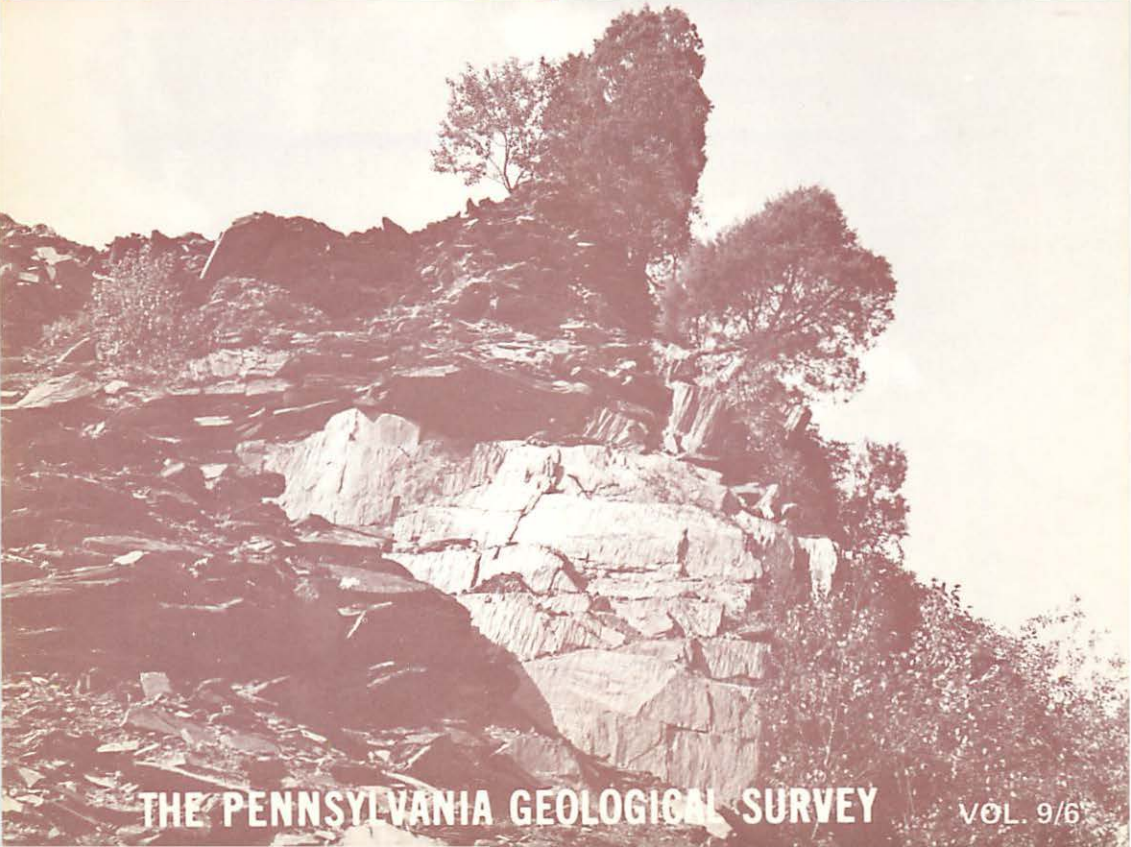
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY VOL. 9/6

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

CONTENTS

ON THE COVER: Peach Bottom Slate, of Lower Paleozoic age, exposed in quarry near Delta, Pennsylvania (York County). Photo shows crenulations on drag folds related to fracture cleavage. Slate contains well developed flow cleavage, fracture cleavage, joints, and lineations. Photo by J. P. Wilshusen.

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DECEMBER 1978

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

IS REACTION TO CRISIS THE ONLY WAY?

At a time when so many of the basic economic "laws" that I was once taught are being shown to be inoperative and essentially repealed by human greed, I still think back to the professor who stressed that a nation has only two fundamental sources of economic wealth: its natural resources and the labor it can muster to harvest and utilize those natural resources. Our nation blossomed and expanded in the 18th and 19th centuries by virtue of its abundant agricultural and mineral resources. And with a population expanding both in size and area of distribution, there was the need and motivation to develop and harvest the resources of our nation – and so it prospered and bountiful quantities of agricultural commodities and mineral resources were brought into production.

In the most recent couple of decades, as the nation found that it was able to supply its quantitative needs of agricultural and mineral resources, it began to pay attention to the quality of its production methods. And so there has come to pass great and proper emphasis on the environmental and conservational aspects of agricultural and mineral production.

