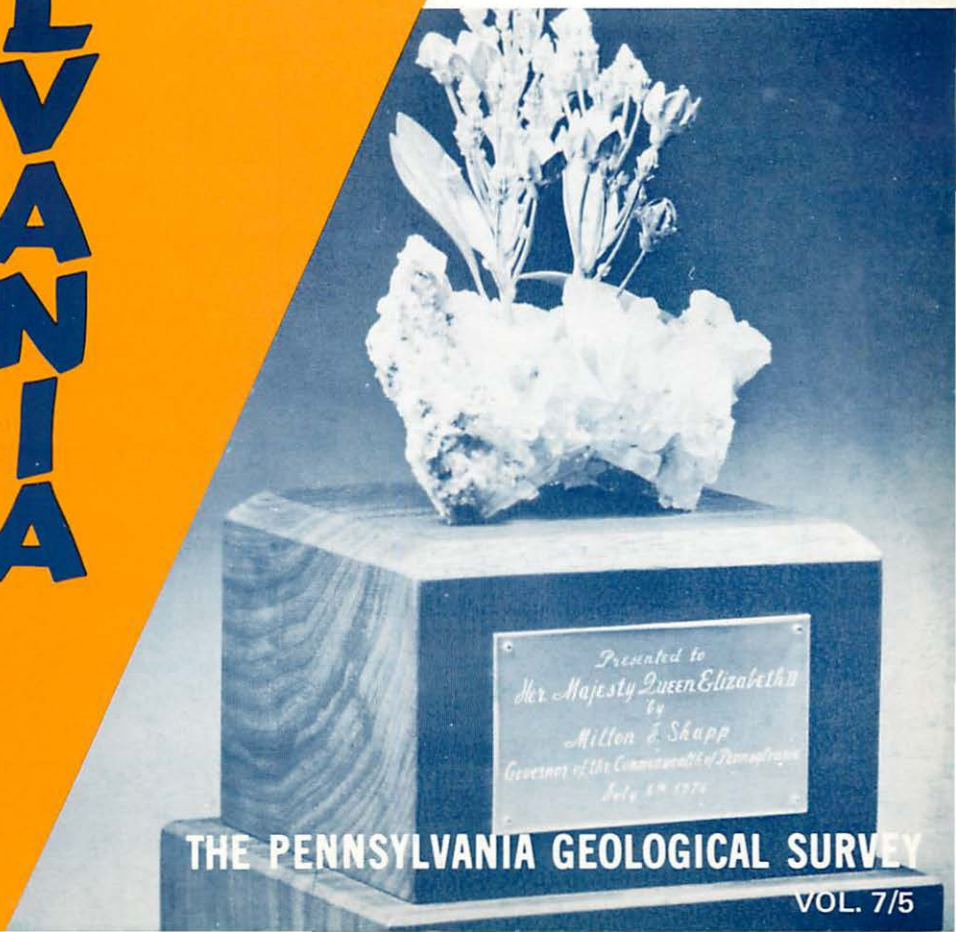
PENNSYLVANIA GEOLOGY



THE PENNSYLVANIA GEOLOGICAL SURVEY

VOL. 7/5

COMMONWEALTH OF PENNSYLVANIA
Milton J. Shapp, Governor

DEPARTMENT OF ENVIRONMENTAL RESOURCES
Maurice K. Goddard, Secretary

TOPOGRAPHIC AND GEOLOGICAL SURVEY
Arthur A. Socolow, State Geologist

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ON THE COVER: Bicentennial gift to Queen Elizabeth, presented in Philadelphia by Governor Shapp on behalf of the Commonwealth. Photo courtesy of F. J. Cooper Inc. of Philadelphia. See story, page 2.

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

OCTOBER 1976

FROM THE DESK
OF THE
STATE GEOLOGIST . . .

WHAT IF

Our vehement reaction to the Arab oil embargo of 1972 was not simply out of concern for our comforts and economic well-being, but it was also an expression of rage over the insult to the freedom of mankind's right to utilize a natural resource with which our Earth has been endowed. Ironically, one does not need to look back upon that Middle East event for an example of such restriction to man's right of access - it is happening right here, all around us.

In several of our western states as much as 73% of the state's land area has been placed off limits for mineral exploration, much of that area with potentialities for energy resources and other vital minerals for which we are now dependent upon foreign sources.

That same syndrome has spread to eastern United States. One state after another, faced with varied sources of opposition, is taking the easy way out by saying "No, don't look in our area - even if we have it we don't want anyone digging for it." And it goes even beyond our shores, as many of the Atlantic coastal states are objecting to exploration for oil and gas on the continental shelf even while they are short of these commodities.

