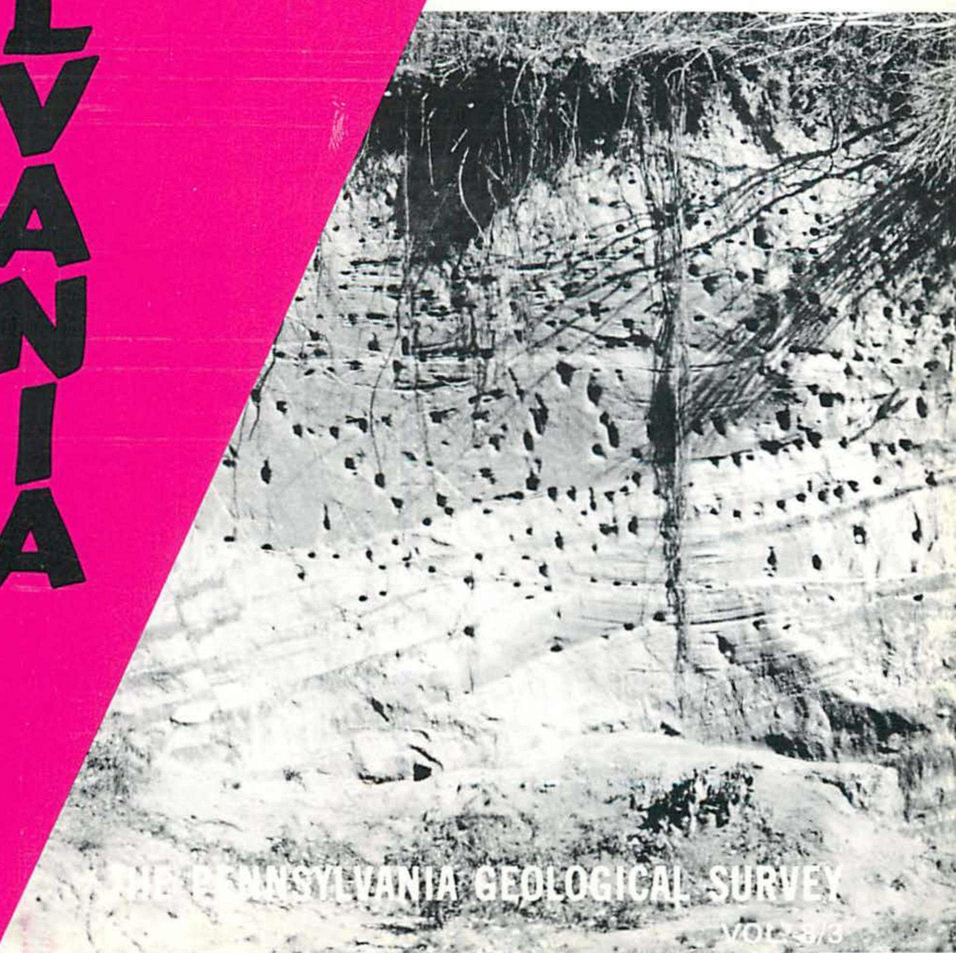
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 8/3

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Multiple benefits are provided by sands exposed in a borrow pit near Oakland in Susquehanna County. Originally deposited by glacial meltwater during late Wisconsinan deglaciation, these deposits now provide homes for cliff swallows and sand for man.

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

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JUNE 1977

FROM THE DESK

OF THE

STATE GEOLOGIST . . .

LABELS ARE CREATED BY MAN

This publication tries to keep the readers informed on geologic developments of general interest. In certain instances these turn out to be issues of some controversy. As scientists and public servants, our responsibility at the State Geologic Survey is to share our data and experiences with all who are interested, regardless of their respective viewpoints. Such is the case with the current interest in the recognized and potential uranium mineral occurrences in Pennsylvania.

In recent months a number of exploration geologists have visited our offices pursuant to our recognition and identification over the years of nearly 50 locations of uranium-bearing mineral concentrations in Pennsylvania. Those are mineral occurrences with which Pennsylvania has been naturally endowed and the present interest in them is due to the increased demand for such resources. The exploration geologists tell us that Pennsylvania has one of the Nation's most favorable undeveloped geological settings for the occurrence and discovery of uranium-bearing mineral concentrations.

Yet even as there is a commercial interest in exploring for uranium concentrations in Pennsylvania, there have also come forth voices of concern and opposition, in several cases blocking further exploration. Some of these state that uranium resources are basically dangerous and morally evil, and that their development should be either discouraged or banned in Pennsylvania.

One cannot escape the reality, however, that the uranium concentrations do exist in the Commonwealth, and the more we can know about them, the better off we would be, whether from an industrial standpoint or an environmental standpoint.

There is, furthermore, a basic question as to whether a resource, or any item, is in itself evil. The same type of engine which drives us to work or to recreation, also propels tanks on missions of destruction. Planes that fly us speedily to far distant destinations also are capable of bombing missions. Dynamite has been used in deadly weapons, but more so for constructing roads, building foundations, farmlands, and reservoirs.