But the indications are growing that there will have to be renewed attention and emphasis paid to again stimulate the quantitative aspects of our natural resources production. A growing world population is going to need increasing quantities of food, even from us. Our own economic machine is beginning to recognize that our once plentiful mineral resources are no longer so plentiful. At the same time, foreign sources of mineral products are becoming more and more difficult to reach; their own developing nations are beginning to utilize those resources at home, while various geo-political factors further reduce our access to those essential mineral resources.

The lesson we should learn from this sequence of events, past and present, is that we must exert renewed efforts to develop at home new sources of the wide array of minerals of which we are so rapidly running short.

Is our nation capable of learning the lessons of past experience and future needs in time to muster the efforts for timely and sound development of our mineral needs? Or will we wait until we react to a crisis?

Arthur A. Socolow

Another Lancaster County Earthquake

Charles K. Scharnberger[1]

Lancaster County is not what one usually considers "earthquake country," but residents were beginning to think of it that way after the second earthquake in three months struck about 3:25 p.m. on Friday, October 6. Because of the time of day, this tremor was felt by a far greater number of people than the July 16 quake which occurred at 2:40 a.m. The epicenter, as determined from intensity reports, was located only 5 km. from the center of the City of Lancaster. The July epicenter was about 15 km. from the city's center. In July, only about 65 newspaper questionnaires soliciting intensity information were returned, but this time the response was close to 400. The result of the intensity survey is shown in Figure 1.

Some of the most useful intensity data was supplied by students in earth science classes taught by Mr. Richard Brown at the Manheim Township Middle School, situated about 2.5 km. northeast of the inferred epicenter. Many students who live in two developments just south of a quartzite-schist ridge known as Blossom Hill reported effects that would fall in the intensity VI category of the Modified Mercalli scale. These effects included: fallen plaster, cracked foundations, pictures and mirrors knocked from walls, and bric-a-brac knocked from shelves.

There were many reports of pets behaving in an excited manner a few minutes before the first sound or vibrations were experienced by humans. Dogs generally whined and acted as though they wanted to be let out, yet would not venture off porches. Rodents scrambled frantically in their cages and even goldfish were reported to have raced and splashed in their bowl shortly before the quake. These reports of animal behavior all came from within or very near the maximum intensity zone.

The general experience was the same for this earthquake as in July: a loud explosive sound followed by vibrations that lasted a

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few seconds. As in July, a few persons reported feeling two distinct vibrations.

An interesting feature of the intensity map is that some areas farther away from the epicenter had greater intensities than areas closer in. Such areas of anomalous intensity were located in both the northern and southern parts of the county and correlate with highlands. In the north this is the area of the Furnace Hills, underlain by Triassic terrestrial sedimentary rocks and mafic igneous rocks. In the south the intensity was enhanced in the Martic Hills, underlain by quartzite and schist of the Glenarm Series.

Unlike the July earthquake, this event was recorded by the Millersville seismograph. A tracing of the seismogram is shown in Figure 2. The arrival of the S-wave may be indicated by the change of frequency which occurs 1.5 seconds into the record. The rock in the epicentral area is the Ledger Dolomite and the seismograph is located in the Conestoga Limestone. Reasonable average values for the velocity of P and S waves in dolomite or limestone are 5.5 km./sec. for P and 3.0 km./sec. for S. Assuming these values and an S - P time of 1.5 seconds gives 10 km. for the distance to the epicenter. This is almost exactly the distance from Millersville to the area of maximum intensity.

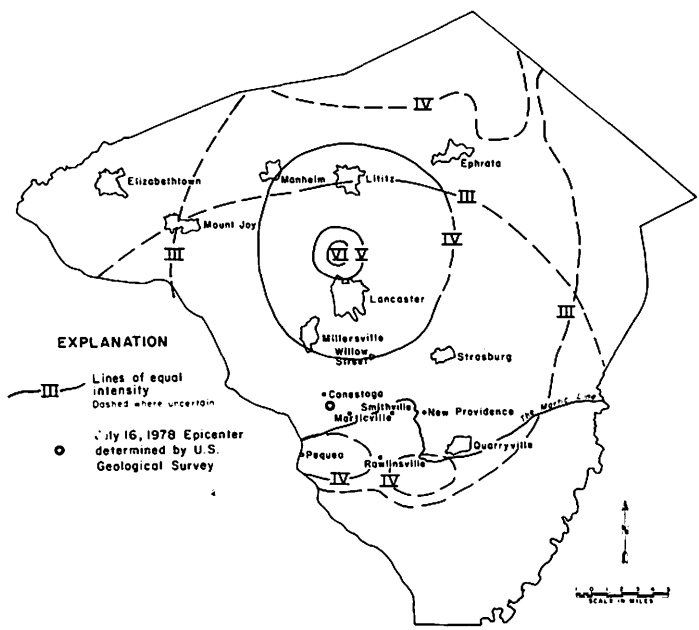

Figure 1.

