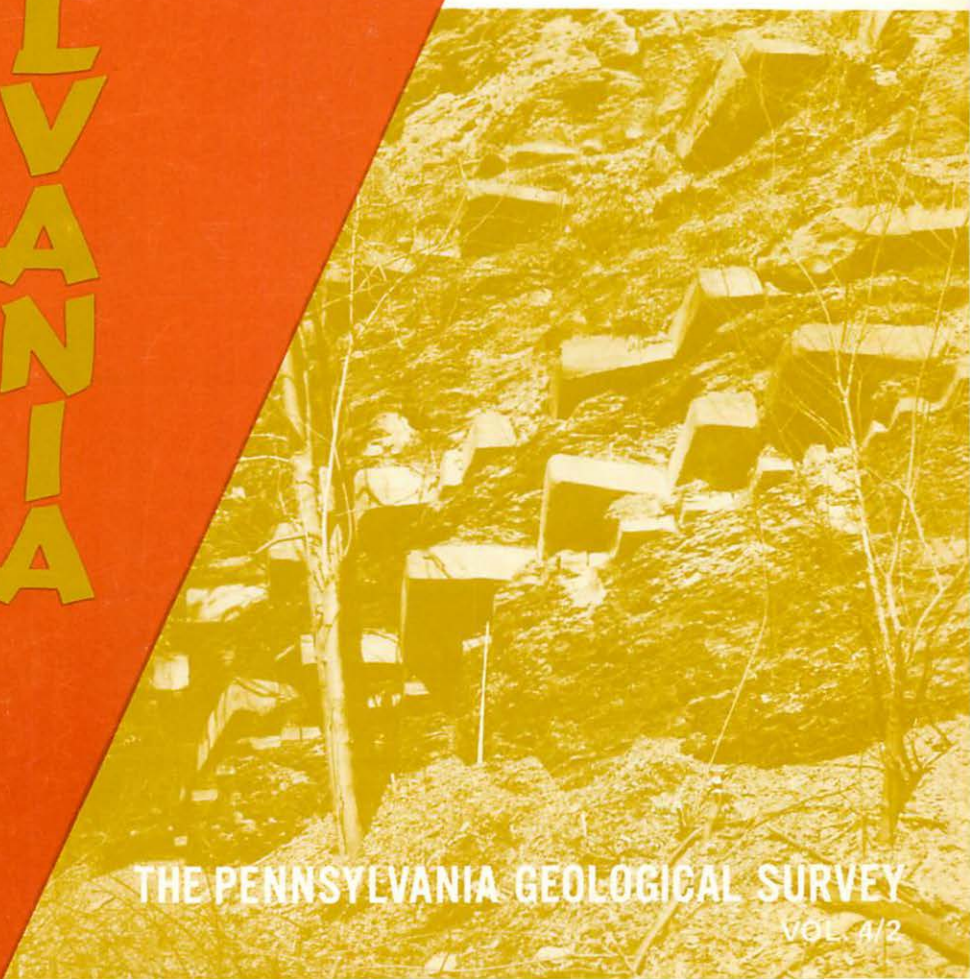
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY
VOL. 4/2

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGIC SURVEY
Arthur A. Socolow, State Geologist

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ON THE COVER — "Steps" in Devonian Trimmers Rock sandstone formed by fractures perpendicular to the bedding. For scale, see meter stick standing next to large tree. Along Penn-Central RR on NE bank of Susquehanna River, SE of Larry Creek, 10 miles west of Williamsport. Photo by R. T. Faill.

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APRIL 1973

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

GEOLOGY AND THE ENERGY CRISIS

Once again the subject of geology stands out as a prominent factor on the contemporary scene. Having already been identified with such noteworthy events as moon exploration, earthquake disasters, and environmental planning, geology now stands out in the key role of the energy crisis.

Whether we are concerned with the shortages of oil and gas, or the pollution from our high sulfur coal deposits, or the radiation problems of nuclear fueled reactors, in each instance we are dealing with a geologic mineral resource. And whatever the resolution of the problem is, be it by new oil and gas discoveries, or by coal gasification and liquification, or by oil shale and tar sand development, or by coal cleaning techniques, or geothermal energy development, the solutions for the energy crisis will entail geologic research and expertise.

Here in Pennsylvania where we face energy shortages as great as any in the nation, we of the Pennsylvania Geological Survey feel that the geological resources within our Commonwealth offer relief from the energy squeeze. Our recent Bulletin IC 72, The Coal Reserves of Pennsylvania, details the existence of over 20 billion tons of recoverable coal in Pennsylvania. Our Bulletin M 65, The Petroleum Industry and the Future Petroleum Province in Pennsylvania, spells out the potential for new oil and gas discoveries in areas and depths of Pennsylvania which have barely been tested to date.

