusual and seemingly enigmatic coal, the Luthersburg.

REGIONAL STRATIGRAPHY. The type area of the Luthersburg coal is in northwestern Clearfield County, to the south of Elk (back cover). Named for the town of Luthersburg, the coal was first described by Edmunds and Berg (1971); regional aspects of the Luthersburg coal were later discussed by Dodge (1992).

The Luthersburg coal is stratigraphically above the Middle Kittanning rider coal and Washingtonville marine shale and below the Johnstown freshwater limestone and Upper Kittanning coal (Figure 1). In context, Luthersburg is a generic term for coals found at this stratigraphic horizon, toward the middle of the Allegheny Formation (Middle Pennsylvanian), that may or may not be genetically related to the coal at the type area.

The Luthersburg coal interval in western Pennsylvania represents depositional environments marking the transition from dominantly lower-delta-plain to upper-delta-plain sedimentation that occurred during a time of rapid westward progradation, base-level drop, and extensive development of sandy channel belts, which, though absent in Elk County, are collectively known as the Upper Worthington sandstone (Dodge, 1992).

CHARACTERISTICS OF THE LUTHERSBURG IN ELK COUNTY. The Luthersburg coal or its horizon in Elk County is confined to the southern areas, where it is preserved in the deeper parts of the Cowanesque and Caledonia synclinal basins (Figure 2). The Luthersburg coal interval, extending from the base of the coal or its underclay to the base of the Johnstown limestone, is seldom exposed. Consequently, information on the geology of the interval is derived mostly from drillers' records of borehole cores and cuttings, supplemented with data from several former underground and surface mines. Key beds used to identify and correlate the Luthersburg coal include the underlying Lower Kittanning coal and overlying Johnstown limestone and Upper Kittanning coal.

Throughout southern Elk County, the Luthersburg interval is characterized by scattered, isolated lenses of banded coal within an overall coarsening-upward clastic sequence composed largely of shale and siltstone. Underclay is generally poorly developed or absent, particularly where the coal is thick. Sandstone is uncommon. The consistent character of the Luthersburg interval in Elk County suggests that the coal occurrences are genetically related.

The Luthersburg coal is low to moderate in ash, moderate to high in sulfur, and free of partings. It is commonly thin but remarkably thick in a few places. As much as 9.2 feet of coal has been reported by drillers (Figure 2)! This was intriguing because coals of the Allegheny Formation are seldom so thick. I began to think back to the conversation I had had with the old-timer; could this be the same coal seam he had mentioned? It soon became evident that it was.

Because of the limited spatial resolution of the drill-hole data, more detailed information was required to better understand the mode of occurrence of the coal. This was provided by a crucial deep-mine map that accurately portrays the three-dimensional geometry (shape)