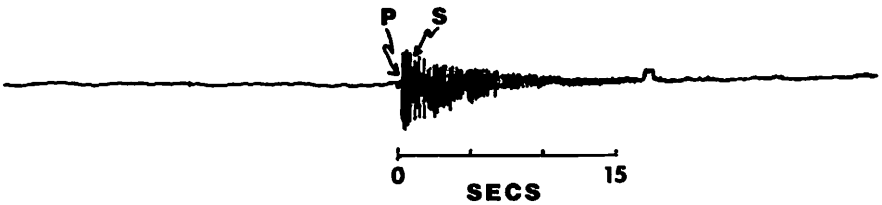

Figure 2

Seismologists in the Department of Geosciences at The Pennsylvania State University estimated the magnitude of the October earthquake to be 3.1 compared to 3.0 for the July event. Allowing ± 0.1 uncertainty in magnitude determinations, there was no significant difference between the two, yet the October event produced greater intensities than the quake in July. This could be because the October earthquake had a shallower focal depth than the one in July. A shallow focal depth would also be indicated by the fact that no allowance for depth had to be made to get agreement between the distance to the epicenter determined from the seismogram and the distance to the epicenter based on intensity reports.

Figure 3 shows the location of mapped faults in the maximum intensity area (Meisler and Becher, 1970). The Blossom Hill fault

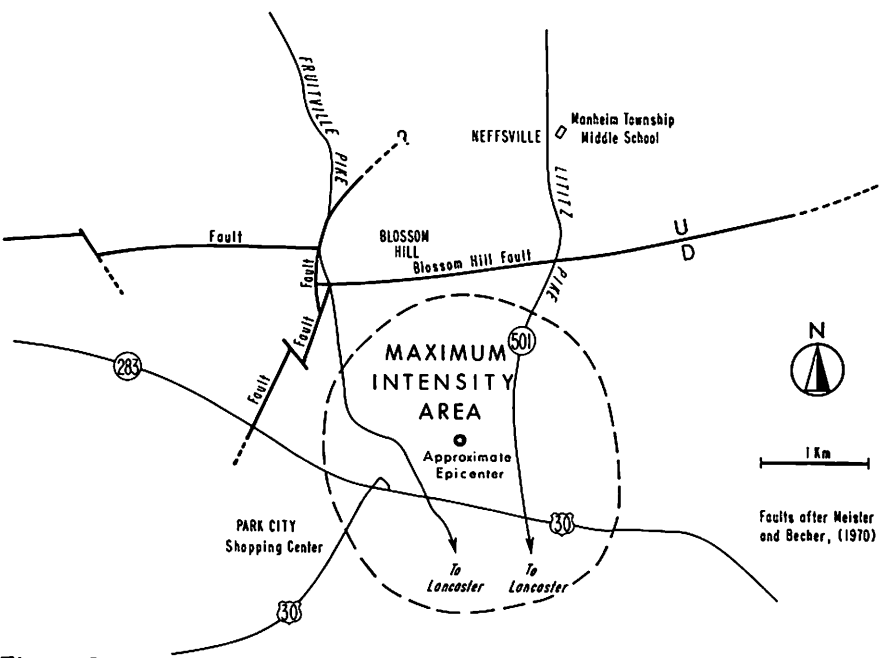

Figure 3

marks the southern margin of a horst of Antietam-Harpers Formation (quartzite and schist) surrounded by carbonate rocks. This fault probably dips south at a steep angle which would be consistent with the location of the epicenter on the south side of the fault trace. However, there is also a set of roughly north-striking faults in the area and there is an obvious dextral strike-separation of the Antietam-Harpers ridge along the northernmost of these faults. Because earthquakes in the northeastern United States are usually associated with north-striking faults (Sbar and Sykes, 1973), these faults to the west of the epicenter are more suspect than the Blossom Hill fault. Given the regional stress field of maximum compression horizontal and directed east-west (Sbar and Sykes, 1973), reverse faulting would be expected.