And so it is with uranium resources. While many properly shudder at the horrors that they associate with nuclear warfare, all too many persons do not recognize the beneficial uses of radioactive materials which are related to uranium resources. Thousands have benefited

(Continued on Page 7)

Pennsylvania Land Use Maps Completed

Detailed land use maps of the entire Commonwealth of Pennsylvania have been completed by the United States Geological Survey under a cooperative agreement with the Pennsylvania Department of Environmental Resources.

Representatives of the Federal agency presented the completed land use maps to DER Secretary Maurice K. Goddard on Friday in ceremonies in the Secretary's office.

Dr. Goddard noted that Pennsylvania is one of the first states in the Nation to have a completed land use survey using the sophisticated new techniques devised by the U.S. Geological Survey.

The LUDA (Land Use Data Analysis) program was introduced by the U.S.G.S. in 1974. Utilizing the latest photo imagery available from high altitude planes, the land use and land cover classification system can recognize and delineate as many as 37 separate land use categories, some for areas as small as 10 acres. The scale of the final maps which have been prepared is 1/250,000 or approximately one inch on the map equalling four miles on the ground.

Recognizing the potential benefits to the Commonwealth and its various planning and economic programs, DER's Bureau of Topographic and Geologic Survey, with the cooperation of the Bureaus of Environmental Planning and Systems Management, worked to arrange a cooperative agreement with the U.S.G.S. in 1975 to prepare land use and land cover maps for all of Pennsylvania.

For this project, Pennsylvania was divided into 14 subdivisions, each of which corresponded to a standard 1:250,000 scale topographic base map. For each of the 14 base maps, six overlays were compiled including the land use and land cover map which identifies 30 different categories of land use. Other overlays show county boundaries, river basin boundaries, State land areas, Federal lands and county census subdivision.

One of the most important aspects of this new mapping program is that the data have been digitized and placed on magnetic tapes so they can be stored in a computer, reproduced, evaluated and analyzed in various ways. The data also can be updated readily as newer information becomes available in future years. Changes in land use will be identifiable, both in type and quantity. With the data digitized, it will be possible to enter other map data into the system and print overlays of other mappable characteristics. Thus, local, state or regional users of land use data will be able to update and add new categories of data or devise systems for subdividing the existing categories.

In announcing completion of the land use maps, Secretary Goddard noted they can be a valuable tool for anyone involved in comprehensive land use planning. These maps and data should benefit State and local government agencies, transportation planners, industry, energy planners, agriculture, conservation groups and recreation agencies. The digitized data on computer tapes from which the map was plotted will be finished in approximately six months and will be housed and made available through the Bureau of Systems Management, Second Floor, Fulton National Building, Third and Locust Streets, Harrisburg.

The initial 98 maps and overlays which were delivered by the U.S.G.S. (seven for each of the 14 subdivisions) will be housed and maintained at the Bureau of Topographic and Geologic Survey, 914 Executive House, Second and Chestnut Streets, Harrisburg. The maps will be available for review and inspection at the Bureau offices and may be copied at the users expense.

Copies of the Pennsylvania land use and land cover maps and associated overlays are also available for review and inspection at the U.S. Geological Survey's National Cartographic Information Center (NCIC) East, Eastern Mapping Center, Room 2B200, National Center, 12201 Sunrise Valley Drive, Reston, Va., Telephone 703-860-6336; the map names and USGS open-file report identification numbers are Clarksburg 76-035, Cumberland 76-036, Canton 76-041, Wilmington 76-636, Cleveland 77-105, Warren 77-106, Williamsport 77-107, Scranton 77-108, Harrisburg 77-109, Pittsburgh 77-110, Neward 77-111, Erie 77-112, Buffalo 77-113 and Baltimore 77-114. Copies also may be purchased at NCIC East. A paper diazo copy of each map or overlay is $2, a film diazo copy is $5.60 and a stable-base film positive copy is $22.

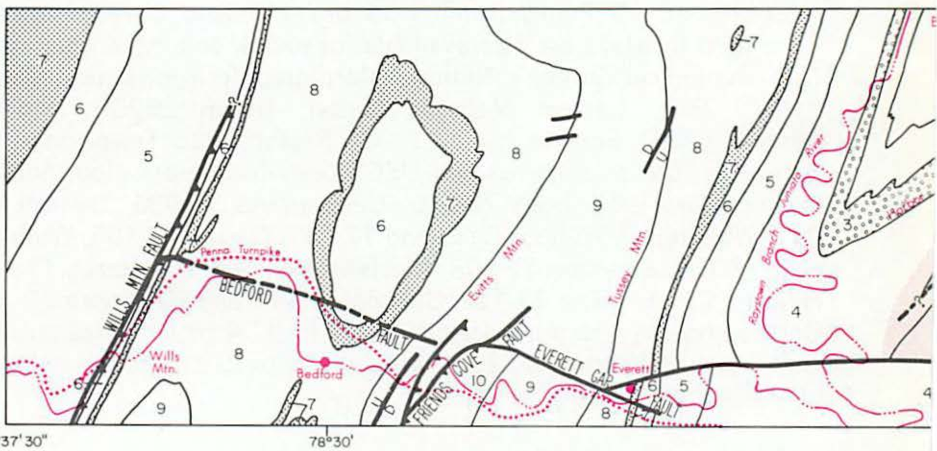
MAJOR CROSS STRUCTURES IN PENNSYLVANIA (PART II)

