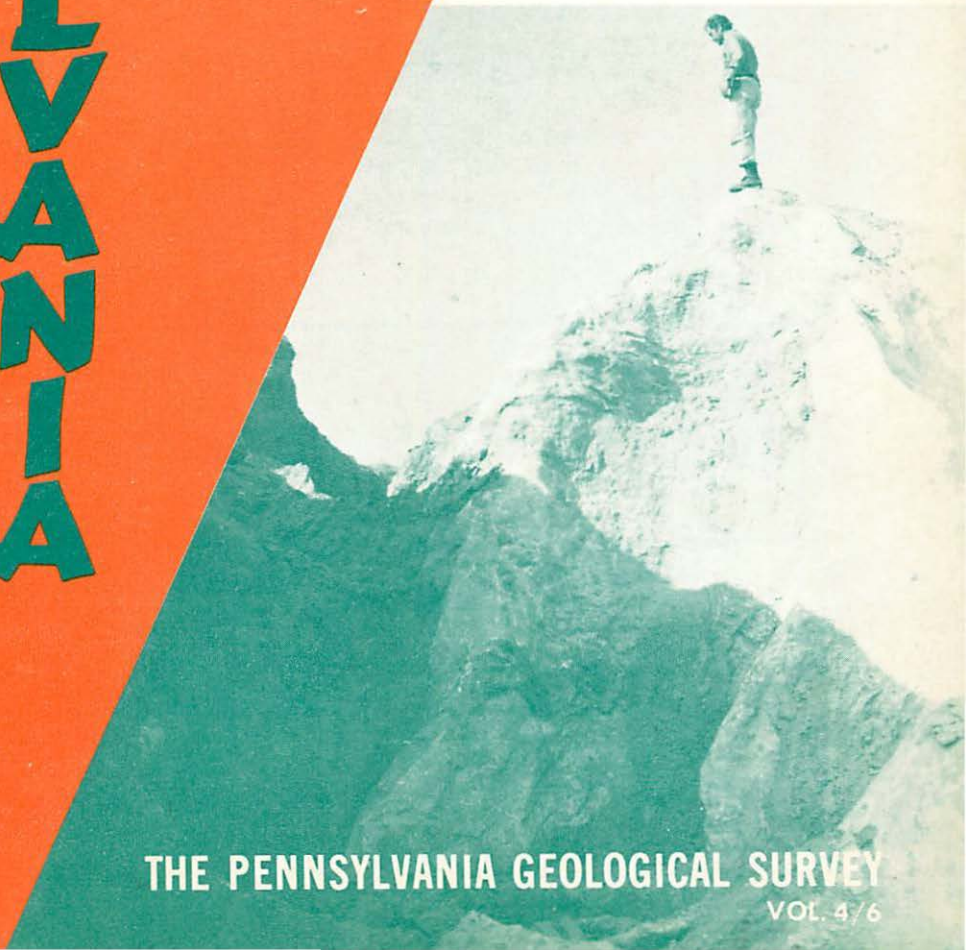
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 4/6

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

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ON THE COVER: Large-scale pinnacle weathering on top of Cumberland County limestone exposed in preparation for quarying.

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

DECEMBER 1973

FROM THE DESK
OF THE
STATE GEOLOGIST...

THE CRISIS THAT CAME TO STAY

The enormity and gravity of the problem prompt me to turn again to the fuel and energy crisis. Amidst the mass of data and analyses issued on the subject, a number of points merit emphasis:

1. The energy and fuel shortages did not develop overnight; our accelerating rate of consumption had surpassed our domestic fuel production for several years.
2. Our fuel shortages cannot be resolved overnight; there is a certain amount of lead time (one to four years) necessary even for the most readily available relief measures.
3. Reduced energy consumption is a necessity for immediate relief; it is not a permanent solution for the aspirations of our American society nor for the underdeveloped nations of the world.
4. No single procedure will resolve our energy needs; it will take the combined effects of increased production of coal, oil and gas (including offshore development), more nuclear energy, production of oil and gas from coal, oil shale, and tar sands, and greater utilization of geothermal energy.
5. Some other touted methods are 20 to 40 years away from technical reality and widespread usage; this probably includes solar energy and fusion.
6. Under the stress of the crisis, we must not allow ourselves to accept the premise that we have to choose between more energy or environmental quality. With reasonable objectives and standards, we can and should have both.

