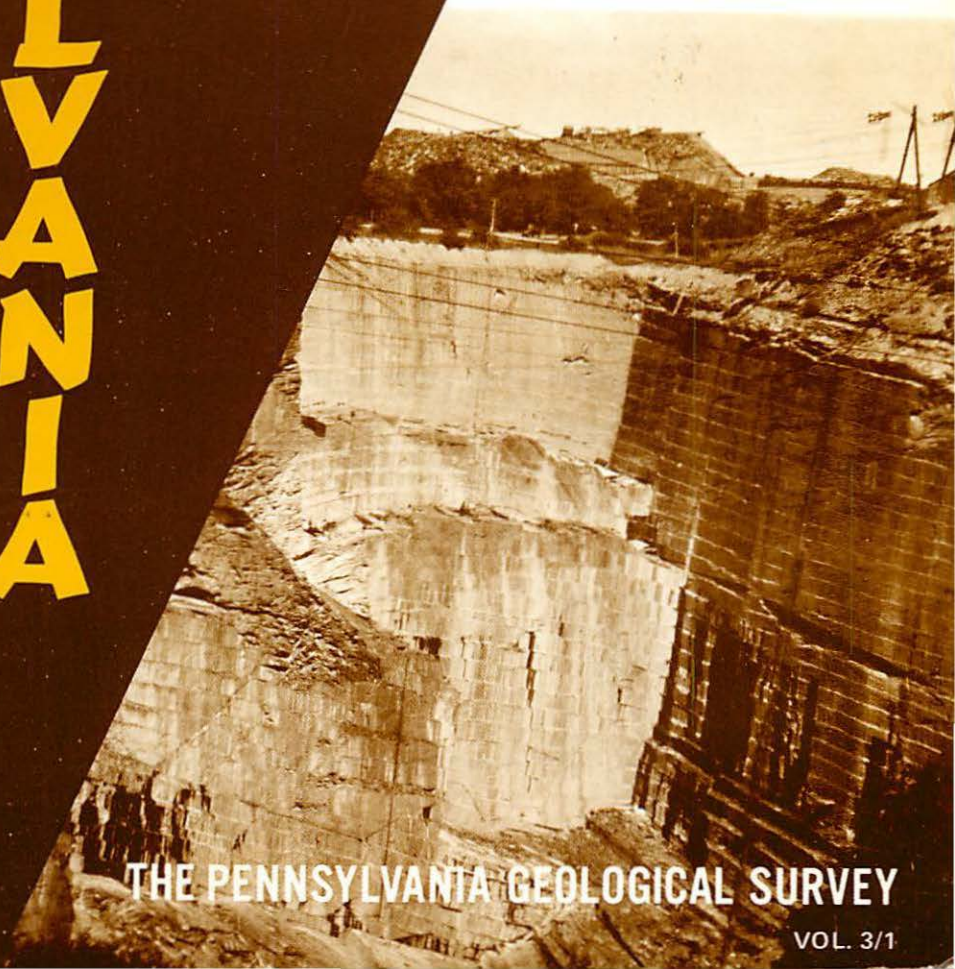


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Feb. 72



THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 3/1

COMMONWEALTH OF PENNSYLVANIA

Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES

Topographic and Geologic Survey

Arthur A. Socolow, State Geologist

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ON THE COVER — Slate quarry in Northampton County, typical of the mineral operations now under jurisdiction of the "All Surface Mining Act." (See article this issue).

PENNSYLVANIA GEOLOGY is published bimonthly by the Topographic and Geologic Survey, Main Capitol Annex, Harrisburg, Pennsylvania, 17120.

FEBRUARY 1972

FROM THE DESK
OF THE
STATE GEOLOGIST . . .



MORE THAN LIMITED INVOLVEMENT

Recently when the American Association for the Advancement of Science met in Philadelphia, a member of the audience approached me after the session I chaired on Geology and Solid Wastes. He expressed his surprise that geologists were so involved with this "public problem" of waste disposal. Further conversation brought out the fact that this man, a non-geological scientist, had the concept that geologists are concerned primarily with mineral deposits and in some more abstract way with rocks. This is not an isolated concept, and yet so very far from reality, particularly in the functions of a state geological survey.

A partial review of some of our Survey services and involvements in just the last few months may help dispel this restricted concept of geology: A proposed reactor site required our environmental commentary. The proposed subdivision of a suburban landsite brought us the question of feasibility of on-site sewage disposal. A mine drainage court case posed the problem of the origin and route of acid underground waters. Expansion of a state college campus gave us the task of locating a high-yield well site. An urban landslide condition called for immediate recommendations to alleviate the problem. The spillage and underground movement of gasoline required designation of best recovery well sites. A federal study of river basin development needed our data on groundwater utilization. A municipal authority faced with a sinkhole cavein called for guidance on the nature of the problem. A major industrial concern faced closure unless a specific type of geologic environment could be found to handle disposal of a problem waste product. Our highway colleagues call for geologic impact evaluations of their individual projects. A condemned landfill operation required prompt geologic assessment of an alternate site. A proposal to dispose of liquid waste into the underground required evaluation of where it would go and what harm it might do. The developing State Water Plan calls for us to prepare basin-by-basin groundwater evaluations across the state. A church wants to add a wing and match the existing building stone. Municipal officials needed advice on the hazards of blasting over limestone terrain. A pipeline company needed to know of potential mine subsidence problems along a proposed route. A foreign metallurgical company asked for some of our clay for research work. One farm owner wanted to know how close an oil well would be permitted to his property line, and another farmer needed to know if he had sufficient underground water for irrigation. A space-research lab asked for some of our Pennsylvania iron minerals which are reputed to be similar to material on Mars. To evaluate the feasibility of a high-speed transportation route, we were asked for the roadbed and tunneling conditions. And there have been the hikers, the fossil collectors, the school children, the Scout leaders, who all want to know what to find and where to go, and we're glad to tell them.