Are there more Lancaster County earthquakes to come in the near future? After the July earthquake I told a reporter that there was very little chance of another one for at least several years. I was proved wrong in 12 weeks. This time I am making no predictions.

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Engineering Geologists Meet in Hershey

Concerned with the need to cope with the relationship of geology to modern engineering practices, over 300 members and guests of the Association of Engineering Geologists met at the Annual Meeting of the Association in Hershey, Pennsylvania during the week of October 14-20. The sessions began with a weekend workshop on "Engineering Geology for Geologists" and continued with two days of field trips, two days of technical sessions and a one-day symposium dealing with "Geological Engineering in Karst Regions."

The workshop was jointly sponsored by the Association of Engineering Geologists and the Education Committee of the American Geological Institute. Approximately 30 noted speakers addressed a wide range of topics which were collectively designed to provide an insider's look at the specialized practice of geology as related to engineering. Copies of the lecture notes for the session are available from the American Geological Institute.

Three field trips were conducted to visit features of significance to engineering geology in central Pennsylvania. The first trip covered the Lower Susquehanna River Power Complex from Middletown to Conowingo Dam. The second trip included features in the Ridge and Valley physiographic province between Harrisburg and the vicinity of Penns Cave in Centre County. A third trip examined features of the Northeast Pennsylvania anthracite coal region; emphasis for this trip was on subsidence in mine areas and mine acid drainage.

During the two days of technical sessions, over 70 papers were presented. Separate half-day sessions covered the general topics: Mine Subsidence Control, Slope Stability, General Geology and Hydrogeology, Quarries and Waste Disposal, Planning and Land Use, Geophysics and Instrumentation, Dams and Dam Foundations, and Foundations and Power Plants.

The symposium on Geologic Engineering in Karst Regions was organized and moderated by Dr. Richard M. Foose, Professor of Geology at Amherst College. Topics discussed in the day-long session included: Geology and Hydrology of Karst, Catastrophic Surface Collapse Caused by Dewatering, Review of Geophysical Approaches to the Detection of Karst, Remote Sensing Techniques and the Detection of Karst, Foundations for Dams in Karst and Mining Problems in a Karst Valley. Dr. Foose discussed Engineering Geologic Approaches to Foundations in the Karst Terrain of the Hershey Valley, and conducted a short field trip to examine features of interest. Special problems affecting the Hershey Medical Center and other major structures were discussed.

It is interesting to note that the Association of Engineering Geologists, an international organization with about 2500 members, chose to have their annual meeting in central Pennsylvania this year because of the numerous practical examples of engineering geology available here. AEG's final announcement for the session called attention to many Pennsylvania places and projects which exemplify that engineering geology has played an important role in our State's development throughout history. State Geologist, Dr. Arthur Socolow also called attention to this fact in his remarks to the group at the opening session of the meetings.

The Bamford Zinc Mine: A Tribute

by Jeri L. Jones

Once where zinc was mined, cereal products are now being manufactured. Again industrialization has taken its toll among historical geological landmarks. The Bamford Zinc Mine is such an example.

The Bamford Mine was located in East Hempfield Township, Lancaster County, Pennsylvania, six miles northwest of Lancaster and one and one-half miles southeast of Landisville. Prior to the spring of 1974, the mine was located in a small wooded area on the north side of Yellow Goose Road, just south of Rt. 283, and was owned by J. I. Dellinger, who resides on the south side of Yellow Goose Road. Numerous dumps, building foundations, and several slag piles were the only evidence of previous mining activity there. In the spring of 1974, the Kellogg's Cereal Company of Battle Creek Michigan purchased the land for the construction of a new plant. It was during this construction that numerous dumps and one of the shafts were exposed. Some new and interesting mineral specimens were also uncovered.

The discovery of the ore at Bamford took place in 1845 when someone was digging holes for a fence and his shovel turned up some lead ore. This ore was taken to a Lancaster chemist for analysis, which showed zinc, lead, and traces of silver. Between 1847 and 1907, four different companies worked the veins (Landis, 1904).

The various Bamford Zinc Mine owners sank three shafts, which had an average width of twelve feet. The richest ore was found at the 75-foot level with the ore never exceeding 12% zinc. Work was apparently halted because the ore ran out below the 125-foot level on the two known veins (Frazer, 1880). Mosier (1948) estimated that about 25,000 tons of ore and waste rock have been removed from the mine since its discovery. Freedman (1972) estimated that approximately 3,000 tons of zinc was recovered. After the zinc was mined at Bamford, the ore was hauled to the railroad station at Landisville, but later a siding was laid from the Pennsylvania Railroad main line directly to the smelter. The cost of producing a pound of zinc in 1877 was $0.05; the sale price ranged from $0.07 to $0.11 (Frazer, 1880).