The Pennsylvania Geological Survey has kept faith in the energy resources of our Commonwealth. Systematically, for over fifty years we have been mapping the distribution, thicknesses, and structures of our coal deposits. We have collected geologic data from thousands of our oil and gas wells so that we could interpret their significance with the aim of locating new oil and gas fields. It is fortunate that we had the foresight to begin the studies and data collection of our mineral fuel resources in years past. The accumulated wealth of knowledge is now paying off, as we are able to make a geological contribution to solving the energy problems of Pennsylvania. The results of our studies are all available through our extensive list of published geological reports.

Arthur A. Socolow

SINKHOLES - A CONSTANT PROBLEM

On Wednesday, February 7, 1973, an article appeared in the Harrisburg morning newspaper describing a sinkhole which has developed in a highway near Mechanicsburg, Cumberland County. On investigation it was found that the sinkhole described in the paper had been filled but that there was another similar problem in the same area. This second sinkhole reported that day had not been filled, and an augering crew was presently trying to determine the limits of the collapse.

An open excavation along Rt. 114 about 1500 feet south of the Mechanicsburg Borough line illustrates the local development of karst features beneath a soil cover. Bedrock exposed is the Rockdale Run Formation.

View of the open excavation looking south along Rt. 114. The tops of the limestone pinnacles can be seen.

The largest pinnacles at least 3½ feet high. The floor was not excavated to bedrock.

View looking to the SW along the trend of the pinnacles. Scale is a box of Polaroid film. Surface of rock on left is a bedding plane.

Removal of the soil left a series of limestone pinnacles. The long axis, or dimension, was aligned along the strike of the limestone, N64°E. The dip of the strata was 41° to the south. All of the pinnacles extended across the width of the cut. The cross-sectional shape of the pinnacle is asymmetrical. The south facing slope was at or slightly greater than the dip angle. The north facing slope was nearly vertical or slightly overhung. Depth to bedrock between the pinnacles increased toward the south (downhill) from 2 feet to a depth greater than 4 feet. The distance from

Sinkhole at base of ditch. Highway is at upper left.

pinnacle to pinnacle increased in the same direction, as did the soil cover on the tops of the pinnacles.

The reported sinkhole was in the bottom of a drainage ditch coming from the area of the excavation. The sinkhole tends toward the southwest (directly under Rt. 114) and has a pool of water at the bottom.

Looking down one of the auger holes. Note the rock ledge which is approx. 5 feet below ground surface. Opening extends beneath ledge. Road bed is directly above ledge.

The adjacent photograph is a shot into one of the auger holes which had broken into a cavity. The roof material here was about 6 inches thick. The material out of focus in the foreground is the ground surface. The light is shining on a bedrock ledge and the hole can be seen extending beneath it. The problem was probably caused by high ground waters or surface water in the ditch which washed the soil material from between bedrock pinnacles. The berm material along the edge of the road acted as an impermeable caprock. The cavity beneath this was formed by collapse as the deeper soil material was washed away.

This sinkhole problem demonstrates a situation which exists throughout the Cumberland Valley and the other limestone valleys in Pennsylvania. The drainage ditch diverts storm runoff from its natural drainage path on the southwest side of Rt. 114. The natural path had become a residential strip complete with basements, lawns and gardens. During periods of excessively high precipitation these homes were subjected to minor flooding. The ditch was dug to prevent this, which it did to some extent. However, it was the diverted runoff which created the sinkhole. Appropriate zoning could have prevented this incompatible interaction of land use and geology. Since this situation already exists, sinkhole development can be prevented by the construction of *lined* ditches or storm sewers which carry the water to the channels of permanent streams.

Evan T. Shuster

USE OF A GENERALIZED SLOPE MAP IN REGIONAL PLANNING

by

Wade G. Fox, Assistant Director for Data Services
Southwestern Pennsylvania Regional Planning Commission

In a review of existing development patterns in the Southwestern Pennsylvania Regional Planning Commission (SPRPC) six-county region (Allegheny, Armstrong, Beaver, Butler, Washington and Westmoreland) it is evident that the rugged terrain has played a vital part in the shaping of the development in the Pittsburg area. For this reason, during the development of the forecasting technique to be used by SPRPC, the slope of the land was identified as an essential component of the forecasting and analysis process. Since computer mathematical models, coupled with the more conventional planning techniques were to be employed in the planning process, it was a requirement that both a quantitative measure as well as graphical representation of the slope be obtained.

To obtain minimum quantitative measure, the amount of undeveloped land with slope exceeding 24 percent was identified and measured. However, for the graphical representation of slope, which was to be used for analysis purposes, it was determined necessary to identify all land by four major slope classifications. The compilation for this amount of detail for an area of 4,600 square miles was a substantial undertaking; therefore, as many shortcuts as possible were taken to hold down the cost and to expedite the program.