The above is far from a complete representation of our diverse activities but hopefully, it may dispel the limited concept of geologic involvements.

Arthur G. Socolow

THE NEW "ALL SURFACE MINING ACT"

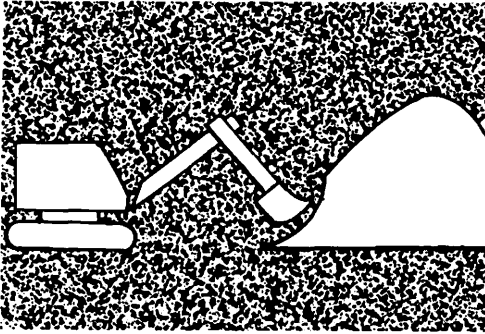
On January 1, 1972, there came into effect a new Pennsylvania law with profound impact upon the mineral industry of the Commonwealth. This is the so-called "All Surface Mining Act", passed by the last session of the State Legislature and signed into law November 30, 1971.

The new "All Surface Mining Law" (Act 147 of 1971) extends the provisions of "The Bituminous Coal Stripping Law," to the surface mining of anthracite and all other minerals. The new act further provides for mine conservation inspectors, imposes powers and duties on the Secretary of Environmental Resources, changes the name of the Bituminous Coal Open Pit Mine Reclamation Fund to the Surface Mining Conservation and Reclamation Fund, declares certain conditions to be nuisances, provides for payments in lieu of bond in certain cases, provides for penalties, and makes numerous editorial changes in the old "Bituminous Law."

The official short title of Act 147 (1971) is "Surface Mining Conservation and Reclamation Act." This act provides for the conservation and improvement of areas of land affected in surface mining of bituminous and anthracite coal, metallic minerals, and nonmetallic minerals of Pennsylvania. It is the intent of this law to aid in protection of wildlife, to enhance land values for taxation, to decrease soil erosion, to aid in the prevention of pollution of Pennsylvania's water resources, to prevent and eliminate hazards to health and safety, to prevent combustion of unmined coal, and generally to improve the use and enjoyment of surface-mined lands.

Basically, Act 147 (1971) is a reclamation law applying to that segment of the minerals industry engaged in recovery of mineral resources by surface extraction methods. The act broadly spells out the guidelines as to how the mineral deposits are to be recovered and how the mined-out lands are to be reclaimed. The act assigns to the Secretary of Environmental Resources the powers and duties of implementing the law by establishing a set of regulations.

For anyone, individual or corporate, to engage in surface mining in Pennsylvania under the new act, he must be licensed by and obtain a permit from the Department of Environmental Resources. As a part of each application for a permit to surface mine, the licensee must furnish (in duplicate): (1) A map showing the boundaries of the proposed land affected (with specific notations on drainage, utilities, houses, buildings, etc.) and related information prepared and certified by a registered professional engineer or registered surveyor; (2) A complete and detailed plan for the reclamation of the land affected, covering some 10 specific items outlined in the law as the minimum criteria to be considered in the reclamation plan. Some of the geologic aspects that may be included in the permit application are geologic cross sections, test-boring information, nature and thickness of mineral seam as well as overlying and underlying strata, and recommendations related to handling surface water as well as those encountered in the mining area.



The information in the permit application is to be reviewed and field checked by authorized persons designated by the Secretary of Environmental Resources and approved as submitted or returned to the applicant with suggested modification (for reconsideration) or reapplication for a surface mining permit.

After successfully obtaining a permit for surface mining, and once such activities are begun on the "permitted" land, periodic progress reports by the operator to the Department of Environmental Resources and on-the-site inspections by the district mine conservation inspector are required by the act.

In Section 3, Definitions, of Act 147 (1971), in the definition of surface mining is listed those operations exempted under the act.

While the act applies to all surface coal mine operations regardless of size or use, it excludes non-coal mineral operations by a landowner for his own non-commercial use, and also excludes small non-coal commercial operations which produce less than 500 tons per acre of mineral product per year. Also excluded are borrow pits for highway construction purposes where the work is performed under bond, contract, and specifications for reclamation comparable to the new act.

Act 147 (71) is a comprehensive law written with the intent of outlining in "flow-sheet" form the sequence of events and responsibilities starting with the individual's wish to surface mine a specific piece of land when he applies for a mining permit, to the concluding act of restoring the mined-out land to its highest and best use condition.

The "All Surface Mining Act" is intended to help preserve the quality of our environment for the benefit of society as a whole. The mineral industry, long a keystone of our society, is being called upon to make a new and greater contribution to this effort.