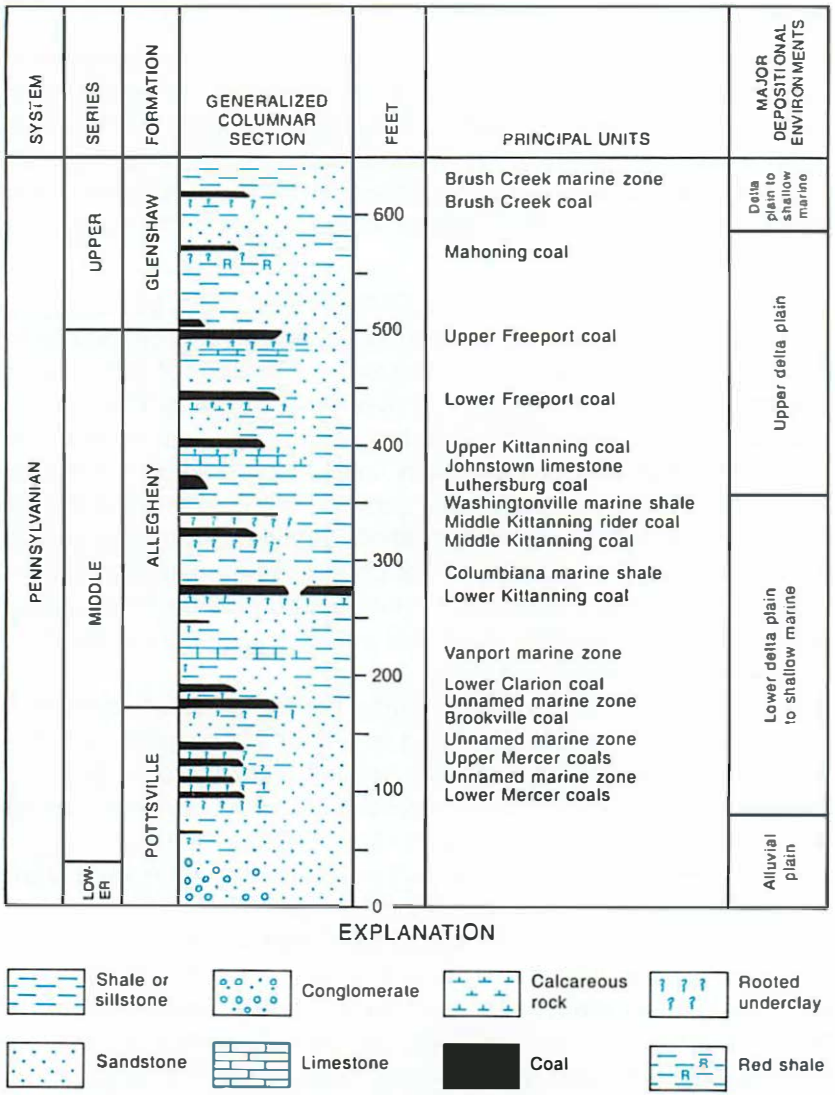


Figure 1. Stratigraphic column of coal measures in Elk County. The thickness of several units in the section is exaggerated for clarity.

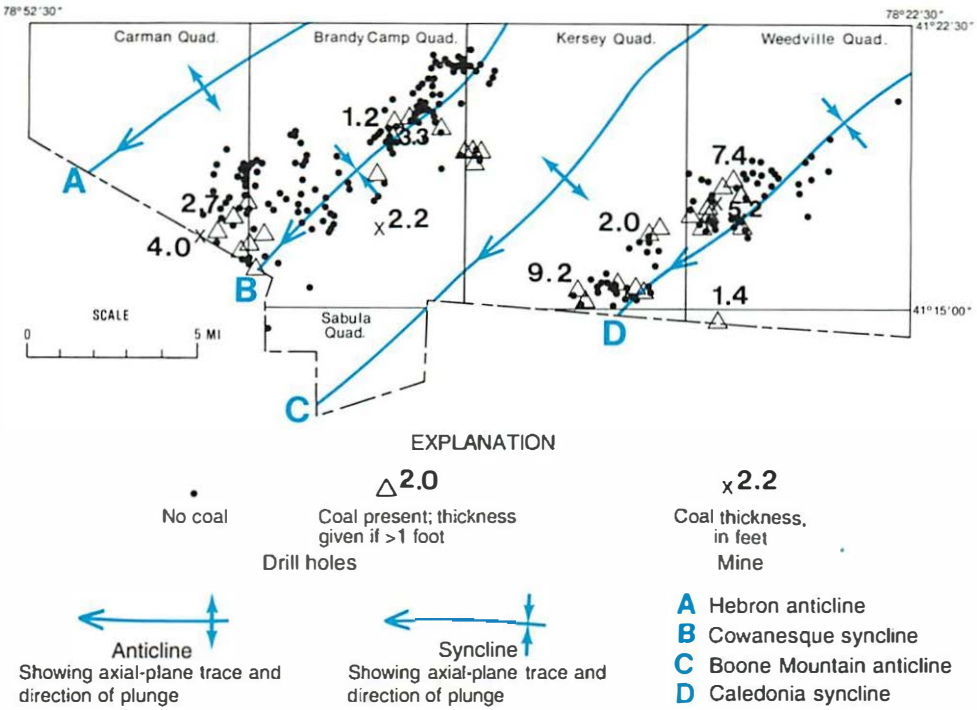


Figure 2. Location of fold axes and distribution of data points for the Luthersburg coal, southern Elk County.

of the coal body. The map strongly suggests that the coal in the mine was deposited as peat in an abandoned stream channel.

CALEDONIA NO. 13 OR "BANANA" MINE. The deep-mine map was prepared by New Shawmut Mining Company for the Caledonia (or Hand) No. 13 mine, which was operated by the Micale family from 1949 to 1966. However, small-scale mining had occurred here intermittently prior to this time, beginning as early as the 1840's. The now abandoned No. 13 mine is located in southeastern Elk County, toward the western edge of the Weedville 7.5-minute quadrangle, about 1.5 miles north-northwest of Weedville near the head of Caledonia Hollow (Figure 3). From the location and character of the mine, it was readily apparent that this was the very one alluded to years earlier by the gentleman I had met near Mount Zion crossroads!

Appropriately nicknamed the "banana" mine, the Caledonia No. 13 is elongate and arcuate shaped, and trends northeast to south over a distance of 1.5 miles (Figure 3). The maximum width of the mine is

about 450 feet. Subsurface control prior to mining is indicated by the drill-hole locations. (No exploratory drilling was done during or in advance of mining.) A drill-hole spacing of less than 200 feet would be required to resolve such narrow, elongate bodies. If not for a fortuitous borehole location and natural exposure in Caledonia Hollow, the coal worked in the "banana" mine would probably still remain undetected.