The first step in the process was to delineate, on prints of the terrain separation (brown) of the 7½ minute USGS quadrangles, the slope in four major categories (less than 9 percent, 9 to 16 percent, 17 to 24 percent, and 25 percent and over). This was a manual interpretation using templets to identify the various slope categories. The three steepest slope categories were color coded on the terrain prints. Next, a lined drawing of the slope categories was made on mylar in ink, and each of the three steepest slope categories identified by a different "Zip-a-Tone" pattern. This completed Phase 1, which resulted in a four-category slope map at the scale of 1" = 2000'. The slope overlays are used in conjunction with reproducible copies of the black and blue separations of the USGS quadrangles. This series of maps is used for detailed review purposes, however, for analysis on a regional basis this series of maps was considered too cumbersome because of size and bulk, therefore, it was necessary to reduce these to a more workable scale. This process will be explained later in the article.

To obtain the quantitative measurement of undeveloped land with slope in excess of 24 percent, a panograph was employed to transfer the steep slope areas onto land use overlays of aerial photographs. On these 1" = 500' and 1" = 880' scale overlays, various categories of developed land and water areas as well as "vacant" land had been delineated, using photo interpretation techniques. Using

Aerial Photo with Land Use Overlay

Block Coding Form

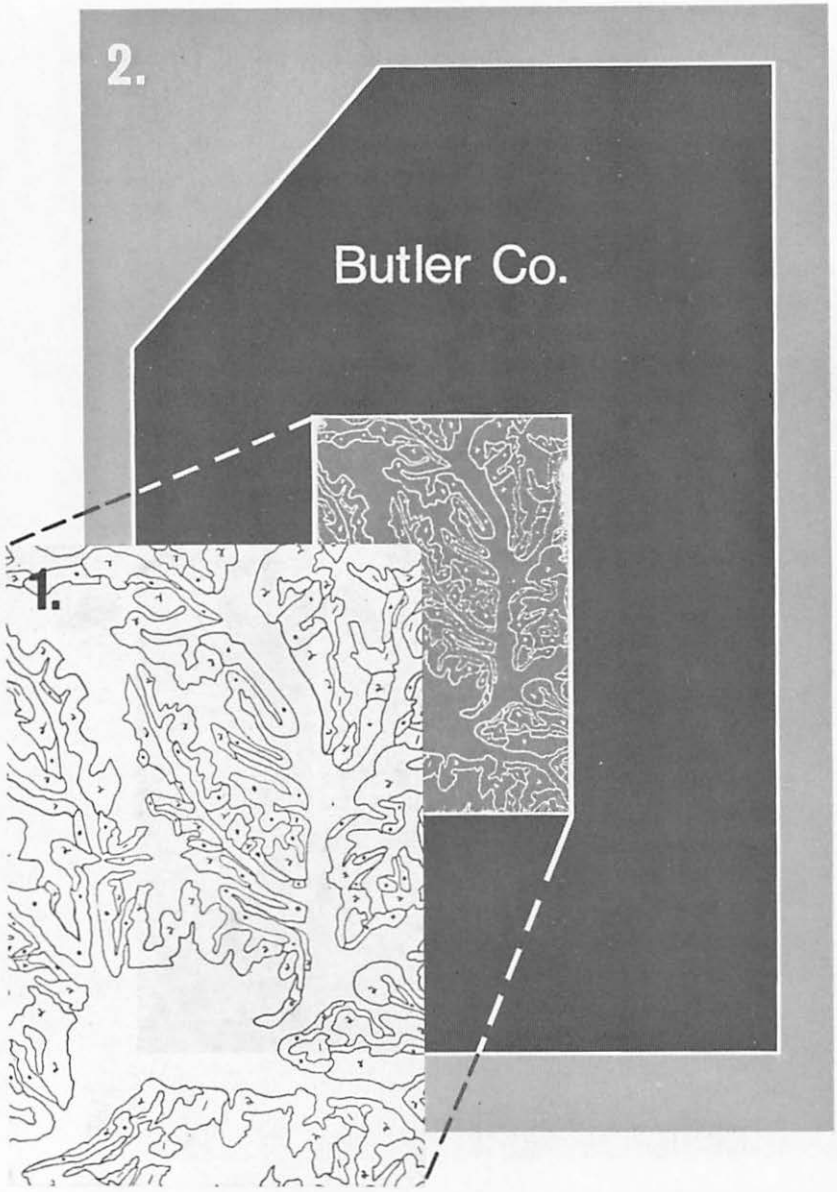
SPRPC 1967 LAND USE MEASUREMENT BY BLOCK WITHIN TRAFFIC ANALYSIS ZONE (MEAS IN 000 SQ FT)