GARBAGE ROAD

Composted household refuse is being tested for road paving. A test section of road, installed at Westinghouse's Research and Development Center, Pittsburgh, has just passed its first 12-month test with flying colors. The road material is reported to be as durable as asphalt and more resistant to cracking. The mix contains 5 percent compost in addition to asphalt, sand, and crushed stone. The project is part of a program aimed at discovering uses for solid waste materials.

NEW COUNTY GROUNDWATER SERIES — MONTGOMERY COUNTY REPORT ISSUED

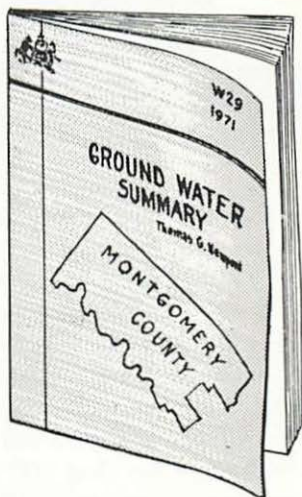
With the continuing growth of our population and the expansion of our industries, there is an ever-increasing rise in demand for quality water supplies. Ground water, or sub-surface water, constitutes one of the largest reserves of quality water available for development in Pennsylvania. Each year more and more of this subsurface water is being utilized in the Commonwealth as over 20,000 new wells are annually brought into production.

The development of new wells calls for guidance to help locate favorable sites for the new wells. Almost forty years ago the Survey initiated its groundwater services with a series of regional reports (Bulletins W1 - W6) summarizing the groundwater conditions for each of the six major regions of the Commonwealth. Those bulletins have served well and continue to be valuable aids. However, over the past thirty years the Survey has accumulated a wealth of new groundwater data based on detailed aquifer studies as well as tens of thousands of individual well records accumulated at the Survey. Precise measurements were made in the field and laboratory and answers to many specific hydrogeologic questions were found.

To bring the benefits of new studies and new data to the users of groundwater in Pennsylvania, the Survey decided to prepare an up-to-date summary of groundwater conditions for each county. The county unit was chosen as one with which Pennsylvanians readily identify, while it also results in a more detailed, local framework of groundwater conditions than the earlier regional reports.

The Pennsylvania Survey has now released the first of the new county groundwater summaries, Bulletin W 29, **The Groundwater Resources of Montgomery County**. This report gives the geologic framework and the water-yielding characteristics of each rock formation in the county. Production data is tabulated for over 800 wells with chemical analyses for 121 wells. Detailed maps and tables enable the reader to zero in on groundwater conditions at any given locality in the county. This report will aid planners, property owners, and well drillers of Montgomery County to plan for the efficient development of the groundwater resources.

Bulletin W 29, **Groundwater Resources of Montgomery County**, is available for \$2.10 plus tax from the Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, Pa. 17125.



WATER WELL RECORDS

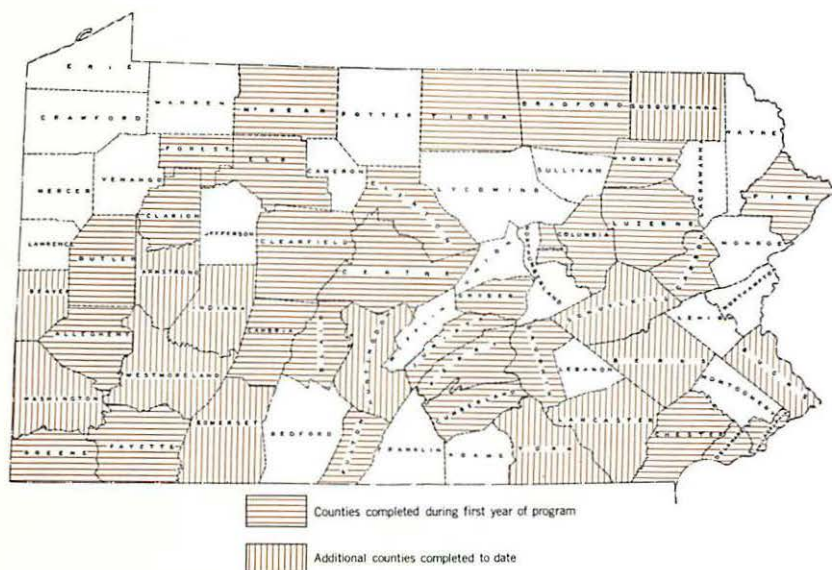
In the April 1970 issue of *Pennsylvania Geology* the Topographic and Geologic Survey first reported on a new program to translate water well drillers' well-completion cards into a computer data retrieval system. This endeavor has enabled the Survey and many others to utilize the vast amount of valuable water well subsurface data in Pennsylvania. Primarily this information has been used to identify the location and the amount of one of Pennsylvania's most valuable resources—ground water.

The index map indicates the 30 counties completed during first year of program. Today, the Geologic Survey has accomplished keypunching thousands of additional water well records and the index map shows the additional 13 counties completed to date.

For a per-page fee of \$0.05 computer printout sheets are available from the Survey's Harrisburg office. Within a county, the wells are listed by townships in alphabetical order. Specific hydrogeologic information such as drainage basin, sub-basin, topography of well site, major and minor aquifers, yield of each aquifer, yielding zones within an aquifer, as well as a complete mechanical description of each well are included.

In recognition of the growing demand for ground water and information on its location and amount, as well as a growing concern over water pollution, the Pennsylvania Geological Survey will continue to add water well information to its computer retrieval system so as to expand its ground water services to Pennsylvania citizens.