The rocks in the shafts and immediate vicinity of the mine are part of the Ledger dolomite. This formation has not only produced

zinc, silver, and copper minerals in Lancaster County, but also in York County (Gordon, 1922). Several areas of shale belonging to the Kinzers Formation intertongue with the Ledge dolomite near the mine, particularly to the southeast and east.

Although Bamford was not one of the more famous Lancaster County collecting spots (compared to Cedar Hill quarry and Pequea mine, for example), Bamford has produced an interesting series of zinc and associated minerals. Primary minerals include galena, sphalerite, calcite, pyrite, saddle-shaped dolomite crystals, and chalcopyrite. One crystal belonging to the tetrahedrite-tennantite series (probably tennantite), was also collected. Secondary minerals include "dry-bone" smithsonite, hydrozincite, fine crystals of hemimorphite and cerussite, limonite, and malachite after the chalcopyrite. Two micro-crystals of azurite, not previously reported from this site, lying on the aurichalcite and the aurichalcite and chalcopyrite were also collected. Freedman (1972) reported finding both anglesite and argentite, a silver mineral, at the mine.

Presently very little of the Bamford Zinc Mine remains. Where once the small wood area stood hiding the mine ruins, there now stands a multi-million dollar structure. On the south side of Yellow Goose Road where once a large dump existed, there now are several small structures. The Bamford mine is now a part of Pennsylvania's rich mining history.

FAREWELL BAMFORD

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STATUS OF THE WATER WELL INVENTORY

by Eugene D. Hess[1]

In the past one and one-half years much of the effort to translate data on domestic water wells for computerized retrieval has been concentrated on wells from the central and south-central counties. Most of the new well records for these counties have been processed and will shortly be available on computer printed reports along with updated data of a few eastern and western counties. Many other counties processed in the past few years are now retrievable thanks to cooperation of the U.S.G.S.. Every county now has some available water well data retrievable via computer.

For the past two years the well data that is translated to the computer have been selectively chosen according to the accuracy of the well site description and the accompanying data. Since most of the well record cards that come into our office from well drillers cannot be field checked, we rely upon the sketch map and written description of the well location. Maps and explanatory notes have been sent to each driller with the result that many well site descriptions have greatly improved. These well record cards that have the most reliable data are selected to be translated for the computer.

Copies of the computer printed reports, as well as the well record cards, are on open file and available on request. Please indicate the county and townships desired when making any inquiry. The computer reports are divided into four separate types. Report A for each county denotes township, well number, owner, well location by latitude and longitude, and well use. Report B for each county lists depth of well, casing length, drill method, water level, yield, and drawdown. The topographic setting, major and minor aquifers, depth and type of surficial material are identified on Report C. Report P includes depths to water-bearing zones and driller's license number for each county. Each report type may be ordered separately. The original well record card contains all the information now on the computer plus a log of rock types. There are thirty well records on each page of the computer report. Three well record cards can be copied on a legal size sheet of paper. Copies are free for ten pages or less; any order over ten pages is 25¢ per page (including the first ten pages). Direct inquiries to Water Well Inventory, Bureau of Topographic and Geologic Survey, 914 Executive House, Harrisburg, PA 17101.

The latest inventory of water well data available for the respective counties is given below.

[1]Dept. of Environmental Resources

County	Number of Sheets	Number of Wells	County	Number of Sheets	Number of Wells
Adams	40	285	Lycoming	80	599
Allegheny	32	204	McKean	16	89
Armstrong	36	270	Mercer	44	313
Beaver	40	281	Mifflin	68	466
Bedford	200	1499	Monroe	316	2366
Berks	296	2214	Montgomery	148	1087
Blair	80	585	Montour	24	165
Bradford	104	778	Northampton	164	1230
Bucks	573	4299	Northumberland	56	414
Butler	100	750	Perry	64	466
Cambria	116	873	Philadelphia	N/W	N/W
Cameron	12	77	Pike	100	420
Carbon	104	766	Potter	40	275
Centre	36	267	Schuylkill	94	706
Chester	527	3957	Snyder	33	251
Clarion	12	69	Somerset	56	412
Clearfield	12	59	Sullivan	32	217
Clinton	34	254	Susquehanna	36	278
Columbia	40	280	Tioga	20	140
Crawford	166	1240	Union	88	666
Cumberland	180	1346	Venango	100	739
Dauphin	168	1263	Warren	12	66
Delaware	12	77	Washington	96	721
Elk	8	41	Wayne	40	285
Erie	176	1323	Westmoreland	44	330
Fayette	12	90	Wyoming	36	273
Forest	16	113	York	224	1680
Franklin	92	646		6685	47,380
Fulton	20	156			
Greene	16	107			
Huntingdon	16	95			
Indiana	64	459			
Jefferson	40	272			
Juniata	44	307			
Lackawanna	80	575			
Lancaster	496	3706			
Lawrence	40	279			
Lebanon	216	1614			
Lehigh	172	1265			
Luzerne	76	560			