Even in Pennsylvania we find that many sectors of the mineral industry, attracted by new evidence of mineral occurrences long overlooked, are finding that access to both private and state lands has become extremely difficult - and in many cases totally impossible.

True, this restricted access often has merit. There are environmental treasures to be protected and there is a record of many horrendous past misdeeds. But while we must establish rules and guidelines to protect our heritage, we must not simply close the door upon our natural resource endowments.

What if Texas, Oklahoma, Louisiana, and California had said "You can't drill for oil here." What if Minnesota and Michigan had said "Don't dig for iron here." What if Pennsylvania, Kentucky, and West Virginia said "Don't dig our coal", and Florida said "Don't dig our phosphates", and Colorado said "Don't dig our molybdenum" and California said "Don't dig our gold", and Arizona said "Don't dig our copper!" And then what if the rest of the world said "Don't dig here!"

Yes, we'd have a clean and tidy landscape - but very little else!

But what if we set some meaningful rules and guidelines and see to it that they are enforced? And what if we recognize that the Earth is unevenly endowed with wonderful and precious resources and we recognize that we can't go on saying "Dig elsewhere, not here." What if?

Arthur A. Socolow

From Our Mineral Collection

TO THE QUEEN

The Pennsylvania Geological Survey is most pleased to have played a small part in honoring Queen Elizabeth of Britain during her Bicentennial visit to Philadelphia in July.

Several months ago we were approached by a representative of the Governor's Office to see if we could provide a mineral specimen that would be native to Pennsylvania, as well as esthetically outstanding. We reviewed our mineral collection and selected a brilliant cluster of quartz crystals which had just recently been collected from the Lehigh River Gap, near White Haven, by Alan Geyer, Chief of our Environmental Geology Division.

The Governor's Office accepted our specimen with enthusiasm and subsequently arranged for a handcrafted vermeil bush of mountain laurel, the Pennsylvania State flower, to be joined with the quartz crystal cluster to form the outstanding creation which is pictured on the cover of this issue. The gift to Queen Elizabeth was presented by Governor Milton Shapp on behalf of the Commonwealth on July 6, 1976, at Philadelphia.

We appreciate the cooperation of F. J. Cooper, Inc., of Philadelphia, which handcrafted the gift, in making the photograph available to us for publication. It has previously appeared in the New Yorker Magazine and in Gourmet Magazine.

surplus topographic maps

As a result of the ongoing program of revising and updating Pennsylvania's topographic maps, we now have a number of quadrangle maps which are out of date and are, therefore, surplus. These are still excellent for group or classroom instruction in map reading and profile exercises. These surplus maps will be provided at no charge as long as they last. Please advise how many different quadrangles are desired and how many copies of each quadrangle. Address requests to: Pennsylvania Geological Survey, 914 Executive House, Harrisburg, PA 17120.

SURVEY ANNOUNCEMENTS

MINERAL COLLECTING IN PENNSYLVANIA NOW REVISED

Mineral Collecting in Pennsylvania, the most popular and best-selling publication ever issued by the Pennsylvania Geological Survey, has been completely revised and reissued. Authored by Messrs. Alan R. Geyer, Robert C. Smith II, and John H. Barnes, the 260-page report details the specific locations and available minerals at 63 localities in 31 counties across Pennsylvania. Included in the report are guidelines to mineral identification, collecting procedures, and lists of museums and mineral clubs in Pennsylvania. Special note has been made of the need for safety and for respect of private properties.

The new, fourth edition of **Mineral Collecting in Pennsylvania** is dedicated to Dr. Davis Lapham, who co-authored the first three editions of this publication. An avid collector himself, and a dedicated friend to all collectors, Dr. Lapham served as Chief Mineralogist of the Pennsylvania Geologic Survey until his death in December, 1974.

The newly revised Bulletin G 33 will be of widespread interest to the thousands of Pennsylvanians who singly, in family outings, and with clubs and groups engage in one of the most satisfying recreational experiences, mineral collecting.

Bulletin G 33, **Mineral Collecting in Pennsylvania,** is available for $1.60 (plus $0.10 tax for Pennsylvania residents) from the Pennsylvania Bureau of Publications, P. O. Box 1365, Harrisburg, PA 17125.

SABULA-PENFIELD QUADRANGLES, CLEARFIELD COUNTY

An area with major coal and gas resources is described in a new, comprehensive report by Messrs. Thomas M. Berg and Albert D. Glover of the Pennsylvania Geological Survey. "Geology and Mineral Resources of the Sabula-Penfield Quadrangles" deals with a 112 square mile area of northwestern Clearfield County, with small portions of Elk and Jefferson Counties included. The report, with geologic maps, sections, and tables, details the distribution and reserves of the coal deposits and the locations of existing gas-producing wells. These data along with the structural and stratigraphic descriptions of the area will be important in the exploration and potential development of new resources. Measurements indicate remaining re-

serves of over 150 million tons of Lower Kittanning coal over 28 inches thick in the mapped area; in addition, there may be undiscovered gas pools at greater depths.