Pennsylvania can make major contributions to easing the energy crisis. Large reserves of minable coal (both bituminous and anthracite) are available for direct use and for new gasification and liquifaction techniques. Our existing oil and gas production could be expanded by exploration of large, favorable, untested deep zones. And we have a valuable pool of academic and industrial researchers capable of leading us to new, applied energy techniques.

The Topographic and Geologic Survey is pushing ahead with a program of defining our coal, oil and gas resources in greater detail. We are pleased that industry and government have already been able to put our data and services to good use in dealing with the crisis.

Arthur A. Socolow

THE FUTURE OF ANTHRACITE,— A POSSIBLE SOLUTION TO THE SULFUR PROBLEM

During the past few years, the coal industry has been aware that its importance to our economy will increase at the end of this century, at least until nuclear fuel can account for a significant portion of the energy market. The gasoline shortage in the spring of 1973, the oil shortage for the winter of 1973-1974, and the very real possibility of more shortages of railroad cars available for coal transportation all have added to a vigorous search for energy sources, and especially for coal which is known to have large domestic reserves. Some of this recent attention has been focused on Pennsylvania, both because of our large coal deposits and because of our proximity to the large eastern market area. Rumor and speculation have been particularly rife concerning the Pennsylvania anthracite district, an area of declining coal production. The question is, will the new need for coal energy revitalize the Pennsylvania anthracite area in spite of the technological and economic problems involved?

One factor in this speculation has been the sulfur content of coal which eventually produces the environmentally deleterious SO_2 as a contaminant in the air. Either a low-sulfur source or a method of economically removing sulfur from stack gas, or both, has been sought. In 1970, the Clean Air Act stipulated that 1.2 lbs. of SO_2 per million BTU input was the maximum permissable amount (equivalent to about 0.6 lbs. of sulfur per million BTU). Future national regulations, or more strict state laws, may further lower the amount of permissable SO_2. In fact, present planners are using a figure of 90% sulfur removal, a figure that includes a safety factor of 5-15% sulfur and which they hope will suffice for any stricter regulations that may accrue. The rumors regarding a possible upsurge in anthracite mining thus are based on the general knowledge that anthracite is a relatively low-sulfur coal with a rather high BTU value and consequently it may meet the new environmental standards with little or no stack scrubbing, a process which may increase coal costs by 20-25% in the case of lime used as a sulfur-removal material.

Although the BTU range of Pennsylvania anthracite is large and may vary both laterally and vertically, the BTU content after simple cleaning and drying operations can approach 12,500 BTU, a rather high-energy coal source. Furthermore, large coal reserves are known to exist here, particularly in Schuylkill County in the Southern anthracite field (Edmunds, 1972). Although its BTU content is not quite as high as Pennsylvania bituminous coal which may approach 14,500 BTU after cleaning and drying, anthracite is higher in BTU content than coal from the Western United States and it is close to the large eastern market.

The sulfur content of coal is likewise variable and averages cannot be expected to directly reflect the sulfur content of any one coal or one local

mine. They do, however, give an indication of whether or not sulfur must be removed, and approximately how much, to meet current minimum standards. A preliminary compilation of such average sulfur contents by the Pennsylvania Geological Survey is given in the accompanying table, based upon about 600 anthracite analyses. The sulfur content listed for bituminous coals is an estimate. Two observations are immediately apparent: 1) anthracite coal in Pennsylvania contains only one third as much sulfur as Pennsylvania bituminous, and 2) the coal of the Middle and Southern anthracite fields contains much less sulfur than the coal from the Northern anthracite field. The question then arises as to whether Southern or Middle field anthracite would meet present air-pollution standards without special SO_2 removal techniques.

Table of Approximate Average Sulfur In Pennsylvania Coal

Area	Avg. % sulfur	Range % sulfur
Northern anthracite field	0.87	0.5 - 3.5
Middle anthracite field	0.60	0.3 - 1.7
Southern anthracite field	0.68	0.3 - 1.7
Pa. anthracite seams	0.76	0.3 - 3.5
Pa. anthracite culm	0.80	0.4 - 2.7
Pa. bituminous coal	1.8 - 3.0	0.3 - 7.0

Utilizing the 1970 permissable sulfur limits, the minimal BTU of coals containing different sulfur contents can be calculated. For example, a coal containing 3% sulfur would require a coal with more than a 50,000 BTU content, a 1% sulfur coal about 16,000 BTU, a 0.8% coal about 13,300 BTU, and a 0.7% sulfur coal about 11,600 BTU. From the known BTU content of Pennsylvania anthracite and bituminous coal, it becomes obvious that all bituminous and most Northern field anthracite would require additional sulfur removal. For anthracite from the Northern field, approximately 20-30% of the sulfur would have to be removed to meet current federal standards; more for coal at some localities. For Pennsylvania bituminous coal, 70% or more of the sulfur would have to be removed.