With Notes on a Possible New Location
for Natural Gas Exploration

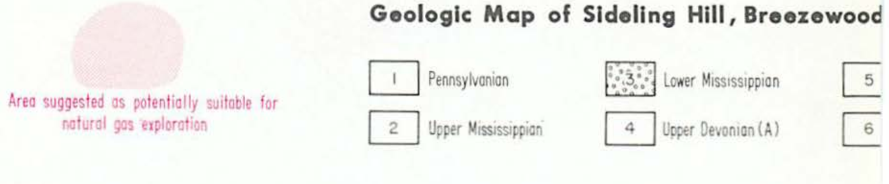
by D. M. Hoskins and S. I. Root

This is the second of a two-part article (for Part I, see Pennsylvania Geology, vol. 8/2, p. 8-11) describing unusual cross structures discovered while preparing the new Geologic Map of Pennsylvania.

West of the termination of the Shippensburg Fault and along its trend no additional surface offsets are known until two short faults offset the Tuscarora Formation on Tuscarora Mountain. Several small, short faults also offset the same formation just north of N 40° latitude on the next two Tuscarora ridges to the west (Cove Mountain and Scrub Ridge). These latter short faults are probably related to faulting associated with the northern end of the McConnelsburg thrust fault which here is composed of several traces as it feathers to extinction.



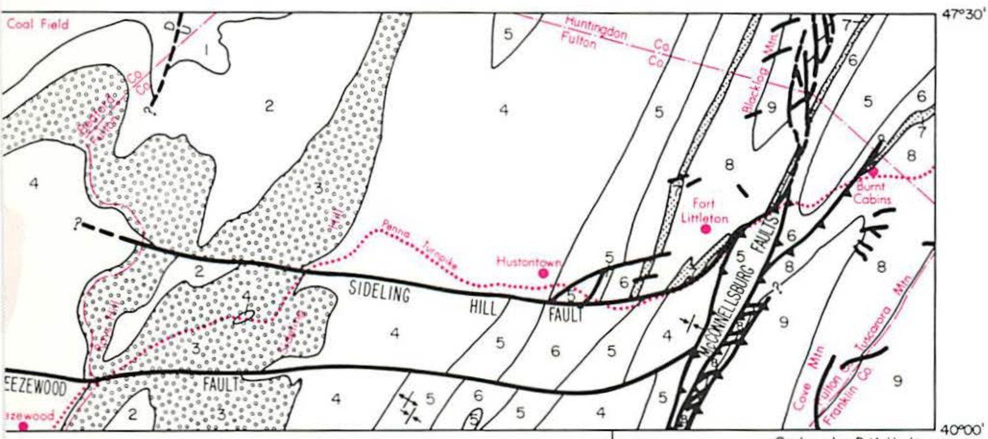
Geologic Map of Sideling Hill, Breezewood



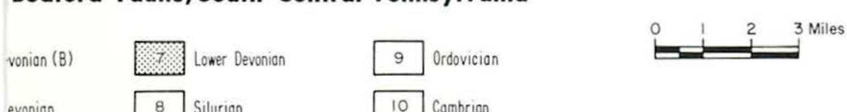
The northerly of the two major faults west of the McConnellsburg Fault is here called Sideling Hill Fault. It begins paralleling the Pennsylvania Turnpike and McConnellsburg Fault at the Fort Littleton exit of the Pennsylvania Turnpike where it juxtaposes Middle Devonian rocks. Within one kilometer, its trace is nearly east-west where it crosses the nose of Shade-Black Log Mountain anticline and places late Silurian rocks in contact with Middle Devonian rocks. South of Hustontown, the basal contact of the Catskill Formation is displaced one kilometer to the west. Displacement of contacts and structures where the fault crosses the Broad Top synclinorium indicate vertical movement.

As with most faults, exposure of rock in the fault zone is nearly non-existent. A nearly unique outcrop along the Sideling Hill Fault existed during the construction of the now unused Sideling Hill Tunnel of the Pennsylvania Turnpike. The Sideling Hill Tunnel was constructed in the fault zone because the associated topography on Sideling Hill allowed for the shortest tunnel in this area. Cleaves and Stephenson (1949, Plate 24) show the complexity of folding and faulting encountered in what should have been a region of nearly uniform, low angle, northwest dip.

The trace of the fault west of the Turnpike tunnel is shown by the prominent abrupt termination of the Mauch Chunk Formation



Bedford Faults, South-Central Pennsylvania



in the Ray's Hill-Sideling Hill syncline. The portion of the fault west of the tunnel was independently determined by W. S. Kowalik (personal communication).