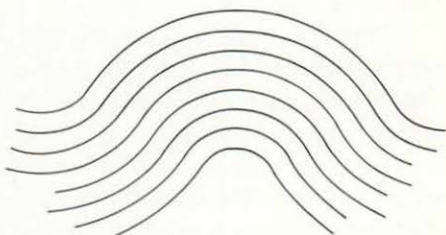
Alan R. Geyer



KINK BAND FOLDING IN CENTRAL PENNSYLVANIA - II.

The folds in the Valley and Ridge province in central Pennsylvania have long been considered by some to be simple, parallel folds, similar to the type called concentric fold (Fig. A). In such folds, the beds are uniformly bent over the entire width of the fold, producing a geometry of concentric circular arcs. A consequence of this geometry is that the dip of bedding increases progressively

- A. Idealized concentric fold. Each layer is uniformly bent across the fold and the dip of beds increases progressively away from the fold crest.

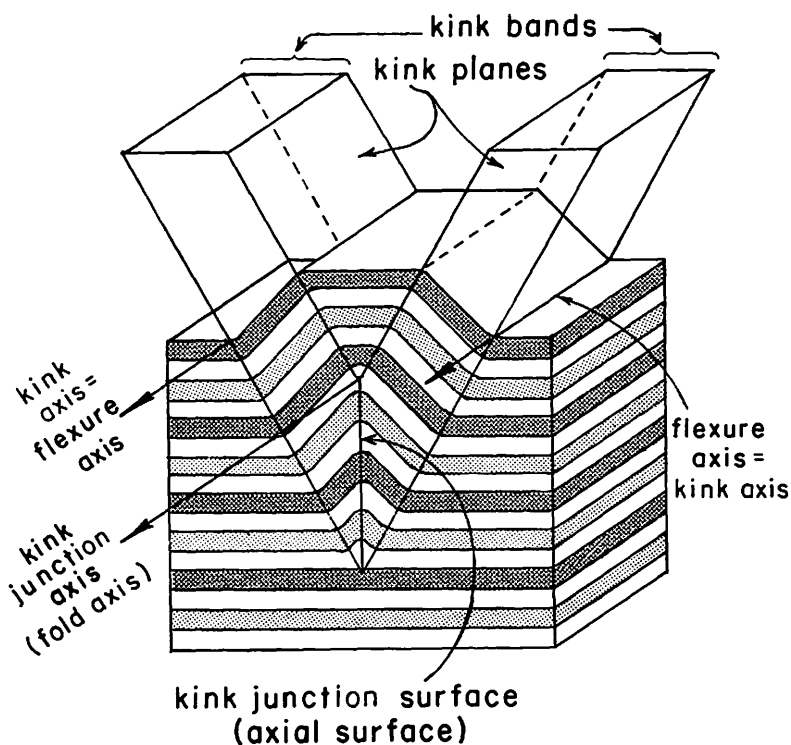


away from the fold crest. In the past ten years, it has been recognized that many of the Valley and Ridge folds do not possess this concentric geometry, but a quite different one similar to that of chevron folds (Fig. B). Throughout each limb of the fold, the bed attitude is constant—the change in bed attitude from one limb to the other occurs within a relatively narrow zone, called the fold hinge. The bending of the beds has occurred only within the narrow hinge. In the limbs, the beds have only been rotated, not bent, because they have retained their original planar aspect.



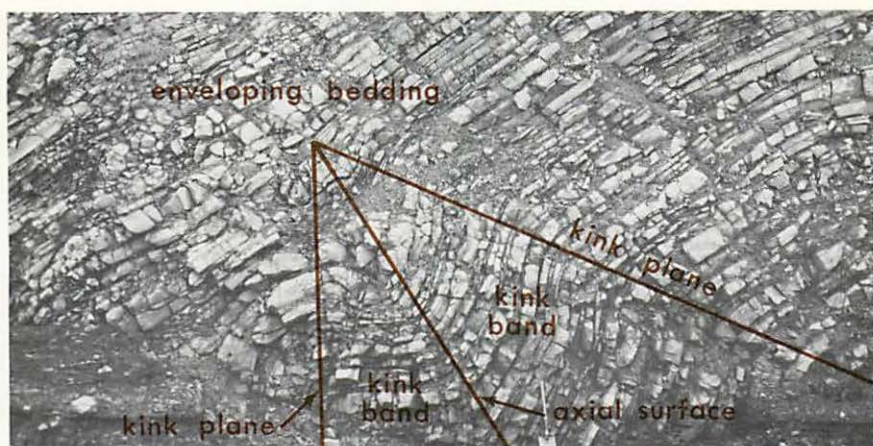
- B. Typical fold in the Valley and Ridge province. Each layer is sharply bent in a narrow hinge, and the dip of beds remains constant in each fold limb. Penn-Central R. R. cut, 0.8 miles south of Mifflin, Pa.