It is most noteworthy that the sulfur situation for Southern and Middle field anthracite, however, is strikingly different. For these coals, the average per cent of sulfur yields BTU contents that are attainable and thus these coals might be used without special scrubbing and still meet minimal pollution requirements. Anthracite (cleaned and dried) with about 0.7% sulfur or less is both acceptable and available.

Other questions may arise. For example, the sulfur contents quoted are averages and hence either low to moderate sulfur anthracite would have to be selectively mined or integrated mining and mixing of coal is required throughout a district. This in turn would require a considerable initial investment. In addition, mining costs in this district would be higher because the coals have a steep dip and are complexly folded and faulted.

Dewatering and keeping water out of areas being mined would have to be considered. However, the prospect of either no sulfur removal or a single rather than a dual process sulfur-removal system is a significant advantage in the consideration of Pennsylvania anthracite for economically permissable mining. The rather low transportation costs to bring it to market and the fact that this is an area of good labor supply also are in its favor.

We believe that an expansion of mining in the Pennsylvania anthracite district, primarily because of its low sulfur content, deserves consideration. Energy sources are in increasingly short supply and an increased cost for fuel, whether coal, oil, gas, or electricity, can be expected over the next 25 years. It is now that plans should be made for the potential use of Pennsylvania's anthracite.

by Davis M. Lapham

CONSIDERABLE CUMBERLAND COUNTY CRYSTAL

An eight-inch long, eight and one half pound quartz crystal was recently collected by Dr. Samuel Root during geologic mapping in Cumberland County. It is composed of milky quartz and is doubly terminated with equal development of positive and negative rhombohedral faces. This unusually large crystal was discovered in a stone pile in a farmers field about 9000 feet WSW of New Kingston. Underlying these fields are limestones and dolomites of the upper part of the Ordovician Beekmantown Group. Although chert and quartz rosettes occur at this horizon (See Pennsylvania Geologist vol. 1, no. 8) quartz crustals of this size are unknown.

Reasons for development of such a large crystal have not been ascertained, however, two ideas should be considered. First, a large west dipping thrust fault passes within several hundred feet of the collection site so that the crystal development could be related to silica-rich fluids migrating along the fault. Second, possibly it may be related to Triassic dike intrusion into chert and quartz bearing carbonate rocks, as Stony Ridge dike is only several hundred feet from the collection site. Mineral collectors should be especially vigilant where similar geologic relations are duplicated elsewhere.

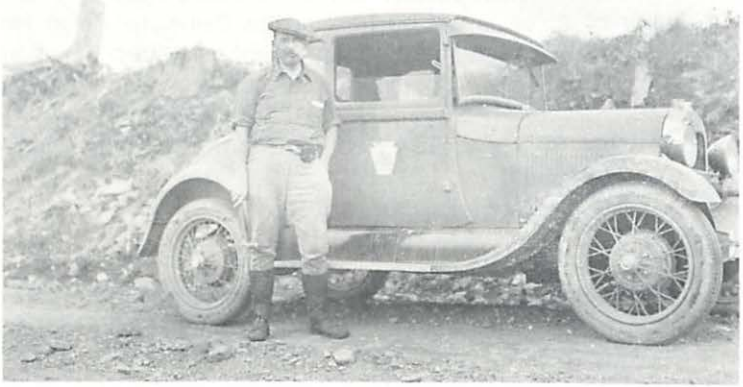
PENNSYLVANIA LOSES A NATIONALLY-KNOWN SCIENTIST

Dr. Bradford Willard, past member of the Bureau of Topographic and Geologic Survey and past Chairman of Lehigh University's geology department, was a creative geologist throughout every phase of a career that spanned 52 years. For those who knew Dr. Willard, or "Brad" as his friends called him, his probing mind, and his dry wit will always be remembered.

The Survey came to know Dr. Willard best after he reported to work that Monday morning July 1 in 1929, and remained on the staff for the next nine years. He came to us after several previous years as instructor at Brown University and Harvard. Prior to that time, he had graduated from Lehigh University and received his Ph. D. degree from Harvard.