Two miles south of the Sideling Hill Fault, a more extensive fault, herein named the Breezewood Fault, parallels the same east-west trend. The eastern portion of the Breezewood Fault shows displacement westward of the base of the Catskill, similar to the Sideling Hill Fault. North of Breezewood, the movement is apparently vertical. Here rocks below the Catskill are elevated and the nose of the plunging anticline defined by the basal contact of the Catskill reappears. At Everett the formation contacts are displaced westward south of the fault, implying again lateral movement.

The Breezewood Fault joins with the fault mapped for a short distance by Knowles (1966) and in his report, referred to as the Everett Gap Fault. The Everett Gap Fault, more properly, is restricted to the west-northwest trending fault from Everett to where it joins with the Friends Cove thrust fault. Knowles (op.cit.) also noted a fault offsetting Evitts Mountain on strike but not continuous with the Everett Gap Fault. He did not map it westward but new mapping shows that it continues for another six miles, joining with another short segment of a fault previously mapped by students at the 1930's Penn State Field Camp.* Evidences for the fault between the two previously mapped short segments are (1) offset of the late Silurian and early Devonian rocks in the notch where the Pennsylvania Turnpike crosses a ridge north of Bedford, and (2) the anomalous straight stream segment of the west branch of the Juniata River where it cuts into and through the very resistant Tuscarora Formation south of Wolfsburg. The Bedford Fault continues westward and joins with the northern portion of the Wills Mountain thrust fault which bounds the west side of the Wills Mountain Anticlinorium. No observable offsets occur in surface rocks west of this junction.

The junction of the Breezewood and Everett Gap faults marks a change of the structures from a nearly east-west to a west-northwest trend. This trend continues to the Ohio-Pennsylvania line, as mentioned in Part I of this report.

A Possible Locality for Natural Gas Exploration

North of Breezewood, rocks below the base of the Catskill are upthrown in an anticlinal structure which is cut off by the Breezewood Fault. These rocks are not present south of the fault because they had disappeared by northward plunge approximately five miles south of the Breezewood Fault near Mattie. South of Mattie, along the same anticlinal structure, is the Purcell gas field described by Cate (1963). Since the anticlinal structure which contained natural gas in the Purcell field is repeated north of the Breezewood Fault in the anticlinal structures which occur near Graceville, it is within the realm of possibility that this structure and its terminating fault may form a trap for natural gas and might be considered as a locale for testing its potential for the production of natural gas.

*Maps on file at the Pennsylvania Geological Survey.

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(FROM THE DESK Continued)

from diagnostic nuclear medicine and nuclear scanning devices which can detect body malfunctions while effective treatment is still possible; other thousands have received life-saving radiation treatments to combat cancerous growths. Radioactive materials dependent on uranium resources are also being widely used in industry to test the structural soundness of metallic objects and metal welds. Most recently, this technique was used to spot and repair the faulty welds of the Alaska pipeline. Radioactive tracers are being used to track down and curtail leakages of pollutant liquids and gases, and other radioactive sources are used to sterilize surgical equipment.

Our naturally endowed resources are in themselves neither good, nor evil. Those attributes depend upon the uses that man imposes upon them. And thus in considering Pennsylvania's uranium resources, consideration should be given to the benefits they might contribute.

Arthur A. Socolow

Pennsylvania Geological Survey's Best Sellers For 1976

The number one and two best sellers continue, as in the past two years, to be G-40, *Fossil Collecting in Pennsylvania,* and G-33, *Mineral Collecting in Pennsylvania.* The most popular map continues to be Map No. 1, *The Geologic Map of Pennsylvania.*

"Cavers" found G-65, *Caves of Southeastern Pennsylvania,* an attractive item and it was our third most popular seller. Fourth and fifth on the popularity list were our two recent reports on bituminous coal, Report M-68, *Bituminous Coal Resources in Southwest Pennsylvania,* and M-69, *Analyses and Measured Sections of Pennsylvania Bituminous Coals;* this reflects the interest in Pennsylvania's major energy resources.

The environment was on the minds of purchasers of our publications because our Environmental Geology Reports No. 1 and No. 2, *Engineering Characteristics of the Rocks of Pennsylvania* and *Environmental Geology for Land Use Planning* again were our 6th and 7th most popular, after dropping from the top ten in 1975.

Field trips to local areas interested our readers as our *Guide to the Geology of the Pittsburgh Area,* Bulletin G-59 was our eighth most popular seller.

Ninth and tenth place were shared equally by two reports on economic mineral resources; one, our Bulletin PR 188 which was *Oil and Gas Developments in 1974* and one of our oldest reports, Mineral Resource Report M-6, Part 1, *Bituminous Coal Fields of Pennsylvania.*

Maps 42, 43, 44, and 45 were the most popular after Map 1. These four maps are all of the Pittsburgh region and are titled, respectively, the Geologic Map, Structure Contour Map, Oil and Gas Fields Map, and Mined Out Area Map of the Greater Pittsburgh Region.

as youngsters see us

(from an article by Harold Dunn, *Science Digest* – June, 1976)

"Knowledge about rocks and minerals has advanced to the point where it is no longer understandable."

"One of the main byproducts of rocks is geologists."

"We have had rocks on earth forever and maybe even longer."