CONTROL SHEET NO. --/----

TRAFFIC ANALYSIS ZONE 601

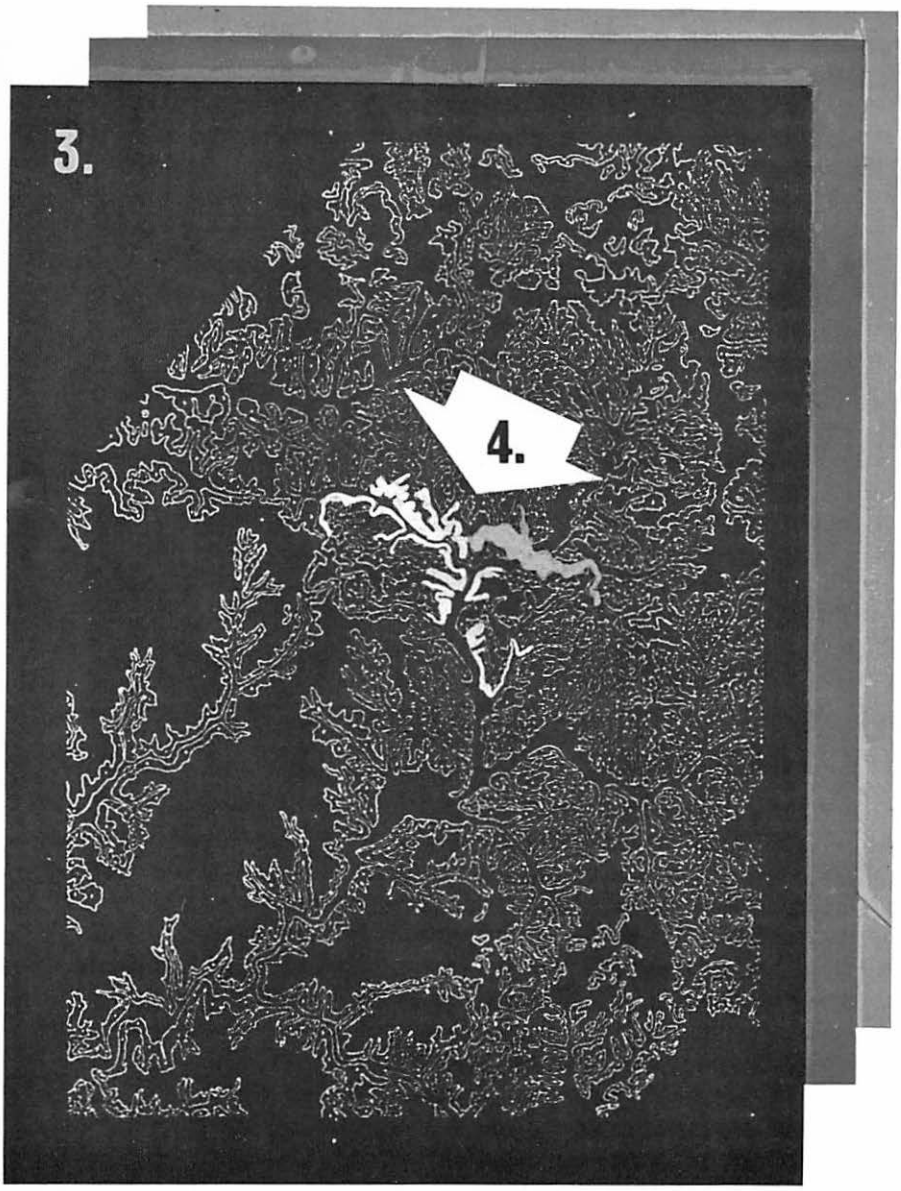
PHOTO BLOCK-XY	RESID	NON-RESID	RES-O/S	PVT-O/S	SP-O/S	OTH-O/S	STRIP	DERLT	WATER	VAC+25%	VAC-25%	TOTAL
>289 7013-5959											360	360
>226 7019-5875											960	960
>289 7019-6147	80									140	2350	2570
>289 7023-5942											3610	3610
>226 7033-5829										210	5740	5950
>226 7028-5731		40								530	5700	6070
>289 7028-6050											560	560
>225 7030-5775										1890	4280	6170
>289 7030-6034	80										4830	4910
>226 7031-5851										750	3500	4250
>226 7032-5874											2310	2310
MEAS	160	100										

Figure 1: Example of Aerial Photograph with land use overlay and Block Coding Form.