Dr. Willard was one of the most prolific writers to have been associated with the Pennsylvania Geologic Survey having written some 96 books, articles, and pamphlets on some aspect of Pennsylvania geology. During his years with the Survey his major pursuits were in the fields of stratigraphy and paleontology. His best-known work was the Survey's Bulletin G-19, "The Devonian of Pennsylvania". This book is a true classic. Written in the late '30's this is required reading even today for all new staff members and in most geology departments around the State.

Probably the most widely circulated of Dr. Willard's publications is the Survey's Educational Series Bulletin ES-4, "Pennsylvania Geology Sum-



Dr. Bradford Willard, Survey field Geologist in the 1930's

marized". Originially published in 1935, it has since gone through several revisions, the last of which was in 1962, and is currently in its sixth printing, with tens-of-thousands of copies having been distributed.

The Delaware Water Gap held a particular scientific fascination for Dr. Willard. Many of his publications were written on the rocks and fossils of this region. He soon came to be the foremost authority on the geology of that area.

At a Lehigh University faculty dinner in June 1959 honoring his 20 years as Geology Department Chairman, a silver tray was presented by his colleagues. At that same time, a Survey publication titled, "The Geology and Mineral Resources of Bucks County, Pennsylvania", by Dr. Willard and others, was just released and the first hard-bound book with maps were presented to him. Dr. Willard had labored for many years to see the Bucks County report come to be a reality. Here at last was one of the best county reports ever published by the Survey.

With his passing, the Pennsylvania Geologic Survey, the Commonwealth, and the field of geology lost one of its most brilliant, versatile, and enjoyable men. His work remains a testament to his ability. Although it is impossible to write an adequate summation of any man, he exemplified a unison of sparkling sociability and scientific objectivity. Whether as Dr. Bradford Willard, or simply as Brad, he was a man toward which all of us can set our aim.

Dr. Willard is survived by his wife, son and daughter. His son, Gates Willard, is also a prominent geologist.

NORTHEAST SECTION OF GSA TO MEET

The annual technical meetings of the Northeast Section of the Geological Society of America will be held at the Baltimore Hilton Hotel on March 21-23. The wide-ranging program will include special symposia on *Mining in Northeast Urban Conditions, Chesapeake Bay Environmental Conditions, and Structural Problems of the Coastal Plain.* For further details contact Dr. Arthur Socolow, GSA Section Secretary. Pennsylvania Geological Survey, Harrisburg, Pa. 17120.

Errata:

The Pennsylvania Geologic Survey recently completed a core drilling project in the Dubois area. As reported in the June 1973 issue of Pennsylvania Geology (vol. 43), the location of drill hole No. 2 is in error. The correct coordinates should read: 41 12' 57" N. latitude, and 78 55' 16" W. longitude.

WHAT STARTS A COAL MINE FIRE?

Coal mine fires have been a great concern to many people during the past century. Not only are they dangerous to living creatures, both human and wild life, they also can be quite costly as they consume the important fossil fuel which is in great demand today. The concern now is to put out these fires and hopefully to eliminate the threat of harmful pollution that accompanies them. A question that many people ask is what starts these fires, a question not only of curiosity but also born of the need for prevention. In some cases, it is a freak accident of nature, but mainly they began from some careless mistake of man.

One possibility for their ignition is spontaneous combustion. This may occur as air mixes with combustible fuel dust and methane gas such that the coal begins to oxidize. The insulating strata surrounding the coal beds will contain the heat given off by oxidation and may slowly raise the temperature to the point of ignition. Tests in laboratories have shown that this process can actually occur and by removing the source of air currents the heating slows down or even stops.

Nature also can play other roles in originating these fires by unintentionally igniting a coal bed or culm-bank pile. For example, forest fires and lightning undoubtedly start some fires that eventually ignite a nearby coal seam or such fires may come in direct contact with the coal. A thick accumulation of organic plant and animal debris also might provide sufficient heat through oxidation to ignite a fire. Consequently, organic debris should not be placed near coal deposits or culm banks.

By far the greatest contributor to the fires is the carelessness and ignorance of man. Ignition of coal may result from the burning of trash and garbage near an old coal mine. Because of the convenience of an abandoned nearby "dump hole," trash may be taken to a mine. The coal nearby then may ignite to create an uncontrollable fire. Campers who leave burning fires or hot ashes create an ideal situation for starting a culm or coal seam fire. Miners can also start the fires either intentionally as may have occurred at Shenandoah, Pennsylvania or by an unfortunate accident as at Glen Lyon, Pennsylvania. It has been reported that some fires are purposely started to produce "red dog" an ash used for pavement, landfill, and bricks (see accompanying table).