The presence of kink bands of all sized (see previous issue of *Pennsylvania Geology*, v. 2, no. 5, p. 10-12) and the similar geometrical elements (narrow zones of bending, wide zones of constant bed attitude) suggest that the two structures are intimately related. For example, where two kink bands are inclined towards each other (i.e., dipping towards each other), the beds within one kink band are rotated in the opposite direction to those of the other kink band. Where these kink bands join each other, a fold geometry results (Fig. C). Each kink band constitutes one limb of the fold, and the junction between the two kink bands is the fold hinge, within which lies the axial surface of the fold. Bedding maintains a constant attitude throughout each limb because bedding in a kink band possesses a constant attitude. The bending of the beds occurs only at the junction of the two kink bands and thus the fold hinge is narrow with respect to the fold wave length. The planar aspect of bedding in the fold limbs indicates that the beds are not bent here (as they would have been in a concentric fold)—they have only been rotated to their present attitude.



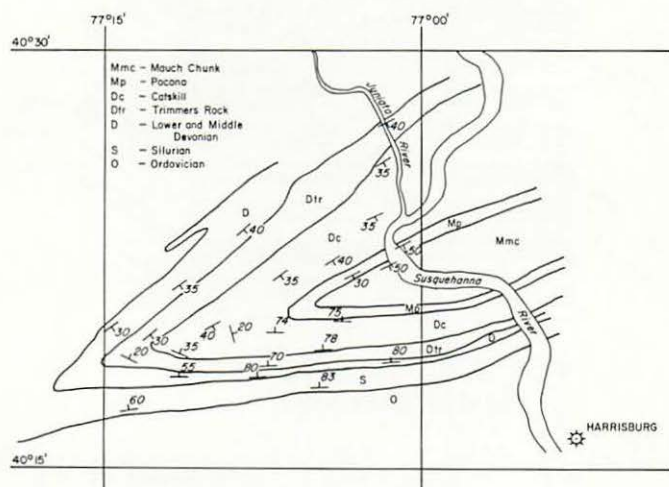
C. Generation of kink band fold by the junction of two oppositely inclined kink bands.

Thus the junction of two kink bands results in a fold which possesses the same geometrical attributes as are observed in Valley and Ridge folds, and such kink band folds can be seen in their entirety in some outcrops (Fig. D).



D. Simple kink band fold (syncline) in the Salona Formation. Route 322 road cut, at Reedsville, Pa.

Although small kink band folds can be demonstrated in outcrops, the large folds of the province are never so completely exposed. To prove that the largest folds are kink band folds, it must be shown that they possess the same geometrical elements as the smaller folds. A simple example of one of the largest folds in the province is the Cove syncline (Fig. E), which plunges gently to the east-northeast. From the representative dips plotted on this map, it can be seen that



E. Generalized map of Cove syncline northwest of Harrisburg, Pa. Selected strike and dip data from J. L. Dyson's maps of the New Bloomfield quadrangle.

the dips do not progressively decrease toward the fold hinge as would be expected in a concentric fold. Rather, they remain fairly constant across each fold limb. In addition, the hinge is narrow with respect to the fold wave length—the outcrop patterns are straight in each limb, and abruptly change direction within a very short distance. These are the same geometrical attributes that are seen in small folds.

Just north of Millerstown, the hinge of the Tuscarora anticline (one of the largest folds in the province) is exposed in a road cut (Fig. F). At first glance, this fold appears to be concentric, and the radius of curvature of this hinge is approximately 0.8 miles—but the wave length of this fold is 9 miles. In concentric folds, the radius of curvature must be at least as large as, if not greater than, the half-wave length. Thus the small radius of curvature indicates that the hinge of this large fold is narrow compared to the wave length.

It can be concluded, then, that some of the largest folds in the province possess the same geometrical properties as the smaller folds. Because the small folds can be generated by kink bands, it seems probable that the largest are also kink band folds.

Rodger T. Faill



F. Hinge of Tuscarora anticline. The bending of beds within the hinge is uniform and thus approximately concentric. But the hinge is narrow relative to the wave length. Considering the entire fold, these beds are sharply bent. Routes 22-322 road cut, 0.5 miles north of Millers-town, Pa.