The Northeastern Section of The Geological Society of America will meet February 28 to March 3, 1979 (Wednesday through Saturday), at the Hershey Motor Lodge & Convention Center, Hershey, Pennsylvania, together with the Eastern Section of SEPM and the Northeastern Section of the Paleontological Society. The meeting is sponsored by the Pennsylvania Bureau of Topographic and Geologic Survey; the Department of Geology, Dickinson College; and the Department of Earth Sciences, Millersville State College.

Technical sessions will be held Thursday, Friday, and Saturday, March 1, 2, and 3. Some 1200 geologists are expected.

Six symposia have been scheduled: (1) Mineral Resources in the Northeastern U. S.; (2) Trace Elements and Health; (3) Geology of Pennsylvania and the New Geologic Map of Pennsylvania; (4) Geology of Underground Radioactive Waste Disposal; (5) A Sampling of Current Research by the U. S. Geological Survey in the Northeastern U. S.: A Symposium on the Occasion of the Centennial; (6) Adirondack Geology. This symposium will be followed by an evening discussion session.

A short course on remote sensing and geology, conducted by Richard Williams, U. S. Geological Survey, will be conducted on February 28.

There will also be a Friday evening session open to public participation concerned with the geologic hazards of karst and trace elements. In addition to a large exhibit area, there will be a science theater of new and previously released U. S. Geological Survey films.

Registration information will appear in the December issue of the magazine "Geology" issued by The Geological Society of America. Registration includes free beverages at a welcoming party Wednesday evening and a smoker Thursday evening, as well as luncheon Friday preceding the annual business meeting of the section.

(Middle) East meets West

Seeking to compare technical and administrative techniques, Dr. Eliahu Zohar, Director of the Israel Geological Survey in Jerusalem, paid a two-day visit to the Bureau of Topographic and Geologic Survey in mid-November. Having previously visited the U. S. Geological Survey, Dr. Zohar was particularly anxious to see how a state geological survey functions.

During the course of discussions, Dr. Zohar noted that geologic and mineral resource investigations hold a high priority with the Israeli government. Israel, with an area approximately one-seventh that of Pennsylvania, maintains a Geological Survey staff more than twice the size of the Pennsylvania Survey staff. Dr. Zohar stated that mineral resources mapping and development is considered extremely vital to the Israel economy. He noted also that engineering geology and environmental geology are quickly being recognized as important subjects in that land where so much construction is taking place and where natural hazards, such as earthquakes, abound. Israel has a growing awareness, also, for the need to protect natural environmental conditions as development takes place.

Dr. Zohar was extremely interested in the Pennsylvania Geological Survey's attention to environmental geology. He gave a great deal of attention and praise to our atlas on Environmental Geology of the Greater Harrisburg Area (EG 4). He was particularly enthused over Pennsylvania Survey's technique of identifying engineering and economic geology factors on our geologic maps by use of a three column legend, a Pennsylvania Geological Survey innovation.

Many of the scientific and technical procedures utilized by our geologists are apparently similar to those conducted by the Israel Geological Survey. In comparing administrative procedures with Pennsylvania Survey Director, Dr. Arthur Socolow, it was noted by Dr. Zohar that it is a small world—the Israel Geological Survey also has problems of budget, manpower, and even red tape.

These exchanges with foreign visitors have proved to be extremely enlightening and certainly, mutually beneficial. We are pleased to have such distinguished visitors come to Pennsylvania.