Central Pennsylvania Sand Dunes

by Carol Myrna Chase

Along the east bank of the West Branch of the Susquehanna River opposite Lewisburg is a sand dune field created during the Wisconsin age, the latest of several periods of glaciation that covered parts of Pennsylvania. Although the Wisconsinan glacier halted several miles to the north of the West Branch (Figure 1), large amounts of its sedimentary debris were flushed into the river and deposited on floodplains downstream.

As the glaciers retreated and the supply of sediment dwindled, the river began to cut into the material it had previously deposited, leaving terraces on the sides. As the river eroded downward, the water table was lowered, causing the terrace surface to dry out, thus providing a supply of loose material for the wind to move about.

Along the east bank of the river in Northumberland County opposite Lewisburg, the floodplain is extremely broad, and the terraces are well developed. The prevailing westerly winds swept across the lower terraces, and picked up the silt and sand sized particles, depositing them on the upper terraces to the east.

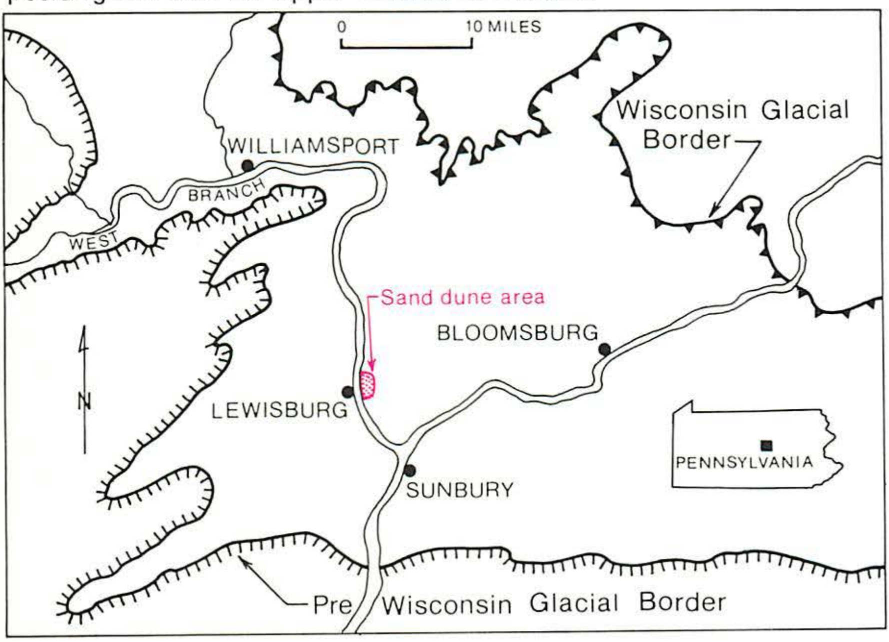

Fig. 1 Index map of the sand dune area showing approximate extent of area glaciers.

The sand was first blown into transverse dunes (Figure 2), long, parallel sand ridges which trend perpendicular to the direction of the wind. In cross-section they are asymetric with their steep faces to the