1. Reduce 1"=2000' slope overlays to 1"=4000' negs.
2. Strip into county map composite.

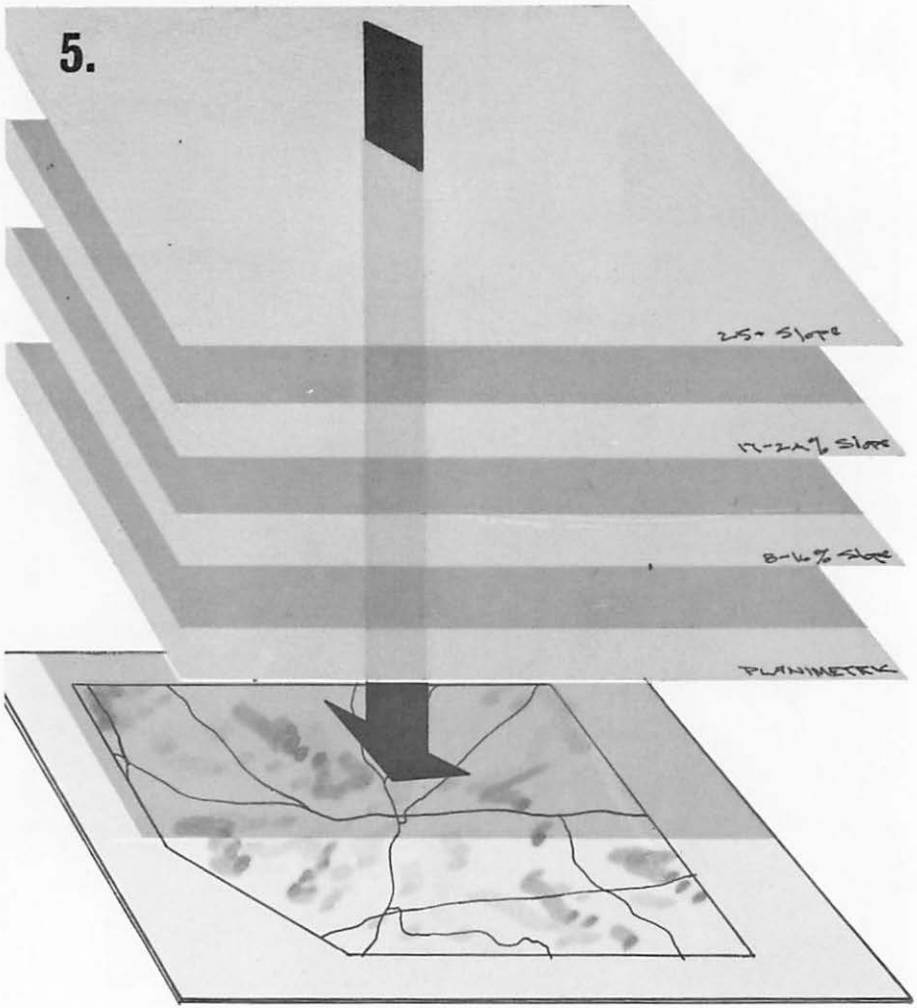
Figure 2a: Process followed to produce county slope maps.



3. Reproduce three Strip-Rite negatives.

4. Peel off each slope category.

Figure 2b: Process followed to produce county slope maps.



5. Reproduce composite base map of three slope categories and planimetric detail.

Figure 2c: Process followed to produce county slope maps.

Figure 3: Example of completed section of county slope map.

the panograph to bridge the scale difference the "vacant" land areas were further defined into two categories—land with slope less than 25 percent, and land with slope 25 percent or greater. These two categories, for obvious reasons, were given the names "vacant usable land" and "vacant unusable land". Then, as part of the normal land use survey procedures, (see figure 1) the two "vacant" categories were measured along with the other land uses on a block basis (over 50,000 block were delineated in the SPRC region). This completed Phase 2 of the process where a quantitative measure of slope was available for computer processing.

As part of the SPRPC cooperative planning process, which involves various planning departments within the six-county region, it was determined essential that the four-category slope map be reproduced on a county-by-county basis to supplement the individual USGS quandrangle. The scale decided upon for the county composite slope map was 1" = 4000' which would conform to an existing series of data overlays that SPRPC had already developed at that scale.

Since the slope information had become an essential part of the planning process, it was considered necessary that it be combined with our county base maps of reduced USGS quadrangles at the 1" = 4000' scale. To achieve a composite of the USGS planimetric information together with the four slope categories on a single base map, it was necessary to use mechanical screens to depict the three steepest slope categories.

The following procedure was used to produce the slope map (see figure 2):

1. The slope overlays at 1" = 2000' scale were photographically reduced to 1" = 4000' scale.
2. The reduced negatives were "stripped" together for each county in the region (actually due to the size limitations, two counties were done in two-parts each).
3. From the county composite slope negative three "Strip-Rite" contact prints were reproduced—one for each of the three steepest slope categories. This photographic process etched the slope lines onto a red material that is adhered to a clear mylar base material.
4. Each slope category separation was then "peeled"—that is—the areas encompassed by the line for a particular percent of slope was cleared by peeling it off the mylar. The last manual operation was to opaque out all lines on each separation that belonged to the other slope categories. The results were three negative separations for each county, one depicting the slope category 9 to 16 percent, one for the 17 to 24 percent, and one for the 25 percent and over. Land area less than 8 percent of slope was left clear.
5. The final step was to reproduce the composite county map containing the three steepest slope categories and the planimetric detail. A mechanical screen was selected for each of the slope separations which would result in a light tint of gray for the more gradual slope, and a dark tint of gray for the steepest slope. Since the USGS planimetric detail was to be mose

prominent, no screen was used at all, and a black line effect was achieved. The composite map was created on a reproducible material so that diazo prints may be obtained.

An example of the resulting composite map is shown in figure 3. SPRPC staff has found this map to be very useful in its planning programs. Not only can future development forecasts be located more easily, but highway, as well as water and sewer planning on an areawide basis has been simplified.

Slope maps that are available at the SPRPC office include:

1. 1" = 2000' USGS 7½-minute quadrangles for those areas of the six-county region that had the quadrangles available as of 1966. The four slope categories are shown by patterns and may be reproduced with planimetric or contour USGS separations.
2. 1" = 4000' county maps showing all four categories of slope. For the counties of Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland.
3. 1" = 2 miles six-county region map showing areas with slope of 15 percent or more. Slope overlay may be printed with a variety of base maps at the 1" = 2 miles scale.