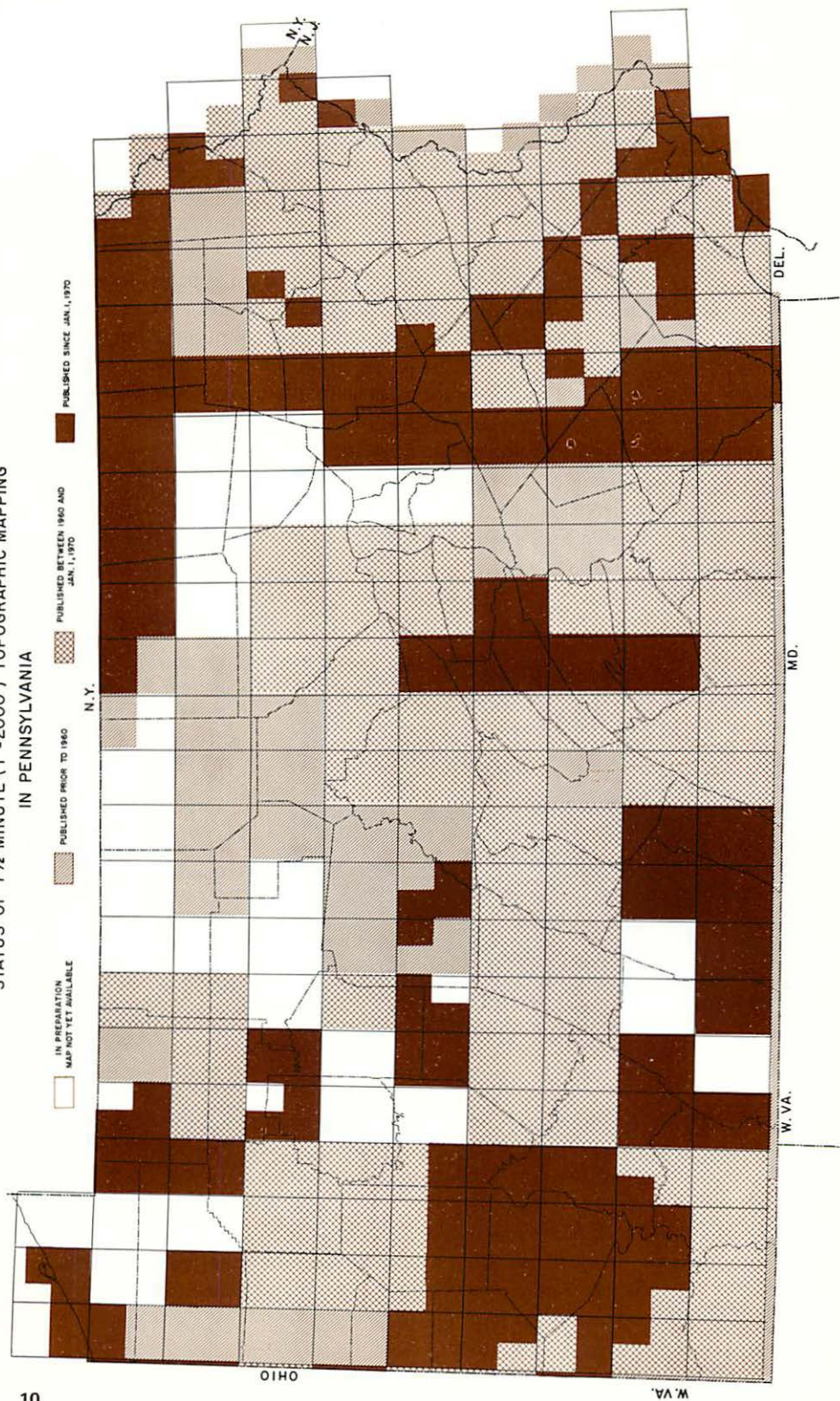
THEY KNOW US

We are often concerned that possibly some people who should be making use of our geological services may not be aware of our existence. We know now, however, that at least the Post Office knows who and what we are.

Recently at the Survey office, we received a letter which was mailed in New Jersey and was addressed simply as follows: **Somewhere in Pennsylvania Where Rocks can be obtained.** That's all there was; there was no name of a city or person. Yet the letter came directly to us without any wandering.

It's nice to know we're known.

STATUS OF 7½ MINUTE (1"=2000') TOPOGRAPHIC MAPPING IN PENNSYLVANIA



TOPOGRAPHIC MAPPING IN PENNA.

The topographic mapping program in Pennsylvania is being conducted cooperatively by the Pennsylvania Geological Survey and the United States Geological Survey.

The adjoining map shows the progress to date in preparation of up-to-date 7.5 minute quadrangle (1 inch = 2,000 feet) topographic maps for Pennsylvania.

During calendar 1971 an additional 143 7.5 minute quadrangle maps were published by the U. S. Geological Survey. A detailed index to these and prior published maps is available free from:

Pennsylvania Geological Survey	Washington Distribution Section
Dept. of Environmental Resources	U. S. Geological Survey
Main Capitol Annex	1200 South Eads Street
Harrisburg, Pa. 17120	Arlington, Va. 22202

Topographic maps may be purchased for \$0.50 each from the Washington Distribution Section as listed above. On such orders, customers should state the name of the map as well as the type of map desired and are urged to use order blanks supplied with the Index to Topographic Mapping in Pennsylvania mentioned above. Orders must be accompanied by cash, check, or money order in the exact amount. Stamps will not be accepted as payment.

At slightly higher costs, maps may be purchased across the counter at agents in Pennsylvania listed on the detailed index.