The background of four fire sites examined by the Survey has provided some interesting stories (also see table). One account of the Shenandoah fire places the blame upon bootleggers who dumped a burning stove down the shaft when their illegal operation was discovered. Another description of the same fire states that the fire began when some burning timbers from an enginehouse fell down the shaft. The Glen Lyon culm fire which started in 1932 may have began by combustion caused by the careless dumping of hot ashes on the culm bank during disposal operations. Fire origins generally are shrouded in an uncertain history (see table). The underground

fire at Glen Lyon probably was started by an electrical wire which was knocked down during a wreck and subsequently ignited seven trolley cars of dynamite. The origin of both the Williamstown and Forestville fires is still uncertain. Extensive damage and considerable danger are generated by the fires. Because the fires are very difficult to control, they consume vast amounts of coal over the 20 or more years that they have been burning (see table). Many of the fires are not detected until years after their start (airborne infra-red photographs now are used for detection) and by this time, stopping them is almost an impossibility. The results can be quite devastating as the burned-out underlying coal seam may cause subsidence of the land surface destroying buildings and in general creating an eyesore over the whole area. The gases emitted by the burning materials can be very dangerous if ingested in great amounts (e.g., arsenic, selenium, sulfur, chlorine). Some of the gases such as hydrogen sulfide, sulfur dioxide, sulfur fumes, and carbon monoxide are polluting the air to such extents that visibility is reduced to virtually nothing. People who live near the coal fires suffer from various respiratory diseases and many have to be hospitalized. Water supplies may become polluted, paint discolors and peels, and cement construction crumbles more rapidly as a result of these fires and their resultant fumes. It is no wonder that the Commonwealth considers them a hazard.

Why all the concern from the Pennsylvania Geologic Survey? Recently new minerals were discovered at four mine fire sites (Williamstown, Glen Lyon, Shenandoah, and Forestville, Pennsylvania) which previously have not been found in the state, some nowhere else in the world. These discoveries led to an in-depth probe of the fires to find out what rare and harmful elements occur in the coal. For example, this may enable com-

Burning coal mine at Laurel Run

Location	Dates of Fire*	Possible Causes
Glen Lyon Culm Bank	1932 - present	a) Spontaneous combustion b) Careless spread of hot ashes during normal refuse operations c) Burning of trash d) Spread of original culm fires to other areas
Underground	1956 - present	a) Electrical spark igniting dynamite
Shenandoah	1956 - present	a) Burning timbers fell down shaft b) Deliberately throwing in a hot stove in protest of bootlegging curtailment c) Children playing with fire near the mine
Forestville	1953 - present?	a) Burning of trash b) Obtain "red dog" c) Spontaneous combustion
Williamstown	1930's - present	a) Spontaneous combustion b) Spread of other culm fires c) Burning of trash d) Brush fires

*These are approximate dates

panies utilizing coal in the future to filter these minerals and elements out of the smoke emitted by power plants. Additionally, soluable compounds such as halides, sulfates, and native elements that are potentially dangerous even after extinguishment of the fires are being identified so that steps can be taken to eliminate any harmful effects.

Scarlift, a state agency program in the Department of Environmental Resources, presently is extinguishing the culm fires. Water from abandoned coal mines is being used to put out the fires, in some necessitating water dams or troughs to prevent flooding. The extinguished coal is then to be dumped as fill. These operations are state-funded by bonds used to temporarily purchase the fire areas and to extinguish the fires.

Linda Main
Edinboro State College

NATURE TO PRODUCE CHRISTMAS SPECTACULAR

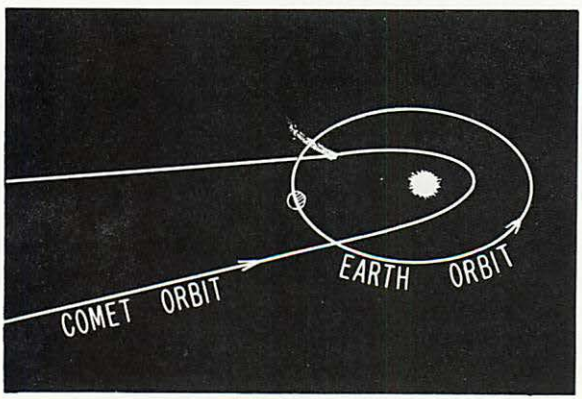
A spectacular visitor from outer space known as Comet Kohoutek 1973f should begin to show itself about mid November and achieve its most dramatic display during early January.