Coal isopachs for the "banana" mine and vicinity are shown in Figure 3. Where mined, the coal ranges in thickness from about 3 to 9 feet and is reported to reach 13 feet locally toward the northern end of the mine. Transverse sections through the mine are lenticular or U-shaped. The mine floor rises toward the edge of the workings by about 5 to 10 feet; the level of the roof remains nearly constant (Lewis Burch, 1992, oral communication). Coal is thickest along the thalweg, or line of maximum depth of the paleochannel. The coal abruptly pinches out to the east and west a short distance beyond the limits of mining and is replaced laterally by dark shale or silt-

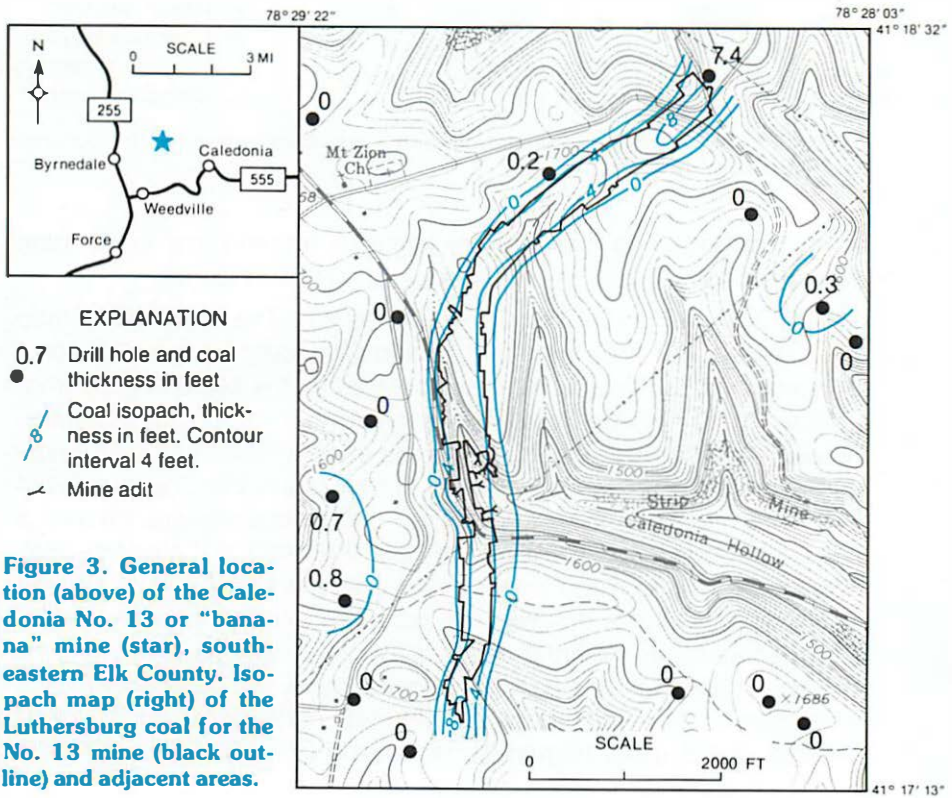


Figure 3. General location (above) of the Caledonia No. 13 or "banana" mine (star), southeastern Elk County. Isopach map (right) of the Luthersburg coal for the No. 13 mine (black outline) and adjacent areas.

stone. Within the mine, the coal is reported to be overlain by light claystone or siltstone and underlain by hard dark shale and perhaps some underclay locally (Lewis Burch, 1992, oral communication). As is typical for channel-fill coals, well-developed underclay is absent. The coal in the mine is banded, remarkably free of partings, locally capped with bony coal, moderate in ash, and high in sulfur.

Elsewhere in Elk County, the one other abandoned underground mine in the Luthersburg coal is also elongate, though less pronounced.

It is important to note that channel coals need not be thick. However, unless encountered incidentally, it is only where such coals are thick that there is sufficient economic incentive to mine them and consequently determine their three-dimensional geometry. Thus, many channel-coal deposits may go unrecognized or undetected.

INTERPRETED DEPOSITIONAL ENVIRONMENTS. It is likely that at least the thick Luthersburg coal in Elk County originated as peat in stagnant or standing water mostly in rapidly abandoned, sinuous stream channels. Accommodation space, thickness of coal, and lack of partings or impurities in the channel-fill coals indicate that the stream channels were rapidly abandoned and subsequently relatively stable and isolated so that the accumulating peat was not subject to influxes of fine-grained sediment from across the floodplains.