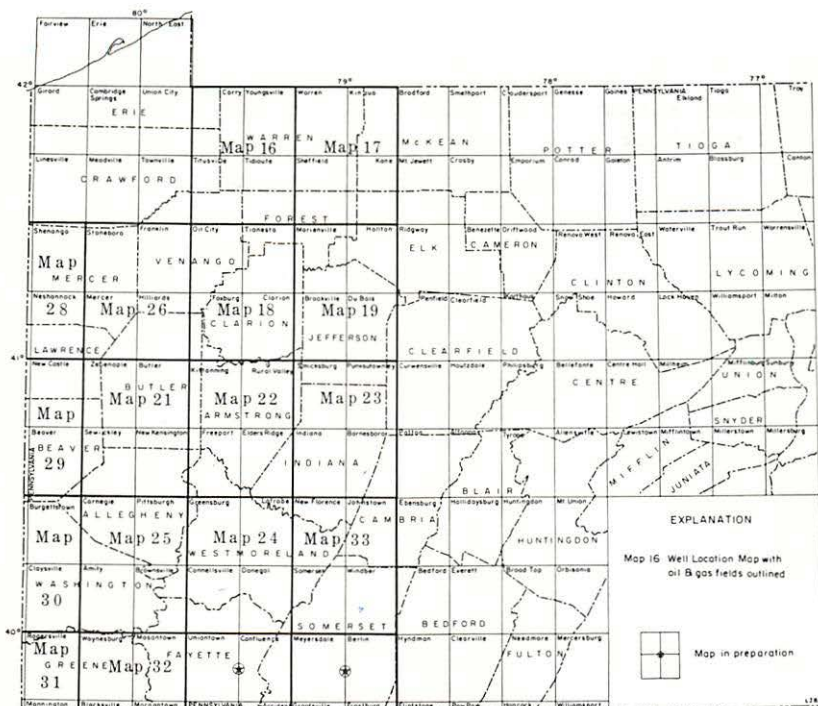
OIL AND GAS ACTIVITY IN PENNSYLVANIA

Activity in the oil and gas fields of the Commonwealth is on the increase, especially in the gas fields. Several public utility companies are giving farmouts, some covering proven gas acreage. One company is constructing a pipeline to transport the gas being developed by the farmouts. Seismic activity in the Commonwealth is at an all-time high.

The two Onondaga reef discoveries in New York have caused an active lease play in Tioga and Potter counties of north central Pennsylvania. Several major oil companies are in the play. Amoco has leased several million acres in Pennsylvania and New York. They are committed to drill a minimum of five wells in the next 15 months and eight wells in the following year.

In the newly discovered East Emporium Field of Cameron County as many as five new Oriskany development wells are contemplated. After fracturing, the discovery well had an initial production of 14 million CFGPD. The deep wildcat in Pike County in extreme northeastern Pennsylvania is drilling ahead at a depth in excess of 12,000 feet.

From January to the middle of November of 1971 a total of 562 wells had been drilled with a total footage of 978,052 feet. Of these 562 wells, 283 were oil wells, 146 gas, 25 dry, 42 service, 3 stratigraphic tests, 2 combined oil and gas, 1 disposal, 26 gas storage and 34 wells drilled deeper. The exploratory drilling for the year had discovered a small oil pool, a small shallow gas pool, and an Oriskany gas field.



NEW AND UPDATED OIL AND GAS BASE MAPS

The above index map shows the oil and gas base maps that are now available. Numbers 31, 32, and 33 are new as of January 1, 1972. Numbers 16, 17, 18, 19, 21, 22, 23, 24, 25, 26, 28, 29, 30 have been updated (posted date January 1, 1972). Paper prints of these maps, which show the locations of all the wells drilled for oil and gas since 1956 with gross field limits, can be obtained by writing to Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, Pennsylvania 17125. Cost of each map is \$0.50, plus 6 percent state sales tax. A check for the appropriate total amount made out to the Commonwealth of Pennsylvania must accompany the order. When ordering, please specify the map number.

YORK ROCK-O-RAMA

Sponsored by the York Rock and Mineral Club, the third annual Rock-O-Rama will be held at Alert Fire Company #1, Manchester Township, Emigsville, Pennsylvania, on Saturday, April 8 (10 a.m. to 9 p.m.) and Sunday, April 9 (10 a.m. to 6 p.m.).

SULFUR REMOVAL FROM COAL GAS PROCESSES

High-sulfur bituminous coal, barred for use in most steam-electric generating plants by recent air-quality standards, is being experimentally converted into pollution-free fuel by a one-step treatment process.

A mixture of high-sulfur coal, coal tar and hydrogen is heated, pressurized and blown at high turbulence through a bed of cobalt molybdate catalyst. Products are a desulfurized fuel that can be burned like oil in powerplants; an oil for carrying more coal to the process; and hydrogen sulfide gas that can be converted into marketable sulfur.

The process is under development at Bureau of Mines Energy Research Center in Pittsburgh, Pennsylvania. In recent tests, a bituminous coal containing 3.4 percent sulfur was converted to a viscous fuel containing only 0.3 percent sulfur.

The growing demand for clean-burning fuel has also resulted in the awarding of two contracts totaling \$1.2 million by the Bureau for the continuing development of a process for converting coal to gas.

from "Research and Development", September, 1971.

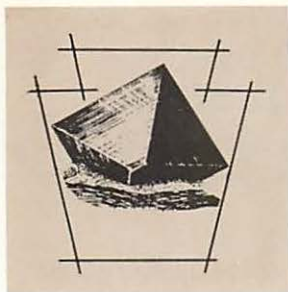
NEW SURVEY PUBLICATIONS

The following list of publications has been released by the Survey during the past few months. All of these publications are available at the Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, Pennsylvania, 17125. Checks should be made payable to the Commonwealth of Pennsylvania. For Pennsylvania addresses, please add 6% State Sales Tax. For free publications write to the Pennsylvania Geological Survey, Main Capitol Annex, Harrisburg, Pennsylvania, 17120.

<i>Publication</i>	<i>Price</i>
G 60 Pleistocene geology and unconsolidated deposits of The Delaware Valley, by G. H. Crowl (40 p., 24 figs., 1 pl.)	\$2.80
Map 27 Industrial minerals produced in Pennsylvania (sheet, 14½" x 21")	Free

CORRECTION

The price lists for G 56a in Vol. 2/6 of Pennsylvania Geology is incorrect, the correct price is \$2.75 not \$2.25.