The comet was discovered in March of this year when it was more than 4 astronomical units (600 million km.) from the Sun. Louis Kohoutek of the Hamburg Observatory is the discoverer. The official designation of "Comet Kohoutek 1973f" indicates that it is the sixth comet to be discovered in 1973 and distinguishes it from Comet Kohoutek 1973e which was discovered by the same astronomer in February.

Some astronomers do not agree on the estimated brightness of the Comet and reports vary from a maximum predicted brightness of minus 10, second only to the Sun and full moon, to a minimum brightness of magnitude—4 which approximates that of the planet Venus. In either case it will be a dramatic sight, particularly in the evening sky at dusk a few days after perihelion, which places the time at early January.

During mid November Comet Kohoutek will be visible in the East shortly before sunrise and may require the use of binoculars or a small telescope to be seen well. During December the comet may be visible in the southern sky during the day if the brighter estimate of its luminosity is correct. During daylight it might be necessary to screen the Sun with an outstretched hand to observe the comet. Perihelion will be attained on or about December 28th at which time Kohoutek will be 21 million km., or only 30 solar radii, from the Sun. After this point the comet will become an evening object in the southwestern sky after sunset.

Extreme care must be taken if daylight observations are attempted for damage to the eye could easily result from staring into the Sun. In no case should binoculars or telescopes be used for daylight observation as retinal damage is sure to occur if the Sun is viewed through these optical devices.



January will be the best time to observe the comet tail in its full glory. In the evening twilight, a few days after New Year's Day, estimates of the length of the tail range from 20 degrees to 30 degrees across the sky which is about 10 to 15 full moon diameters. During this time amateures with adjustable cameras and fast films can obtain the most spectacular pictures.

Science teachers, students, and interested amateures should consult with the following references for additional information:

1) "Comet Kohoutek - Prospects and Plans," Sky & Telescopes, Aug. 1973.
2) "A Great Comet Coming . . . Kohoutek", Astronautics and Aeronautics, Oct. 1973.
3) "Get Set For the Sky Spectacular of the Century", Popular Science, Nov. 1973.

William H. Bolles
Department of Education

FROM BACTERIA TO POLLUTION-FREE ORE?

The present mining system for obtaining sulfide ores of copper, lead, zinc, molybdenum and other metals can be a dirty business. For example, smelters are coming under increasing pressure from environmentalists to reduce their air pollution arising from toxic trace elements and oxidized sulfur compounds. As a result, a new science has sprung up: biogenic metallurgy and chemical leaching. Reactions using certain microorganisms utilize inorganic matter and oxygen. Thus, certain bacilli are associated with the leaching of copper from copper sulfide ore minerals, producing water-soluble copper sulfate. Recently, colonies of microorganisms on molybdenite also have been identified (Brierly, Brierly, and Muir, Research and Development, Aug. 1973, p. 24-28).

Although study of the possibility of utilizing microorganisms to concentrate ore elements is just beginning, application to ore and waste piles as well as to below-surface ore bodies is intriguing. Also interesting is the fact that lower-grade rock could be processed than now is economically feasible, an important consideration as today's high-grade resources dwindle. Finally, this chemical leaching method that utilizes microorganisms does not pollute the air, certainly a point in its favor in any technological society.

Although there presently are many unknowns, such as which organisms react with a particular ore and the mechanisms of concentration, study is progressing, but rather slowly. Recognition of the help these little fellows may give us could stimulate needed research in this new field.

SURVEY ANNOUNCEMENTS

CLAY AND SHALE RESOURCES IN THE GREATER PITTSBURGH REGION — ON OPEN FILE

The Bureau of Topographic and Geologic Survey, Department of Environmental Resources, in cooperation with the U. S. Geological Survey and the U. S. Bureau of Mines, is continuing a multi-phase clay-shale program under the Greater Pittsburgh Regional Studies Program.

Phase II, now complete, involved the collection of 162 samples throughout the region from each major clay or shale geologic unit represented.