TENTH ANNUAL CURRICULUM CONFERENCE

The Pennsylvania Department of Education for the tenth consecutive year is sponsoring a Curriculum Conference at Shippensburg State College, June 19-22, 1973. One of the sessions is called, "Man and the Environment – A New Approach to the Teaching of Geology", and will be of interest to earth and space science teachers. The workshop will stress the environmental aspects of geology which are most important in a secondary school level. Several speakers will present topics on engineering geology, ground-water, mineral resources, topography and their effects upon man. An environmental geology field trip is planned.

The conference begins with registration at 1 p.m., Tuesday, June 19th and closes after lunch, Friday, June 22nd. The overall cost including registration, meals and room is $35 if a room is shared and $45 for a single room. For commuters: the registration fee of $10 should be submitted with the pre-registration form. Meal tickets can be purchased at the conference registration desk.

Interested persons should contact *Mrs. Bertha P. Boyd, Conference Coordinator, Department of Education, Box 911, Harrisburg, Pennsylvania, 17126; Phone (717) 787-5218.*

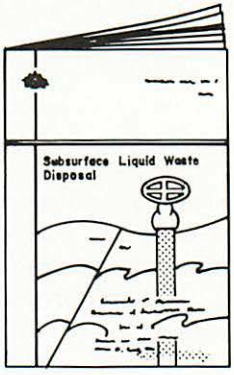
Registration for the conference closes June 1 or earlier if workshop quotas are filled.

SUBSURFACE LIQUID WASTE DISPOSAL -- A NEW PUBLICATION

With our population and industrial growth, the problems of environmentally acceptable waste disposal have become a serious concern. Of particular note are industrial liquid wastes which are difficult to store and treat at the surface. One solution considered is injection of these liquid wastes into deeply buried rocks. However, there is a mixed opinion with regard to their success and the possible environmental danger.

A new publication, "Subsurface Liquid Waste Disposal and Its Feasibility in Pennsylvania", has been released by the Bureau of Topographic and Geologic Survey. It provides a background for decisions that will be necessary on the part of industry, government, and the public in order to carry out a safe and sane liquid waste disposal program. Regulatory agencies must be able to answer with a high degree of certainty:

1. Where is the injected liquid going, both initially and as long as it is potentially hazardous?
2. What will the effects be, both direct and indirect, present and future, upon our environment?



Environmental Geology Report 3, "Subsurface Liquid Waste Disposal and Its Feasibility in Pennsylvania", is written by Dr. Neilson Rudd, an expert on fluid mechanics and the subsurface behavior of rocks. Continuing in the format of the "EG" series of reports, the author has used diagrams, sketches, and tables to illustrate a technical and complex subject. As an additional aid we have color-coded those headings, sentences, and paragraphs which provide the basic "thought" or "meat" of the page. Again, this report attempts to bridge the gap between fundamental geologic facts and the real-world, daily needs of an every changing society.

We continue to say that geology has an important input in improving and protecting the environment of Pennsylvania. It is for this reason that the Environmental Geology Series of publications are designed to present information that will assist in defining the most effective use and protection of our land and mineral resources.

Environmental Geology Report 3 may be obtained by writing to the Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, Pennsylvania, 17125. The cost per copy is $2.00 plus 6% state sales tax for Pennsylvania residents.

LILLIAN HEEREN - THIRTY YEARS AS A DRAFTSMAN

Miss Lillian Heeren, Draftsman III for the Oil and Gas Division of the Bureau of Topographic and Geologic Survey completed 30 years of continuous service on March 14, 1973 as Head Draftsman for the Division. She was honored on her thirtieth anniversary with a luncheon given by her fellow workers and presented with a gold wristwatch.

Lillian had started at Carnegie Tech in the curriculum of Painting and Design. When the Second World War broke out she thought she would be of more use as a draftsman, therefore, she transferred to the University of Pittsburgh where she took up drafting. Dr. Daniel Bush, professor at the University and cooperating geologist with the Survey, needed a draftsman to finish Special Bulletin No. 1 entitled "Oil bearing sands in southwestern Pennsylvania" so he hired Lillian who completed her studies while working for the Survey.

In the early part of her career with the Survey she worked in field offices such as Pleasantville and Butler, as well as in her headquarter office in the Cathedral of Learning at the University of Pittsburgh where space was provided in the Geology Department. During her early years she spent most of her time on Survey projects that were given her by Dr. Richard E. Sherrill, head of the Geology Department at the University of Pittsburgh and Dr. Charles R. Fettke, head of the Geology Department of Carnegie Tech, both being cooperating geologists with the Survey.