Abandoned channels such as these, which fill in very slowly and have a good chance of preservation, represent a depositional setting that is potentially rich in extraordinary (rare) fossil faunal assemblages (Hook and Ferm, 1985; Dodge, 1992). Animal remains would have accumulated in the channel bottoms and been preserved in the anoxic, organic-rich mud, which later became dark shale. No attempt has ever been made to search for such fossils in the floor of the Caledonia No. 13 mine. Unfortunately, the area around the mouth of the No. 13 was surface mined and backfilled in the early 1980's, thus precluding access to critical exposures.

Water depth within the abandoned channels was shallow enough to support luxuriant plant growth. The channel vegetation was ultimately transformed into banded coal. Formation of underclay (paleosol) was inhibited by submergence of the channel bottom, lack of weathering of the substrate, and insufficient time to develop soil prior to peat accumulation.

The channel coal pinches out along the channel margins, and relatively thin, scattered patches of coal, in places underlain by well-developed underclay, may represent small, isolated peat bogs or mires that formed locally within shallow depressions on the floodplains.

The paucity of sandstone in the Luthersburg interval in Elk County suggests that the paleochannels represent low-gradient, suspended-load tributary streams that presumably flowed into trunk streams elsewhere. These ancient trunk channels are now occupied by the Upper Worthington sandstone.

The paleoclimate during Luthersburg time was probably tropical wet-dry seasonal (Cecil and others, 1985; Dodge, 1992).

CONCLUSIONS. Recognition of the depositional environments of the Luthersburg coal has both scientific and economic importance. The fluvial character of the Luthersburg interval provides insight into the size, shape, and distribution of the coal bodies, but reliable estimation of coal resources still requires considerable subsurface data. Although the Luthersburg coal was formerly mined in Elk County, the relatively small size of the coal bodies and high cost of intensive exploration probably make further exploitation uneconomical in the foreseeable future, unless perhaps incidental in surface mining.

Finally, one must never underestimate the knowledge and experience of our local residents. Through their keen insight, lucid observations, and overall interest, they are an indispensable source of information on the geology and mining history of both Elk County and the Commonwealth.

The author thanks New Shawmut Mining Company, Saint Marys; Hepburnia Coal Company, Grampian; and Hess and Fisher Engineers, Inc., Clearfield, for providing the records and maps that form the basis of this study. The late Lewis Burch, mining surveyor, provided valuable information on the internal appearance and character of the "banana" mine.

REFERENCES

Cecil, C. B., Stanton, R. W., Neuzil, S. G., and others, 1985, Paleoclimate controls on late Paleozoic sedimentation and peat formation in the central Appalachian basin (U.S.A.): International Journal of Coal Geology, v. 5, p. 195–230.

Dodge, C. H., 1992, Mode of occurrence of the Luthersburg coal, Allegheny Formation (Middle Pennsylvanian), in Elk County, Pennsylvania, and some regional implications [abs.]: Geological Society of America Abstracts with Programs, v. 24, no. 3, p. 17.

Edmunds, W. E., and Berg, T. M., 1971, Geology and mineral resources of the southern half of the Penfield 15-minute quadrangle, Pennsylvania: Pennsylvania Geological Survey, 4th ser., Atlas 74cd, 184 p.

Hook, R. W., and Ferm, J. C., 1985, A depositional model for the Linton tetrapod assemblage (Westphalian D, Upper Carboniferous) and its palaeoenvironmental significance: Philosophical Transactions of the Royal Society of London, ser. B, v. 311, p. 101–109.

Yo-Ho-Ho and a Bottle of Unrefined Complex Liquid Hydrocarbons

by John A. Harper
Pennsylvania Geological Survey

Have you ever tasted crude oil? Probably not! In fact, most people would react to the question with disgust. If you have ever been near an oil well, oil pipeline, tanker, or refinery, you are undoubtedly familiar with the sight and odor of this liquid hydrocarbon. Pennsylvania's crude oil, called Penn Grade crude, often looks and smells pretty bad. Although it ranges in color from pale amber to pitch black, depending on its composition, most people familiar with the substance probably associate the words *crude oil* with a disgusting dark-green color and an odor reminiscent of some of the more volatile cleaning fluids, not an especially appetizing description. To make matters worse, a list of the chemical components in crude oil would make the Environmental Protection Agency's most wanted hit-list.

Many of us are familiar with the following more common uses for crude oil from our history books: applying it as waterproofing for clothing and canoes; mixing it with flour to create an excellent-quality axle grease and cheap lubricant; and burning it for inexpensive, albeit smoky, light. It is also an excellent furniture polish.

There was a time, more than 100 years ago, however, when many people not only tasted crude oil willingly but relished it as the cure for a plethora of medical problems, both internal and external. Both the Native Americans and the early settlers found "Seneca oil" or "rock oil" an excellent curative for burns, bruises, and old sores, and especially as a liniment for various "rheumatick" complaints. Some people even found the oil-laced waters of Oil Creek in Venango County a gentle but effective laxative (Giddens, 1947). Later, one man in particular made special use of the supposed curative properties of Penn Grade crude oil.