Phase III, the clay-shale sample test data, is now being released to open file. Evaluation for potential uses are reported for the 162 clay-shale samples. These evaluations are based upon the results of firing tests and determinations of other critical properties. Data presented in the report include: 1) test results for raw properties, slow-firing and preliminary bloating, 2) emission spectrographic analyses, and 3) rapid rock analyses. The site of each sample is plotted on a location map of the region.

Phase III is now on open file at three locations: Bureau of Topographic & Geologic Survey, Room 419, Town House Apartments, Harrisburg; the Survey's Regional Office at 1201 Kossman Bldg., Stanwix Street, Pittsburgh; and the U. S. Geological Survey, 102 East Mall (Second Floor), Carnegie. All interested persons are encouraged to examine this report at any of these locations.

CONSTRUCTION AGGREGATES IN THE GREATER PITTSBURGH REGION OF PENNSYLVANIA — OPEN FILE REPORT

The Bureau of Topographic & Geologic Survey, Department of Environmental Resources, in cooperation with the U. S. Geological Survey, has released to open file a detailed report concerning sources of construction aggregates in the Greater Pittsburgh region. Active producers of sand and gravel, crushed stone, and slag — the present source of aggregate in the area — are identified and information on the geologic formation, physical test results, and current uses of aggregate from each operation is summarized.

Eight geological subdivisions with a potential for sand and gravel are plotted and discussed by origin, relative age, lithology, thickness, extent of weathering, and evaluated for construction aggregate. Areas where residential, industrial and/or recreational land-use conflicts exist are screened out.

The outcrop patterns for the Loyalhanna Formation and the Vanport Limestone — two important sources of crushed stone in the region — are plotted and isopachs showing the thickness of the Vanport are shown. Six other geological units supplying crushed stone and the availability of slags are also discussed. An evaluation of the potential for each unit is made.

This report is on open file at three locations: Bureau of Topographic & Geologic Survey, Room 419, Town House Apartments, Harrisburg; the Survey's Regional Office at 1201 Kossman Bldg., Stanwix Street, Pittsburgh; and the U. S. Geological Survey, 102 East Mall (Second Floor), Carnegie. All interested persons are encouraged to examine this report at any of these offices.

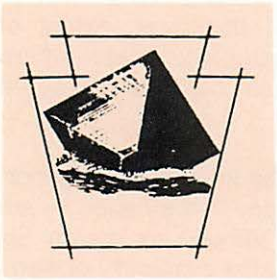
STUDENT INTERN AT THE SURVEY

Linda Main, a junior geology major at Edinboro State College, joined the Survey staff on September 10 to be with us for 16 weeks as an Intern, one of many such students working in various positions in State Government.

Linda is a resident of New Castle and graduated from New Castle High School in 1971. She is studying for her Bachelor of Science degree at Edinboro and hopes to go to graduate school to major in geophysics and seismology. Linda is an outstanding student at Edinboro and received the 1972 chemistry award for the outstanding chemistry student at Edinboro.

While at the Survey, Linda will learn how a Survey operates and functions. She is engaged in several short-term research projects dealing with minerals from burning coal mines, analysis of glacial sands and gravels in northeastern Pennsylvania and preparation of isopach maps for hydrologic investigations.

The Student Intern Program operates in cooperation with the Department of Education and is aimed at giving students practical experience in their chosen field of work.



EARTH SCIENCE TEACHERS' CORNER

usgs popular geology leaflet series

Several new U.S.G.S. leaflets have been published.

"THREE RINGS: TIMEKEEPERS OF THE PAST", 15 pages

Botanists and hydrologists have found that trees are nature's timekeepers and historians, providing windows to the past; U.S.G.S. Water Resources Division has been conducting basic research to determine what hydrologic and environmental information is revealed in the growth records of trees.

"The NATIONAL ATLAS STORY", 15 pages

This atlas makes available for the first time in one volume a comprehensive source of information, presented in cartographic format, about the principal characteristics of this Nation; basic details on the Atlas and an order blank are included in this leaflet.

"WATER IN GREAT SMOKY MOUNTAINS NATIONAL PARK", 14 pages

This leaflet describes the role of water in carving the natural beauty of the park, the abundance of water available, the use of water, the early settlers of the region, and the destructive side of water in flood and erosion.

"GEYSERS", 23 pages

The answers to the following questions are given in this leaflet: What is a geyser? Where do geysers occur? What causes hot springs? How are geysers born and why do they die?

These pamphlets and many others are available free of charge from the U.S. Geological Survey, Distribution Section, 1200 South Eads Street, Arlington, Virginia 22202.