This report should be useful to the mineral industries, as well as to planners, professional geologists, engineers, and conservationists. Industries that have a need for a particular nonmetallic mineral or rock type may be able to locate potential economic deposits in the area. Professional geologists will be able to use the basic stratigraphic and structural data in this report for regional and topical interpretations. Highway and construction engineers should find the report helpful in evaluating future construction sites. The report will provide a basic geologic framework for conservationists and planners in the prevention of water pollution, in the intelligent and responsible application of land planning, and in the more efficient development of mineral resources in the future.

Atlas 74ab, "Geology and Mineral Resources of the Sabula – Penfield Quadrangles" is available for $18.80 (plus $1.13 tax for Pa. residents) from the Pa. Bureau of Publications, P. O. Box 1365, Harrisburg, PA 17125.

REPORT ON BRODHEADSVILLE AREA, MONROE COUNTY

The bedrock and surficial geological environment of a rapidly developing region in the Pocono Mountain Area have been mapped and described in the new geologic Atlas 205a, "Geology and Mineral Resources of the Brodheadsville Quadrangle", by Thomas M. Berg of the Pennsylvania Geological Survey. Particular attention is paid in this report to the mineral resources which have economic potential, and to the environmental characteristics, including engineering rock properties and water resources, which are critical to wise land use planning. The full-color, bedrock geologic map of this 56 square mile area of southwestern Monroe County is accompanied by a separate map of unconsolidated surficial materials, particularly important in this region of glacial deposits.

The wide range of environmental information included in the text and maps of this geologic atlas will be of aid to planners, transportation and recreation officials, engineers, and all who are concerned with the proper relationship of man to his physical environment.

Atlas A 205a, "Geologic and Mineral Resources of the Brodheadsville Quadrangle" is available from the Pa. Bureau of Publications, P. O. Box 1365, Harrisburg, PA 17125 for $9.50 (plus $0.57 tax for Pennsylvania residents).

OIL CITY QUADRANGLE REPORTS NOW ON OPEN FILE

Reports and maps prepared by the Pennsylvania Geological Survey for study of the bedrock and general geology, mineral resources and engineering characteristics of the Oil City Quadrangle, Venango County, Pennsylvania, are now on open file for inspection at the Survey offices in Harrisburg and Pittsburgh. These reports and maps were prepared under a grant from the National Science Foundation to the Pennsylvania Geological Survey. Work was accomplished by geologists from Slippery Rock and Edinboro State Colleges and the Pennsylvania Geological Survey.

Five reports with accompanying plates were prepared:

1. A user's guide to the geologic map of the Oil City 7½-minute quadrangle, Venango County, Pennsylvania.
2. A user's guide to the potential mineral resources of the Oil City 7½-minute quadrangle, Venango County, Pennsylvania.
3. A user's guide to the glacial map of the Oil City 7½-minute quadrangle, Venango County, Pennsylvania.
4. A user's guide to the engineering characteristics of bedrock of the Oil City 7½-minute quadrangle, Venango County, Pennsylvania.
5. A user's guide to the oil and gas well distribution of the Oil City 7½-minute quadrangle, Venango County, Pennsylvania.

Each report is intended to describe to a non-technically trained reader how to use the respective subject maps.

Each report and map is also available free of charge on a microfiche (text) and microcard (map). To obtain these write to the Pennsylvania Geological Survey, Department of Environmental Resources, P. O. 2357, Harrisburg, Pennsylvania, 17120.

GEOLOGY OF THE SINKING SPRING QUADRANGLE

A detailed geologic map and report on an area of approximately 60 square miles just west of the City of Reading has been published by the Pennsylvania Geological Survey as Geologic Atlas 177d, "Geology and Mineral Resources of the Sinking Spring Quadrangle, Berks and Lancaster Counties." Authored by David B. MacLachlan, Tracy V. Buckwalter, and Dean B. McLaughlin, the 228-page report, with full-color geologic maps, deals with the distribution, composition, geologic history, and economic potential of the bedrock units and unconsolidated sediments of the area.

This rapidly developing area includes four geologically and topographically distinct terrains involving some of the most complex geologic structures of the eastern United States. As the land and its resources are increasingly being used, the information in this report is an important contribution towards proper planning and land use management. The rock characteristics, water and mineral potential, and engineering conditions in the area will be of particular interest to planners, industry, engineers, and the public.

Atlas A 177d is available for $17.50 (plus tax for Pennsylvania residents) from the Pa. Bureau of Publications, P. O. Box 1365, Harrisburg, PA 17125.