SAMUEL KIER AND THE SALT WORKS. Samuel M. Kier (Figure 1) was born in Saltsburg, Indiana County, but moved to Pittsburgh at the age of 21. He was an industrial explorer who dabbled in numerous enterprises with mixed success. His first business was running canal boats between Pittsburgh and Philadelphia with his partner,

Figure 1. Samuel M. Kier, 1813–1874. Photograph courtesy of the Drake Well Museum.

James Buchanan, who would later become president of the United States. He was also involved in brick manufacturing, coal mining, steel making, and lumbering. In 1847, Samuel and his father Thomas bought some property in Tarentum, Allegheny County, for the purpose of becoming part of the salt business that thrived there. They had two wells drilled on the property to a depth of 400 feet (to the sandstones of the Pennsylvanian-age Pottsville Formation, according to Hughes, 1933) and built a small salt works to produce salt from brine. Unfortunately, the Tarentum salt wells also produced an annoying quantity of oil that contaminated the brine.

At that time, the salt manufacturers had little use for oil, which was regarded as a contaminant. It could be used as a fine spindle lubricant in manufacturing cotton yarn when mixed with whale oil (Miller, 1974), but more often than not it was discarded into the Pennsylvania Canal that ran along the floodplain of the Allegheny River. There, much to the dismay of canal boat operators, it greased towlines and soiled the decks and sides of the boats (Giddens, 1947). One day, some of the neighborhood boys threw a burning branch into the canal and set the oil aflame. The sight of the canal seemingly on fire made Tarentum residents realize that the oil was good for something after all—light. The oil produced a large amount of noxious fumes and smoke, but it worked well enough to replace whale oil and lard as the primary source of lamp light.

KIER'S PETROLEUM, OR "ROCK OIL." In 1848, when Samuel Kier's wife developed tuberculosis, the doctor prescribed "American Medicinal Oil," which came from a well in Kentucky (Miller, 1974). Kier recognized that the medicinal oil was basically the same material as the contaminant being discarded from the family salt wells. Always the enterprising businessman, he turned his wife's misfortune into a new

business. He packaged the oil in half-pint bottles and sold them for 50 cents each. As part of his marketing strategy, he hired men to drive around the countryside in gaily-colored wagons to proclaim the worth of this new medicine and sell it to the public. In language that would have made P. T. Barnum proud, Kier advertised as follows:

> Kier's Petroleum, or Rock Oil, celebrated for its wonderful curative powers. A natural remedy! Procured from a well in Allegheny County, Pa., four hundred feet below the earth's surface. Put up and sold by Samuel M. Kier, 363 Liberty Street, Pittsburgh, Pa.
>
> The healthful balm, from nature's secret spring,
> The bloom of health and life to man will bring;
> As from her depths the magic fluid flows,
> To calm our sufferings and assuage our woes.

Another advertisement, in the form of a bank note (see front cover), unabashedly promised a cure for just about everything from rheumatism, gout, and blindness to the common cold. But though Kier's raw materials were basically free and the demand for his product was relatively high, he could not sell enough to make a profit. The expense of marketing ate up most of his proceeds, so he eventually withdrew his wagons and sold his oil only through drugstores.

THE FIRST OIL REFINERY. Samuel Kier continued to look for ways to obtain a profit from the previously disparaged crude oil. In 1849, sensing that there were other potential uses for it, he sent a sample for analysis to Professor James C. Booth. Booth was a prominent Philadelphia chemist and a former assistant of Henry D. Rogers, the first State Geologist of Pennsylvania during the First Geological Survey of the state. Booth recommended Kier's oil as a solvent for gutta-percha (Miller, 1974), a resin-based rubber used for molding and casting. He also suggested distilling the oil and gave Kier plans for constructing a small still. In 1850, Kier went into partnership with John T. Kirkpatrick, another Pittsburgh industrialist, and built the first still at his establishment on Seventh Avenue in Pittsburgh, near what is now the Civic Arena. The still was a small cast-iron kettle with a cover and distillation tube that had the capability of distilling one barrel of crude oil at a time. The fruits of Kier's first few attempts were as bad as the original crude, but he eventually learned to control the process and produced an oil that was at least useful for lighting. Kier called his new product "carbon oil" (McLaurin, 1896). Unfortunately, it still smelled pretty bad!

Kier, always trying to improve on things, increased production by substituting a five-barrel still, and experimented a great deal with various lamps. He finally invented a lamp that would burn his "carbon oil" with little or no smoke, and soon Pittsburgh was showing the world that Kier's oil lamps were the world's cleanest and brightest, and provided the best illumination. A few years later, a man named "Colonel" Edwin L. Drake showed up in Tarentum looking for ways to drill a well on Oil Creek near Titusville.