SUSQUEHANNA WATER GAPS — NATIONAL NATURAL LANDMARK

The area of five water gaps along the Susquehanna River, north of Harrisburg was dedicated on September 4, 1969 as a Registered Natural Landmark. Since that time, the number of visitors that have come to admire the magnificent scenery of the water gaps along this section of the river has surely increased.

The State Geologist, Arthur A. Socolow, was a featured speaker at the dedication of a bronze plaque commerating this outstanding natural landmark. His remarks that day traced the history of geologic events which produced the water gaps.

Now, still another event has taken place. The bronze plaque attached to a massive piece of conglomerate was originally placed at the foot of an observation tower along U.S. Route 22-322 between Dauphin and Clarks Ferry. Recently, this land changed ownership and the bronze plaque and stone marker were moved to the very picturesque roadside rest at Girty's Notch along U.S. Route 11-15 between Amity Hall and Liverpool. We heartly recommend taking a few moments of your time to stop to visit.

Alan R. Geyer

MULTI-COLORED FLUORITE AT NEW PARIS

Beautifully colored cleavages of purple, aqua-blue, and yellow-green fluorite (CaF_2), along with a few cubic crystals were collected from the New Paris Lime and Stone Company quarry, approximately 1 mile north-northeast of New Paris in Bedford County. The fluorite, intergrown with white calcite, is restricted to a few, nearly vertical veins up to three inches wide. This may represent the largest single occurrence of fluorite reported from the state; certainly it is one of the most colorful.

The main fluorite vein trends N 14° E, 80° SE and is almost perpendicular to bedding. This vein, along with calcite veins containing smaller amounts of fluorite, as well as unmineralized joints, are all parallel to a pronounced set of joints cross-cutting bedding and trending N 12° E, 88° SE across the quarry. The quarry itself is located on the northwest limb of a gentle anticline and bedding is dipping uniformly to the northwest (N 39° E, 7° NW). The operation is recovering limestone from the Keyser Formation of lower Devonian age and is presently quarrying in the upper part of this formation.

There is no sign of host rock replacement along the largest exposed fluorite vein. This fact and the lack of a paleokarst topography (ancient erosion surface on limestone and associated caves which were buried and preserved in the geologic record) suggest that no large voids developed for later infilling by fluorite, and therefore there is no economic potential for this occurrence as a fluorspar deposit. This fluorite does substantiate widespread, low-temperature hydrothermal activity (not necessarily of magmatic origin) along the Allegheny Front. The temperature of fluorite formation can be determined from the homogenization temperature of the fluid inclusions. Samples were collected for this purpose and are available for analyses. Such a study would be useful in determining possible relationships among fluorite, barite, sphalerite and galena, and the hydrothermal history of the area.

Mr. Pen Ambler of Hollidaysburg brought this locality to our attention. It is through help such as his that we can better understand the geology of the Commonwealth.

Robert C. Smith II
John H. Way, Jr.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

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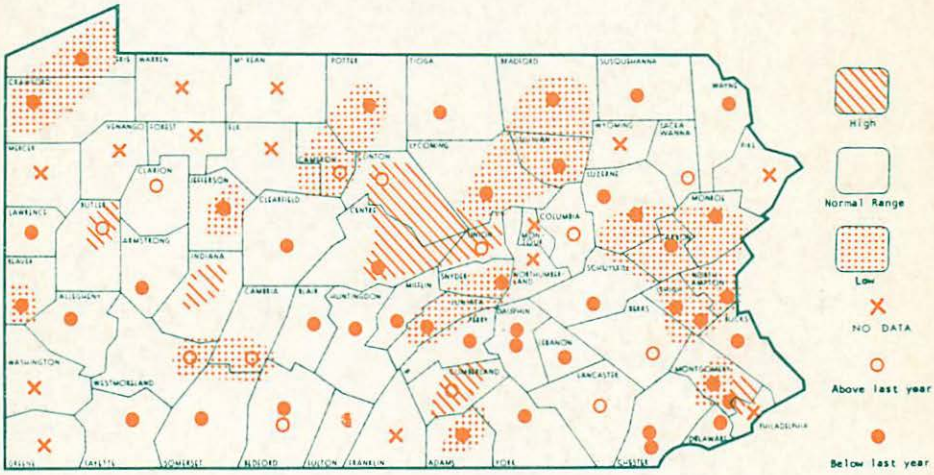

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