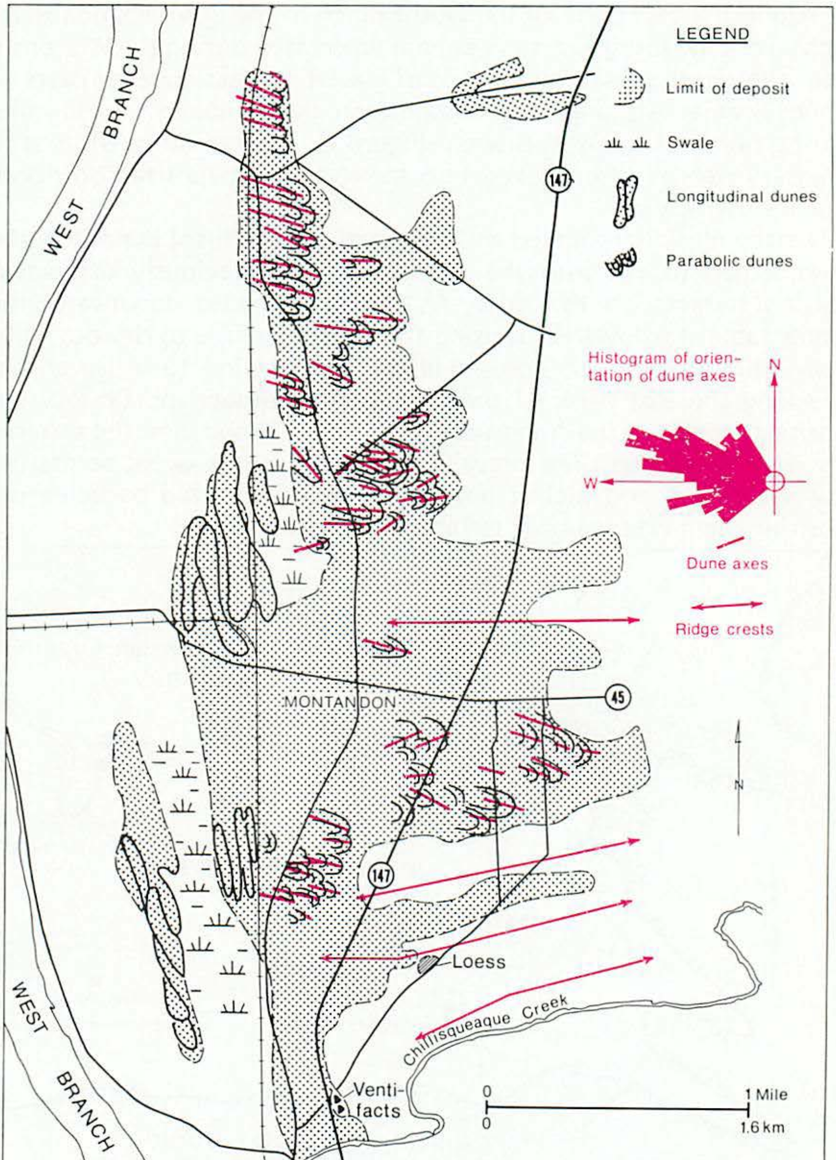

Fig. 2 Map of the surficial deposits of the sand dune area.

leeward. The sand grains were rolled and bounced by the wind up the gentle windward slope and then down the steep slope in the calm air to the leeward of the dune.

To the east of the transverse dunes is a swale where the high water table creates a poorly drained marsh, the water being empounded by the transverse dunes to the west and the upper terraces to the east.

East of the swale, the sand has been blown out into parabolic dunes in a dunefield which extends approximately a mile and a half east of the river. Parabolic dunes are U-shaped dunes with the tails oriented upwind and the convex, steep slope, oriented downwind. If the tails are anchored by vegetation, the dune may be stretched out downwind into long, hairpin-like forms (Figure 3).

Fig. 3 Aerial photograph looking north to the parabolic dunes.

The Montandon sand deposit is typical of windblown deposits in several ways. The thickness of the deposit, as well as the size of the individual grains, decreases with distance from the source. The sand fits into the general size catagory of recent dune sands, the samples having means of sand grain diameters ranging from .06 to 1.0 mm. The surfaces of the individual grains are frosted due to the effects of wind transport, and the grains range in shape from angular to subangular. 85% of the sand is composed of quartz, the remaining 15% being made up of rock fragments and heavy minerals.

Other features occurring in the same area as the dunes include an upper loess (windblown silt) layer, and some small sand-blasted boulders (ventifacts), all of which confirm a windblown origin. The ventifacts are the remains of an earlier, Pre-Wisconsinan till of which the finer particles were partially removed by the wind, leaving the larger pebbles and boulders as a lag deposit smoothed by the windblown sand.

Wind direction is estimated by measuring the orientation of the long axis of the parabolic dunes (Figure 2). These measurements show that the major effective wind was from the northwest, with minor fluctuations from the southwest. The ventifacts, created by windblown sand abrasion, indicate strong winds as well as a lack of significant vegetative cover.

The exact climatic conditions that formed the deposit are more difficult to establish. The dunes may quite possibly have formed during a post-Pleistocene arid period when the region had a steppe-like climate. However, aridity is not a necessary factor in dune building because, as stated before, the down-cutting of the river provided ample dry sediment for the wind to work (Cooper 1942). Parabolic dunes form today in moist climates, in Oregon and other coastal areas as well as the Alaskan tundra (Cooper 1938), so it is possible that these dunes were formed during a cool, moist climate following the retreat of the glacier. Possibly, they could have been initiated just after the retreat of the glacier, and continued building during later arid periods.

This sequence of dunes created from glacial outwash is a common phenomenon of the Wisconsinan age. Similar deposits occur along the Mississippi River in Minnesota, near other North American rivers and lakes, and throughout Europe.

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EARTH SCIENCE TEACHERS' CORNER

NEW U.S.G.S. "POPULAR GEOLOGY" SERIES PUBLICATIONS–

Ferdinand Vandiveer Hayden and the Founding of the Yellowstone National Park; (revised edition 1976); 6 x 9 booklet, 44 pp. Excellent duo-tone pictures and sketches; historical and present-day photos.

John Wesley Powell's Exploration of the Colorado River; 6 x 9 booklet, 28 pp. An abundance of historical photos, maps, and sketches of the Colorado River canyon make this booklet a valuable addition to your library.

Plain Geology; 4 x 9 pamphlet, 15 pp. In 1921, George Otis Smith, then Director of the U.S.G.S., made a plea for "Plain Geology." He felt that many geologists in their writing lost sight of their audience; that their reports were couched in words and phrases that were understandable only to other scientists. His plea was a classic and is just as applicable today as it was in 1921.

Geology of Caves; 4 x 9 pamphlet, 19 pp. Describes the geologic nature, origin, and features of caves; written in non-technical terms.

Sources of Information and Services of the U.S. Geological Survey; 4 x 9 pamphlet, 15 pp. Discusses the wide range of services and sources of information disseminated by the U.S.G.S.