That was the beginning of the petroleum refining industry as we know it today. Had Kier been as clear-headed about this business venture as he was about the potential usefulness of crude oil, his descendants would be enormously wealthy today. But Samuel M. Kier never thought seriously about patenting his process or his lamp, so as Professor Booth later said to him (Giddens, 1947), "We missed it by letting this thing slip."

Still, not everyone could be convinced that crude oil was good only for lighting and lubrication. Giddens (1947, p. 18) quoted from an 1892 interview with Tarentum resident John W. Staley, published in the long-defunct newspaper *The Pittsburgh Dispatch:*

> The "rock oil" which [Kier] sold in bottles for medicine was simply the crude oil of to-day, though there is no question that that found in the Kier well was of the very best. I have taken many a dose of it inwardly, and, sir, if you ever get a bad cold in the chest, there is no better remedy to-day than to soak a flannel cloth with crude petroleum and lay it across your breast. Try it some night. In those days everybody up here in Tarentum used the Kier oil for medicine, and I'll bet you will find plenty of persons still living here who yet believes in the virtues of petroleum as a medicine. I am never without half a barrel of crude oil now in the house, and it is my standard remedy.

Drink up, me hearties!

REFERENCES

Derrick Publishing Company, 1898, The Derrick's hand-book of petroleum, a complete chronological and statistical review of petroleum developments from 1859 to 1898: Oil City, Pa., Derrick Publishing Company, 1,062 p.

Giddens, P. H., 1947, Pennsylvania petroleum, 1750–1872—a documentary history: Drake Well Memorial Park, Pennsylvania Historical and Museum Commission, 420 p.

Hughes, H. H., 1933, Freeport quadrangle, geology and mineral resources: Pennsylvania Geological Survey, 4th ser., Atlas 36, 272 p.

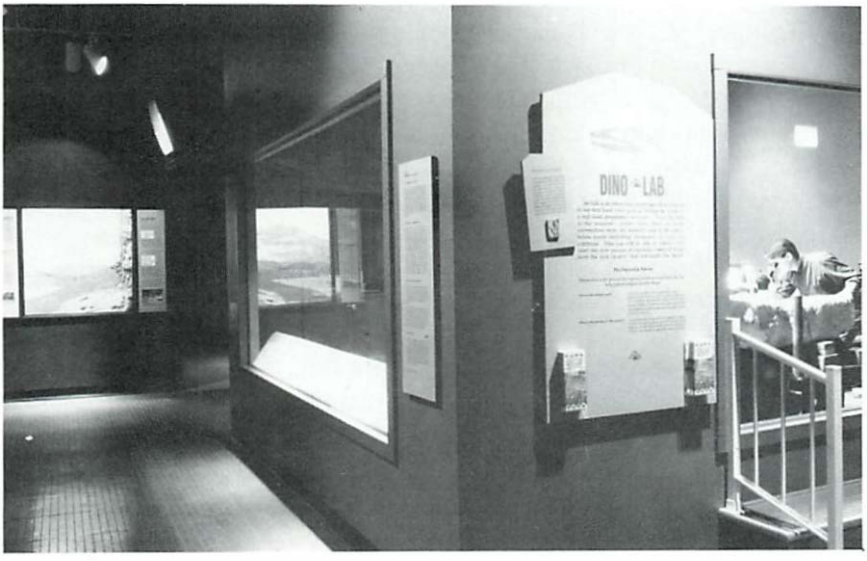
McLaurin, J. J., 1896, Sketches in crude oil—some accidents and incidents of the petroleum development in all parts of the globe, with portraits and illustrations: Harrisburg, Pa., privately published, 406 p.

Miller, E. C., 1974, Pennsylvania's oil industry: Pennsylvania Historical Association, Pennsylvania History Study 4, 69 p.

At the State Museum—Dino Lab: A Window to Paleontology

The State Museum of Pennsylvania in Harrisburg recently celebrated the one-year anniversary of **Dino Lab**, an interactive exhibit that offers visitors a behind-the-scenes look at fossil preparation. Lab technicians (preparators) expose fossil skeletons of dinosaurs and other prehistoric reptiles as visitors look on through one of two large windows. Supplemental information is provided by a short video, traditional exhibit explanations, and a free brochure. A closed-circuit television camera allows the museum-goer to view the preparator's work up close.

The centerpiece of the exhibit is a large block of Late Triassic mudstone (Petrified Forest Formation, Chinle Group of north-central New Mexico) that contains a number of partial and nearly complete skeletons of the small theropod dinosaur properly known as *Rioarribasaurus* (formerly *Coelophysis*). Dinosaurs similar to *Rioarribasaurus* roamed the Pennsylvania landscape during the Late Triassic Period (see *The Graterford Dino-*



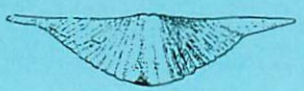
saurs—Tracking Triassic Travelers, Pennsylvania Geology, v. 25, no. 4, p. 2–9). The block was collected at Ghost Ranch, N. Mex., by personnel from the Carnegie Museum of Natural History in 1981 and was donated to The State Museum in 1993.