Welleraspis (Trilobita) in the Conococheaque Formation of Southeast Pennsylvania

by Richard M. Busch[1]
Michael S. Fedosh[2]

A discovery of the ptychopariid trilobite *Welleraspis swartzi* (Tasch) allows us to assign some beds of the Conococheague Formation near Morgantown, PA to the Early Late Cambrian. Previous workers discussed age relationships of the Upper Cambrian Conococheague Formation of southeast Pennsylvania mostly in a sedimentological sense due to a lack of collectable fossils. Gray, *et. al.* (1958) subdivided the Conococheague Formation into five members. From oldest to youngest, these are the Buffalo Springs, Snitz Creek, Schaefferstown, Millbach, and Richland Members.

During spring and summer of 1977 we measured a succession of Millbach beds exposed on the northeast side of a road-cut east of Morgantown, PA beginning at 75°52'45" west longitude and 40°08'

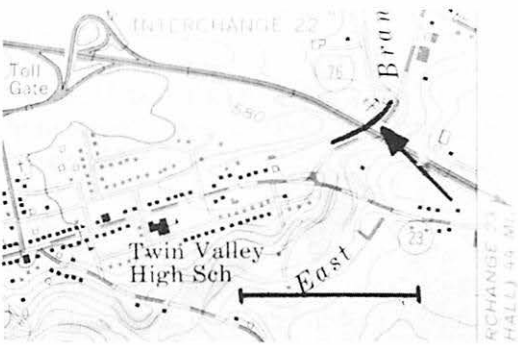

Figure 1: Portion of US GS Morgantown Quad. showing position of measured section. Arrow points to trilobite beds. North is at top of page; scale equals 0.5 kilometers.

Figure 2: Two *Welleraspis swartzi* (Tasch) cranidia enlarged 8.47 times; North Museum catalogue number P-A-1144B.

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45" north latitude (see Figure 1). There is much structural deformation due to microfaulting, faulting, folding, etc., which has no doubt resulted in some shortening or lengthening of the section. Subsequently, stratigraphic thicknesses should only be viewed in a relative sense. About 88 meters of the Millbach Member is exposed here, and due to the presence of abundant stromatolite beds, minor sand, and common oolites, the incomplete sections conforms lithologically to the upper portion of the Millbach as described by Gray, *et. al.* (1958).

Our trilobite specimens were collected in the interval of beds about 59.1 to 61.3 meters from the base of the measured sequence as indicated by the arrow in Figure 1. Specimens occur disarticulated and form scattered "hash beds" throughout the 2.2 meters of very thin to thin, interbedded, fine-grained limestone and dolomite. They appear to be dolomitized within the limestone beds and consequently are collectable only on weathered surfaces. Acid etching produced no specimens. Some ripple-marked horizons and poorly preserved ichnofossils (trace fossils) are also present.

Welleraspis has been reported from a variety of other Upper Cambrian rocks of North America and is a typical index fossil of the *Cedaria* zone. Although its stratigraphic range is sometimes variable, past workers such as Howell (1945) regard *Welleraspis* as being strictly *Cedaria* age. Consequently, we can now state that upper portions of the Millbach Member of southeast Pennsylvania are of Early Late Cambrian Age (early Dresbachian). *Welleraspis swartzi* (Tasch) also occurs in the lower 75.28 meters of the Warrior Formation of central Pennsylvania (Tasch, 1951). Some other occurrences of *Welleraspis* include the Limeport Member of the Allentown Formation in eastern Pennsylvania and New Jersey (Rasetti, 1954), the lower to middle Elbrook Formation of the central Appalachians (Wilson, 1952), and the Nolichucky Shale of the southern Appalachians (Tasch, 1951).

Most of the trilobite material we collected is deposited in the paleobiological collections at the North Museum of Franklin & Marshall College.

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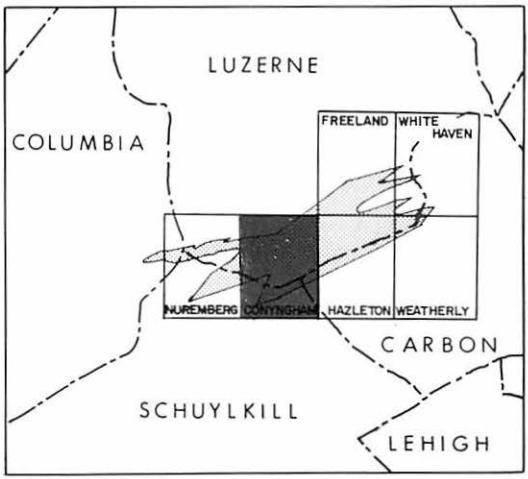
SURVEY ANNOUNCEMENTS

ANTHRACITE AREA STUDY

Recognizing that decisions and plans for the future development of the large remaining reserves of anthracite coal will require accurate data on the nature of the coal and related geologic structures, the Pennsylvania Geological Survey has initiated a detailed geologic mapping project near Hazleton. Covering a portion of the Eastern Middle Anthracite Coal Field, specifically the Conyngham Quadrangle, the area includes parts of Schuylkill and Luzerne counties. This is the first stage of a planned mapping program which will provide the basic information necessary to evaluate the mineral resources, define the ground-water conditions, and plan for proper environmental protection during and after mining.