Selected Bibliography on Maps and Mapping; 4 x 9 pamphlet, 7 pp. Bibliography is intended for teachers and students interested in learning more about maps.

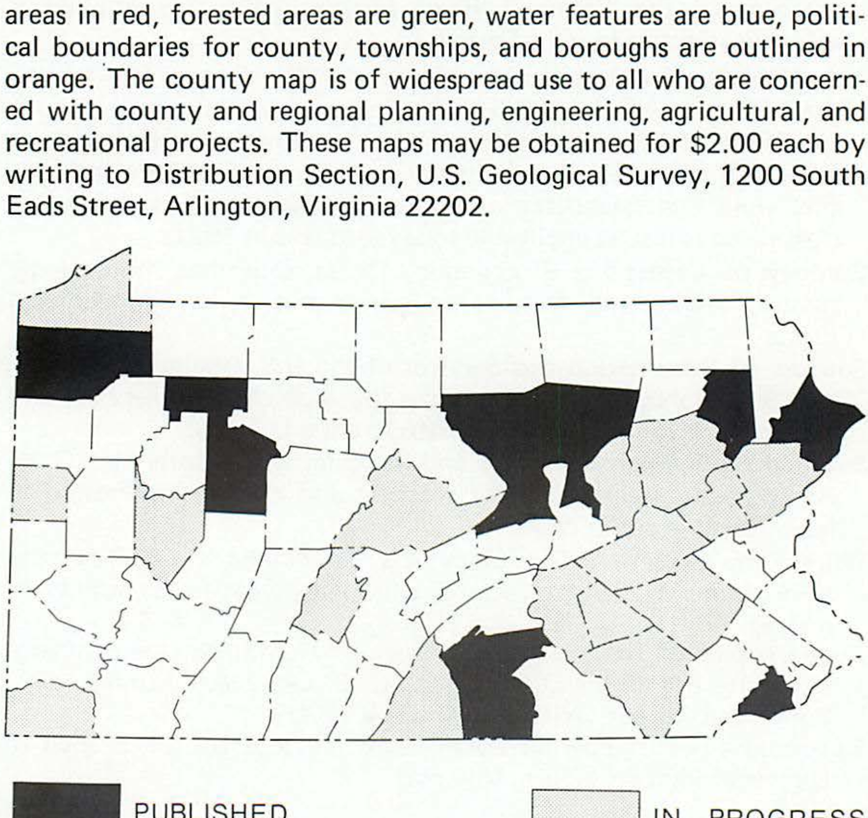
World Data Center -A- Glaciology; 4 x 9 pamphlet, 8 pp. A description of the WDC-A in Tacoma; what it is, what it has, and what it does.

Single copies of these publications may be obtained free of charge from the Branch of Distribution, U. S. Geological Survey, 1200 South Eads Street, Arlington, Virginia 22202.

Bulk quantities of Popular Publications are sold by the Branch of Distribution in Arlington, Virginia.

U.S. Geological Survey Issues New County Topographic Maps

As a product of the cooperative county mapping program with the Pennsylvania Geological Survey, the U.S. Geological Survey has recently issued new topographic maps of Adams, Crawford, Cumberland, Delaware, Lackawanna, Lycoming and Pike Counties. These new maps are at a scale of 1:50,000 (approximately 4000 ft. to the inch) and follow the previously issued maps of Union, Sullivan, Montour, Jefferson, and Forest Counties. As is standard with this new series of county maps, contours are shown in brown at 20-ft. intervals, cultural features are shown in black with major roads and urbanized areas in red, forested areas are green, water features are blue, political boundaries for county, townships, and boroughs are outlined in orange. The county map is of widespread use to all who are concerned with county and regional planning, engineering, agricultural, and recreational projects. These maps may be obtained for \$2.00 each by writing to Distribution Section, U.S. Geological Survey, 1200 South Eads Street, Arlington, Virginia 22202.