Since the opening of the exhibit, four additional dinosaur skulls have been discovered. The preparators, who are trained volunteers, uncover the skeletons and mechanically and painstakingly remove the matrix from the bone by using a simple pin vise and the aid of a binocular microscope.

The State Museum is continually recruiting dedicated volunteers to work in Dino Lab and/or in the Section of Paleontology and Geology. For more information about these volunteer opportunities, contact Dr. Robert M. Sullivan, Senior Curator, Section of Paleontology and Geology, The State Museum of Pennsylvania, Third and North Streets, Harrisburg, PA 17108–1026, telephone 717–783–9897.

Parking at Site 17 in *Fossil Collecting in Pennsylvania*

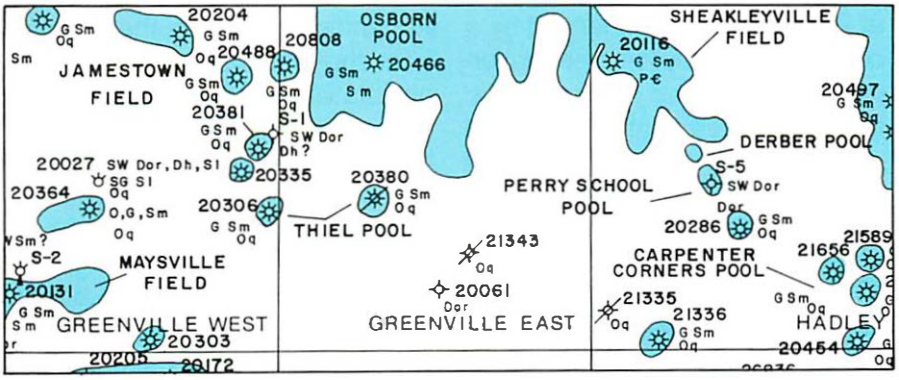
The Pennsylvania Geological Survey has received several complaints from Conrail concerning parking at Site 17—Rockville Quarry Brachiopod Locality, Dauphin County—in *Fossil Collecting in Pennsylvania* (Pennsylvania Geological Survey General Geology Report 40). Collectors are parking under the U.S. Route 22–322 bridge and thereby blocking Conrail's access road along the tracks. This has undoubtedly come about because of unfortunate wording in the directions on page 85 of the book. As written, the directions instruct collectors to "Park at the highway bridge over the railroad and walk up the hill to the quarry." Collectors should instead be instructed to park along the edge of the wide area immediately **south** of the bridge where their cars will not block the access road. Your consideration in this matter will ensure that this excellent site will continue to be available to collectors.



NEW RELEASES

Revised Map of Deep Wells Available

A revised and updated version of *Deep Well Oil and Gas Exploration and Development in Pennsylvania,* Open-File Report 94–01 of the Pennsylvania Geological Survey, has been completed and is now available as an ozalid (blueline or blackline) print. The report, which was last updated in 1989, consists of a map in two sheets at a scale of 1:250,000, compiled and drafted by L. J. Balogh. The map shows the locations of several thousand deep wells (wells that penetrate the top of the Middle Devonian Tully Limestone or its equivalent) in Pennsylvania. All deep wells outside established fields are shown. Only selected wells within developed areas are shown, however, because of space limitations at this scale. All wells are identified by permit number (or Survey file number for wells drilled before permitting), and information is provided regarding the formation at total depth, shows of oil, gas, and water, and producing formations. The fields and pools, many of which are named on the map, are highlighted with a stipple pattern that makes it easier to distinguish developed areas from potential exploratory areas. Open-File Report 94–01 may be ordered from the Pennsylvania Geological Survey, Subsurface Geology Section, 400 Waterfront Drive, Pittsburgh, PA 15222–4745, telephone 412–442–4235. The cost for the entire map (in two sheets) is $6.80 plus $0.48 state and local sales tax if sent to a Pennsylvania address, plus a delivery charge, which is dependent on the delivery destination.



Groundwater Quality at Presque Isle State Park

The Pennsylvania Geological Survey recently published Open-File Report 95-01, **Ground-Water Quality and Flow at Presque Isle State Park, Erie County, Pennsylvania with Emphasis on Impacts from On-Site Sewage Effluent Disposal.** The report, by staff hydrogeologist Michael Moore, includes findings from a comprehensive, three-year study of the groundwater system at Presque Isle. Initiated in 1989 at the request of the Bureau of State Parks and the Presque Isle State Park Advisory Committee, the purpose of the study was to determine whether on-site sewage treatment and effluent disposal systems in the park contributed to the elevated concentrations of fecal coliform bacteria in the nearshore lake water that result in closures of the bathing beaches.