There has been a growing awareness of the value of the large reserves of anthracite coal in northeastern Pennsylvania, particularly in view of the low sulfur content of the coal and its proximity to large energy consumers of the Northeast. Electric power generation and industrial plants are the primary indicated anthracite uses of the future.

The geologic mapping in the Conyngham Quadrangle will be carried out by staff geologist Henry W. Schasse. It is anticipated that the mapping of this quadrangle and the resulting report and map will be completed and available by 1980.



MIDDLE DEVONIAN STRATIGRAPHY OF CENTRAL PENNSYLVANIA

The Middle Devonian stratigraphy of central Pennsylvania has been refined and interpreted in the Pennsylvania Geological Survey's new report, *Middle Devonian Stratigraphy in Central Pennsylvania — a Revision.* Co-authored by Rodger Faill, Donald Hoskins and Richard Wells, the report includes a text and one plate. Type sections of two new members are included.

The new report resolves some of the stratigraphic complexities of the region and should be particularly helpful to professional geologists in understanding rocks of this age.

General Geology Report G 70 is available for $2.25 (plus 6% tax for Pa. Residents) from the State Book Store, P.O. Box 1365, Harrisburg, Pa. 17125.

DUBOIS AREA GEOLOGIC REPORT

A comprehensive new report on the geology and mineral resources of the DuBois area (western Clearfield County and eastern Jefferson County) has been published by the Pennsylvania Geological Survey. Authored by Albert D. Glover and William A. Bragonier, the 130-page report is accompanied by a full-color geologic map and by separate maps and plates for each of the major coal seams in the area. Calculations of coal reserves are presented, as well as data on other potential mineral resources. The engineering and groundwater characteristics of each geologic formation are defined on the map and in the text.

Five major bituminous coal seams in the mapped area represent the most important mineral resource; remaining in-place coal totals 375 million short tons in beds over 28 inches thick. Clay shale, sandstone, sand and gravel, limestone, and natural gas are other important resources.

This report provides a basic geologic inventory requisition toward land use planning, efficient mineral resource development, and sound land rehabilitation design. It should be of extensive interest and use to local officials, coal developers, engineers, conservationists, and the residents of the DuBois region.

Atlas 64, "Geology and Mineral Resources of the Hazen, Falls Creek, Reynoldsville, and DuBois Quadrangles," is available for $21.55 (plus 6% tax for Pennsylvania residents) from the State Book Store, P. O. Box 1365, Harrisburg, PA 17125.

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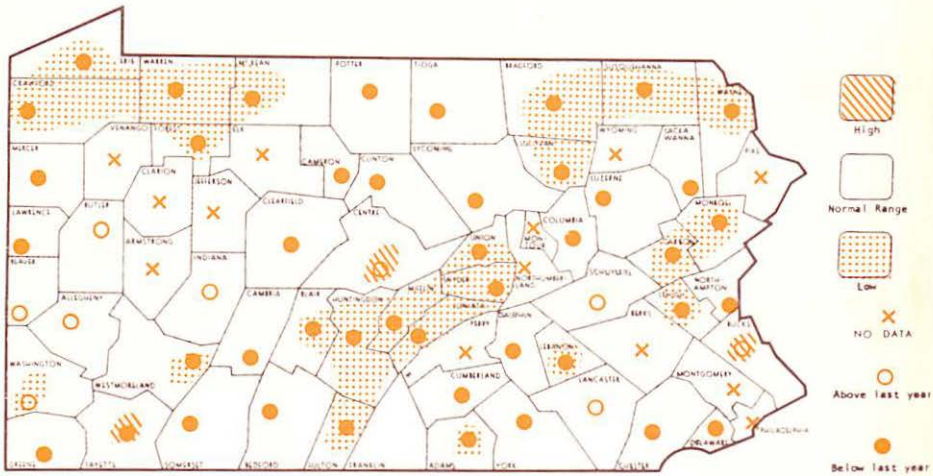

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