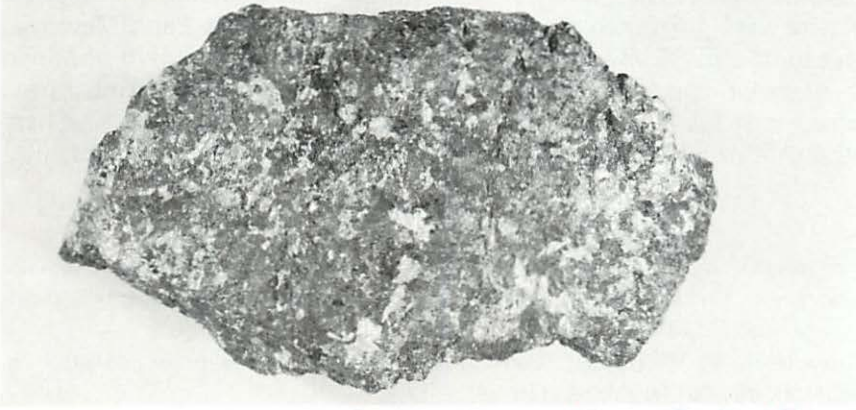


Mystery Prospects, Berks County

by Robert C. Smith II

Berks County continues to be a source of geological and mineralogic surprises (see **Pennsylvania Geology** v. 5, no. 6 on fetid barite and v. 6, no. 6 on molybdenite). Arsenic minerals, normally rare in Pennsylvania and previously unknown in the Reading Prong, have now been found and identified in moderate amounts on the dumps at a long-abandoned prospect north of Huff's Church, Hereford Township, Berks County (latitude 40° 27′ 30″ N, longitude 75° 36′ 49″ W). Almost nothing is known about the history of this prospect or its original purpose. The normally complete maps of d'Invillers (1883, sheet VI) do not show a mine or prospect at this location. Although minerals from nearby prospects are listed, S. G. Gordon's 1922 classic **Mineralogy of Pennsylvania** also does not mention the prospect. All that is known is that B. L. Miller (1912) found an unexciting amount of graphite in a gneiss composed of feldspar, quartz, horn-blende, biotite, garnet, and pyrite, and that the shaft was backfilled during the 1960's.

In addition to the arsenic species discussed below; magnetite, pyrrhotite, chalcopyrite, fayalite, almandine?, hornblende, and abundant graphite are present on the dumps. The arsenic mineral occurs as tin white, metallic blebs up to 1/2 inch and veinlets up to 1/8 inch x 1-1/2 inches, and yields X-ray spacings which suggest



Rock from prospect at Huff's Church containing safflorite (silvery) with pyrrhotite (gray) in hornblende (black). Specimen is 3.5 inches.

that the mineral is safflorite. Safflorite, however, is reported to be a cobalt arsenide, whereas the mineral from Huff's Church contains iron and arsenic with only traces of cobalt. Thus, the unit cell (a=5.23Å, b=5.972, and c=2.928 all ± 0.005) does not fit the presumed $FeAs_2$ composition and the mineral could be called either safflorite or loellingite, depending on whether the importance is placed on atomic structure or chemical composition. Either of these would, however, be a new mineral species for the state.

Assays of a bulk sample derived from almost 50 pounds of one-inch chips each containing at least traces of the white arsenic mineral show that the "ore" contains 1.03% As, 0.13% Cu, 340 ppm (0.034%) Ni, 150 ppm Co, 50 ppm Zn, 30 ppm Pb and Bi, 20 ppm Sn, 0.48 oz Ag/ton, and 0.016 oz Au/ton. Of these, the As content is quite high, and the Cu, Ag, and Au slightly high. At present prices, the latter three would have a total value of about $5.75 per ton, far too low to be mined profitably for an apparently small "orebody." Even the rich magnetite matrix presently has little value in deposits with less than 10 million tons. Was the mystery shaft dug for iron, copper, silver, gold, graphite, or even the shiny white arsenic mineral? At least, the form and amount of arsenic present are probably not harmful.

The host rock has been mapped as a Precambrian hornblende graphite gneiss (Buckwalter, 1959). Bromery et al. (1959) show aeromagnetic anomalies less than a mile to the east. Many pieces of "ore" (magnetite-pyrrhotite-rich rock) are slickensided, suggesting faulting in the area. Analyses of a few stream sediment samples from within a mile of the prospect failed to find any obvious continuation of copper mineralization.

The prospect was kindly brought to our attention by James L. Quickel of Carlisle. Qualitative chemical tests showing the absence of Co were furnished by D. T. Hoff of the William Penn Memorial Museum, and SEM analyses showing iron and arsenic were obtained through Donald Schmerling, Chemetron Corp. Each has contributed because of his interest in Friends of Mineralogy, Pennsylvania Chapter's role in advancing knowledge of minerals in the Commonwealth.

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GROUND-WATER LEVELS

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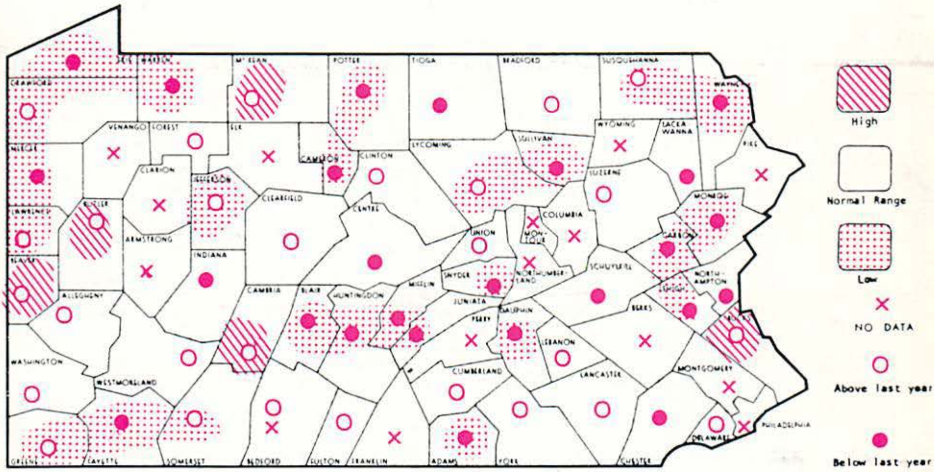

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