The groundwater-flow system at Presque Isle is influenced by a complex interplay of precipitation rates, water level in Lake Erie (which is largely controlled by wind intensity and direction), vegetation activity, air temperature, soil-moisture levels, and tides. The result is a complex hydrologic system in which all precipitation leaves the peninsula as either water vapor (direct evaporation or transpiration by plants) or groundwater flow.

The principal conclusion of this investigation is that sewage effluent was not a factor in the elevated fecal coliform concentrations that closed the bathing beaches.

The most unexpected discovery was widespread, naturally occurring, high concentrations of dissolved arsenic in the groundwater. Virtually all groundwater 18 feet or more below the water table can be expected to exceed the 50 microgram per liter Maximum Contaminant Level (MCL) for arsenic in drinking water. Fortunately, park facilities have long been served by the municipal water system of the city of Erie.

The report is written for readers who have a minimum of technical expertise. Colored hydrographs are annotated to illustrate flow-system concepts. Similarly, annotated graphs are used to illustrate geochemical concepts. Appendicies include the results from the water sample analysis and statistical summaries for several data categories. Copies of the report can be obtained for $10.00, plus $0.60 state sales tax if mailed to a Pennsylvania address, from the Pennsylvania Geological Survey, P. O. Box 8453, Harrisburg, PA 17105–8453. Please make checks payable to *Commonwealth of Pennsylvania.*

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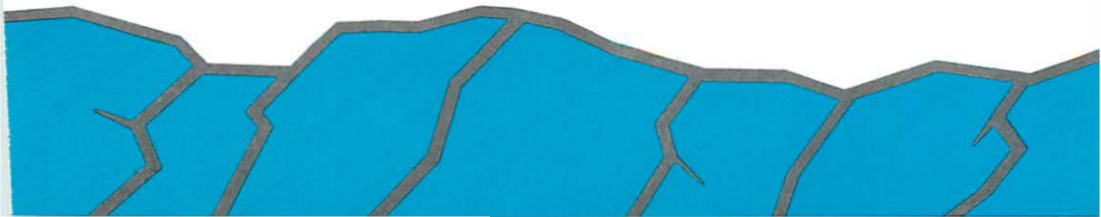
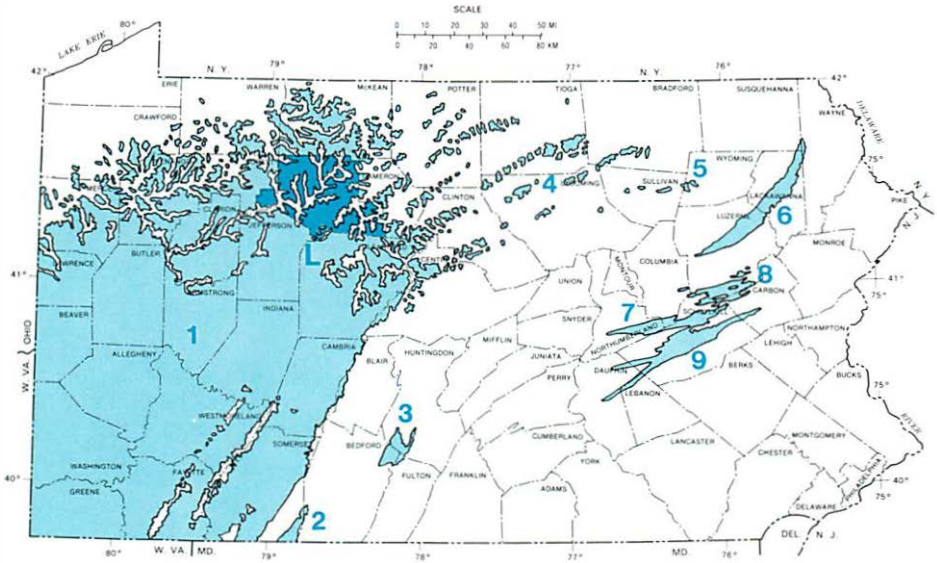
TOPOGRAPHIC MAPPING
GROUNDWATER-RESOURCE MAPPING



COAL FIELDS OF PENNSYLVANIA

(See article on page 2)



EXPLANATION

BITUMINOUS FIELDS

1 Main Bituminous
2 Georges Creek
3 Broad Top
4 North-Central

ANTHRACITE FIELDS

5 Western Northern
6 Northern
7 Western Middle
8 Eastern Middle
9 Southern

Coal measures in Elk County

L Type area of Luthersburg coal

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