During her Survey career she has completed hundreds of maps and figures for Survey publications authored by the Survey's geologists. In the early years the Oil and Gas Division rarely consisted of more than one geologist. Consequently, when the geologist would leave the employment of the Survey, Lillian would be the only one in the Division for months at a time until the vacancy was filled. During those periods, her work would be supervised by the State Geologist in Harrisburg. Lillian has served under all five State Geologists of the Fourth Pennsylvania Geological Survey; namely, Dr. George Ashley, Dr. Ralph Stone, Dr. Stanley Cathcart, Dr. Carlyle Gray, and the current State Geologist, Dr. Arthur A. Socolow.

Of the reports published by the Fourth Survey, Lillian has drafted the illustrations for 67 major reports, some of the maps taking months to draft for printing. Her illustrations have appeared in many other publications and technical articles. She has seen major changes in drafting techniques and has kept up with all of them. One of the major changes being the scribing method with

the use of stick-up letters and symbols for map making instead of using ink drafting pens and freehand lettering. A story of Lillian and her picture was recently published in the Pittsburgh Press Sunday's issue in an article "Happiness is doing a man's job".

Lillian has always loved to travel. She has taken many trips with her friends from the University of Pittsburgh and Carnegie Museum. One of her most pleasurable excursions was a trip around the world by boat.

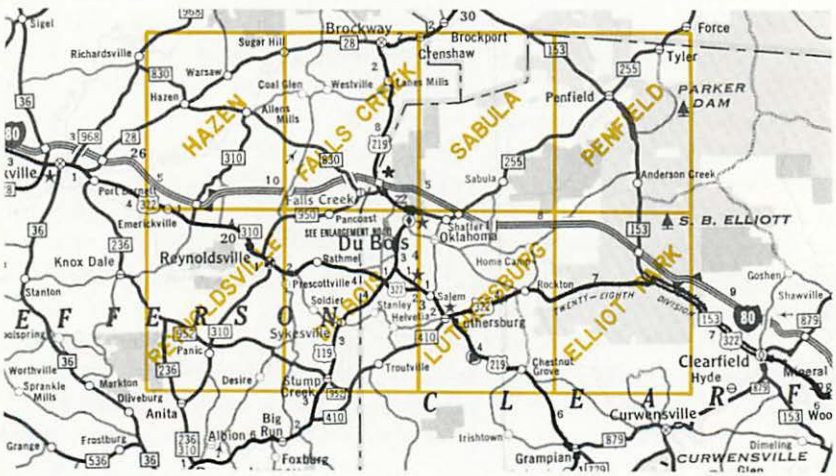
She plans to continue with her Survey drafting duties, and we feel it is most fortunate to have a draftsman of Lillian's caliber whose ability can easily be seen in the Survey's published reports.

GROUND WATER PROJECT AROUND DUBOIS AREA TO BEGIN

Summer 1973 will mark the beginning of a ground water project in the DuBois area which will include parts of Clearfield and Jefferson Counties. The project is to cover eight 7½-minute quadrangles. Geologic mapping of these quadrangles has recently been completed, but not yet published by our Field Geology Division. These are the Hazen, Reynoldsville, Falls Creek, DuBois, Sabula, Luthersburg, Penfield, and Elliot Park quadrangles.

The project will be undertaken by Evan T. Shuster in the Environmental Geology Division. The main objectives of the study will be to determine the quantitative and qualitative aquifer characteristics of the near-surface geologic units. Because the area is expected to undergo significant growth in the near future, Evan will examine the relative potential of these units as sources of potable ground water and the ability of this and geologically similar areas to sustain ground water development.

Field work for this project is expected to require two seasons and the study should be ready for publication by mid-1975.



THE OLD WOODBURY ZINC-LEAD OCCURRENCE, BEDFORD COUNTY COMES TO LIGHT

As part of a research study of all known Zn-Pb occurrences in Pennsylvania, the Woodbury Pb-Zn occurrence in northern Bedford County was relocated by Survey staff geologists John H. Way, Jr. and Bob C. Smith, II. The only known reference to this occurrence is McCreath (1879, p. 280) who stated only the following: "S. Snyder's farm, three miles west from Woodberry, Bedford County. Surface ore: Metallic lead 25.80 and Metallic zinc 32.97%."

To date, the mineralization that was observed occurs as a 25 x 60 foot gossan scar in a field on the private farm of Jacob J. Snyder, whose home is located 3.8 miles west of the present town of Woodbury and 1.5 miles NE of Lafayetteville along Pennsylvania Route 867. Within this scar, crops are severely stunted and there is abundant limonite float in the fields. Some of the limonite contains appreciable smithsonite, galena, anglesite, and cerussite. Fresh pieces of dolomite breccia contain thin veinlets of calcite and sphalerite. To the best of the owner's knowledge, neither geochemical nor geophysical studies have been conducted at this occurrence.

The geology of the area is poorly known, although Survey work is now in progress. The state geological map (Gray and Shepps, 1960) shows the host rock to be Cambrian Warrior dolomite. However, no fault is shown which could have produced the observed tectonic breccia. The trace of another fault ¾ mile to the NW is shown on the state map. It probably is a southeast dipping thrust fault that developed on Ordovician Reedsville shale. Conceivably it could pass beneath the gossan scar at a depth of 2000 to 4000 feet. This thrust contains Beekmantown Group sediments, some of which are known to contain oregrade zinc elsewhere in the Appalachians. Other thrust faults are known to be favorable hosts for ore deposits.