EARTH SCIENCE TEACHERS' CORNER

Local Resident Donates Rock Collection To High School

A permanent rock and mineral collection is the latest addition to the physical science classes in Connellsville Area Senior High School. This outstanding collection was presented to the school by Ted Stillwagon, a local authority and collector whose private collection of rocks, minerals, and fossils has won acclaim throughout the United States.



Mr. Stillwagon (kneeling) points-out an unusual rock to Mrs. Mary Elizabeth Floto, the physical science instructor, and Robert P. McLuckey, principal.

The specimens are displayed in glass front cases that have been located on the second floor of the high school and adjacent to the physical science room. In addition to being a valuable asset to Mrs. Floto's classes studying earth science,

the Stillwagon Rock and Mineral Collection is open to the public during school hours: September through May - Monday through Friday from 8 a.m. to 3 p.m. and June, July, and August - Monday through Friday from 9 a.m. to 4 p.m.

The students have prepared an excellent brochure describing the Stillwagon Collection and have been in charge of elementary student field trips to the senior high and this collection. Here at the Connellsville Area Senior High School is truly a fine example of cooperation between the community, administrators, faculty, and students toward a common goal - quality education.

SURVEY ANNOUNCEMENTS

SURVEY ANALYTICAL TECHNIQUE RECEIVES WIDE APPLICATION

In 1961, the Pennsylvania Geological Survey initiated a new x-ray diffraction technique for the rapid quantitative determination of minerals in fine-grained clay mixtures. Recently, the technique has been quoted by J. Zussman in his excellent new book, "Physical Methods In Determinative Mineralogy", Academic Press, 1967. Since the original work, the Survey has continued to improve the technique. Other suggestions for improvement have been made by Professor George Brindley at Pennsylvania State University, and a refinement by Robert Davidson, Pennsylvania Department of Transportation currently is being initiated for study of raw materials used in highway construction. The Survey developed the technique for the study of raw materials used in the ceramic and lightweight aggregate industries, but it is applicable to any fine-grained rock that is not amenable to macroscopic or microscopic analysis.

NEW LIQUID DISPOSAL BOOK

The U. S. Geological Survey has published "Subsurface Waste Disposal by Means of Wells: A Selective Annotated Bibliography." With abstracts of 692 papers on technology, dispersal, and industrial case histories, this publication (U.S.G.S. Water Supply Paper 2020) is available from the Government Printing Office, Washington, D. C. 20402 for \$1.50.

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In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

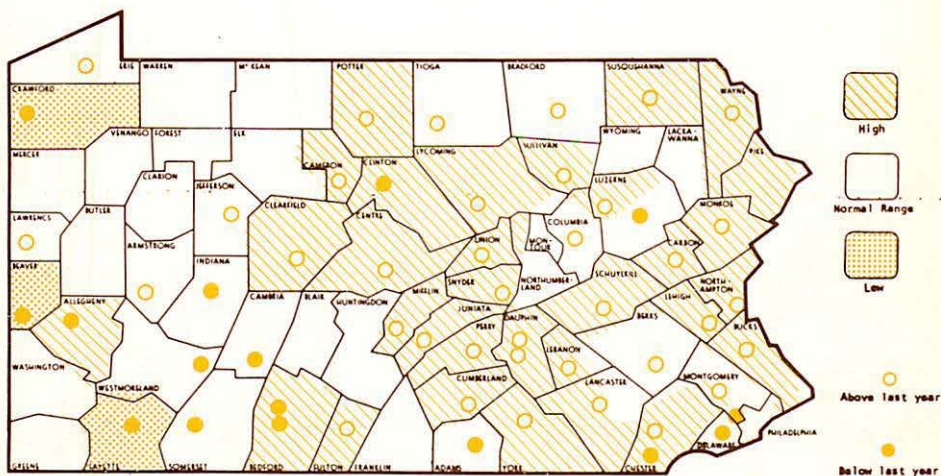
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JANUARY 1972
GROUND-WATER LEVELS



MEET THE STAFF

Donald M. Hoskins, Assistant State Geologist

No Bureau of State Government runs without the presence of an administrator who supervises and handles the necessary daily and mundane duties of salaries, purchasing, personnel, and budgets. The man in this job is Don Hoskins, who has been with the Survey since 1956.

In addition to handling the administrative chores for the Bureau, Don is co-authoring a Middle Devonian stratigraphic paper and is slowly completing his report on the geology of the Millersburg Quadrangle, one of the many atlas reports that the Bureau is charged to prepare. Don also serves as part-time paleontologist and assists amateurs in the identification of their fossil finds. Don wrote one of the Survey's best sellers, "Fossil Collecting in Pennsylvania", now in its second printing, which has sold over 8,000 copies.

Don received his Bachelors at Union College in 1952, a Master's at the University of Rochester in 1954. He served with the U. S. Army Corps of Engineers in Germany until 1956, and has been with the Survey ever since, except for a year and a half leave to obtain his Ph.D. degree in geology at Bryn Mawr College. While with the Survey he has been a field geologist and co-authored an atlas report on the Mifflintown Quadrangle. He then was promoted to Chief of the Field Division supervising all field mapping of the Survey. Later he was promoted to Editor, where he supervised preparation of all Bureau reports. Now Don is the Assistant Director of the Bureau and Assistant State Geologist.

With a doctorate degree in geology already accomplished, Don is currently working toward a Master's degree in State Government with the Wharton Graduate School of the University of Pennsylvania. As a hobby, he grows roses and also makes wine.