Platt (1881) on p. 53 of his report on Blair County states "In a quarry one mile north of Lafayetteville, the limestone is massive, dark colored, much specked with quartz and calcite, and with some very small spurs of zinc ore." This occurrence would be approximately ¾ mile southwest of the J. J. Snyder farm.

Stevenson (1882) on p. 328 of his report on "iron interests" in Bedford County states "The most marked line of ore-bearing sands is in South Woodbury and Bloomfield townships. . . . not following the strike of the rocks but bearing almost north and south. . . . The existence of limonite ore along this ridge has been fully proved by prospecting pits . . . at comparatively short intervals."

Further field work, and possibly some reconnaissance geochemical prospecting, is planned by the Survey. This will be described in a future issue of *Pennsylvania Geology*.

Because this area is private, permission to enter the property is required by the Snyders.

Bob C. Smith, II

REFERENCES:

Gray, C. and V. C. Shepps (1960) Geologic Map of Pennsylvania, Pa. Geol. Survey, 4th ser., 1:250,000.

McCreath, A. S. (1879) Second Report of Progress in the Laboratory of the Survey, Chapter 5, Pa. Second Geol. Survey, MM, 438 pp, 1 pl.

Platt, F. (1881) The Geology of Blair Couty, Pa. Second Geol. Survey, T, 311 pp.

Stevenson, J. J. (1882) The Geology of Bedford and Fulton Counties, Pa. Second Geol. Survey, TT, 382 pp, 2 mps.

PENNSYLVANIA SURVEY LIBRARY NEEDS

Scores of individuals and institutions have generously responded to our earlier appeal for replacements for our flood-ravaged library. We have received contributions of many important out-of-print volumes and long runs of professional journals.

Now that we have been able to take stock of what we received, we have also been able to focus on those items which are still missing and would like to replace.

Listed below are the journals and the particular volumes for which we are issuing an appeal. We would welcome any portions of these missing series. We are prepared to handle shipping costs (preferably Express Collect) and, where desired for financial records, will furnish a written acknowledgement and estimated value of any items donated. Please direct shipments to Arthur Socolow, State Geologist, Pennsylvania Geological Survey, Towne House, Harrisburg, Pennsylvania 17102.

AAPG Bulletin	vol. 1 - 9,12	1916 - 1925, 1928
American Journal of Science	vol. 260 - 272	1960 - 1972
Economic Geology	vol. 1	1906
Journal of Geology	vol. 1 - 10	1883 - 1893
	vol. 68 - 81	1959 - 1971
Journal of Paleontology	vol. 1 - 14	1926 - 1940
Journal of Petrology	vol. 1 - 12	1959 - 1971
Journal of Sedimentary Geology	vol. 1 - 25	1930 - 1955
Micropaleontology	vol. 1 - 17	1954 - 1971
Mineralogical Magazine	vol. 1 - 37	1934 - 1971
Sedimentary Geology	vol. 1 - 7	1964 - 1971
Sedimentology	vol. 1 - 17	1954 - 1971
Tectonophysics	vol. 1 - 12	1959 - 1971
Water Resources Research	vol. 1 - 7	1964 - 1971

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TOPOGRAPHIC DIVISION

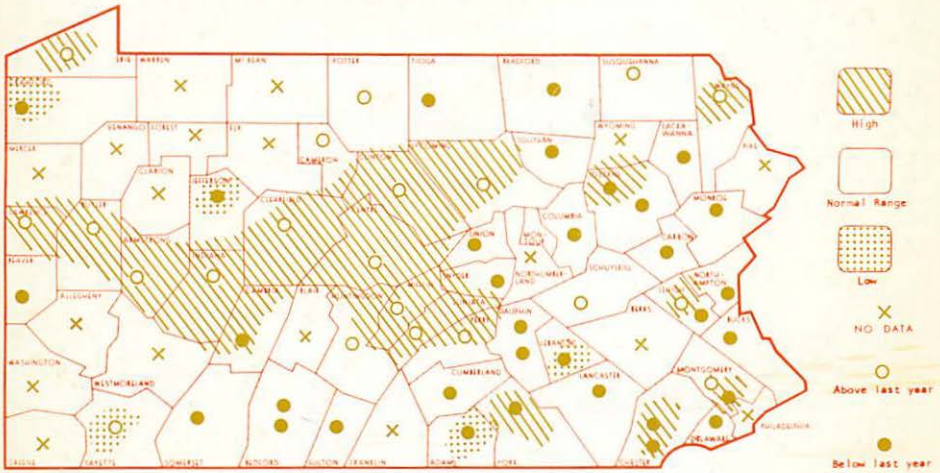
In Cooperation with The U.S. Geological Survey

GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

MARCH 1973

GROUND-WATER LEVELS



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