OIL FIELDS OF THE GREATER PITTSBURGH REGION

The Greater Pittsburgh region, consisting of Allegheny, Armstrong, Beaver, Butler, and Westmoreland Counties, is underlain by 92 known oil fields. The largest well in the area has produced over one million barrels of crude oil and is still producing. Allegheny County alone has produced over 79 million barrels by January of 1976, while Washington County has produced over 71 million barrels.

This significant data is included in a wealth of information provided in the newly released report on "Oil Fields of the Greater Pittsburgh Region" by William S. Lytle of the Pennsylvania Geological Survey. Sponsored in part by the U. S. Geological Survey, the report not only provides the production history of each county for each year, but also gives the geological and historical record of each of the oil fields of the area.

Most important, this is not simply a report of the past, but an analytical projection of the future. On the basis of the best available present data and reserve calculations, it is projected that the six county areas will produce between now and the year 2000 an additional 3,680,670 barrels of crude oil.

This report will be of interest to planners in the area, petroleum geologists, and producers, and all who are concerned with oil history past and energy resources for the future. This new 119-page report, is a logical companion-piece to the recently published Map #44, "Greater Pittsburgh Region Oil and Gas Fields Map" (price $3.70 plus tax).

Mineral Resource Report 70, "Oil and Gas Fields of the Greater Pittsburgh Region" is available from the Pa. Bureau of Publications, P. O. Box 1365, Harrisburg, Pennsylvania, 17125, for $1.65 (plus $0.10 tax for Pennsylvania residents).

REPORT ON THE MILLERSBURG QUADRANGLE OF CENTRAL PENNSYLVANIA

A complete and detailed description of the geologic environment of the Millersburg region in central Pennsylvania is presented in the Pennsylvania Geologic Survey's new publication, Atlas A 146, **Geology and Mineral Resources of the Millersburg Quadrangle.** This actively developing area lies astride the Susquehanna River and includes portions of Dauphin, Juniata, Northumberland, Perry, and Snyder Counties.

Authored by Dr. Donald M. Hoskins, the new report, complete with full-colored geologic maps and cross sections, provides detailed information on the nature and distribution of the rock units, the local mineral resources, and the available groundwater resources. The new report should be of benefit to the numerous growing communities in the area as they address themselves to problems of land use planning, engineering and transportation design, water supplies, and domestic and industrial construction projects.

The summary statements on the map legend, including economic resources, water resources, engineering geology, and environmental characteristics, are designed to make the information readily understandable to all prospective users. Atlas 146, **Geology and Mineral Resources of the Millersburg Quadrangle** is available for $12.80 (plus $0.77 tax for Pa. residents) from the Pa. Bureau of Publications, P. O. Box 1365, Harrisburg, PA 17125.

Stalking the Trilobite on Sherman Ridge

by Barbara Conrad

This article is meant to assist people who have been searching for trilobites for years, and have come to the conclusion that they exist only in books. A good place to look for these fossils is in the upper shale and siltstone units of the Sherman Ridge Formation in Perry County, south of Ickesburg. During the Middle Devonian Era, this shale was silt and sand that was being deposited in a shallow offshore marine environment.

Trilobites are fossil, aquatic arthropods. They are unusual because they are the remains of some of the earliest creatures on earth to evolve a chitonous, segmented exoskeleton, a pair of jointed appendages for each segment, a well developed brain, and compound eyes.

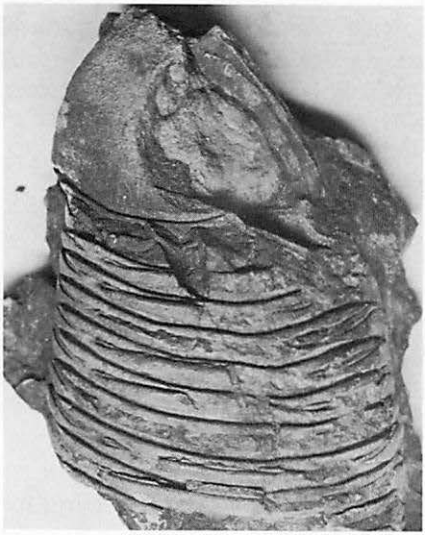
One of the reasons for the uncommon occurrence of complete trilobite fossils is the fact that they were very vulnerable to their environment during several stages in their life cycles, particularly during molting. In the formation mentioned above, three types of trilobites can be found: Genus—Trimerus, Subgenus—Dipleura; Genus—Phacops; Genus—Reedops.

The most common trilobite remains are segments discarded during molting, and fossils in the rolled position. Careful observation and luck will turn up flat, whole trilobite casts and molds that range in size from 1.5cm to 23 cm.

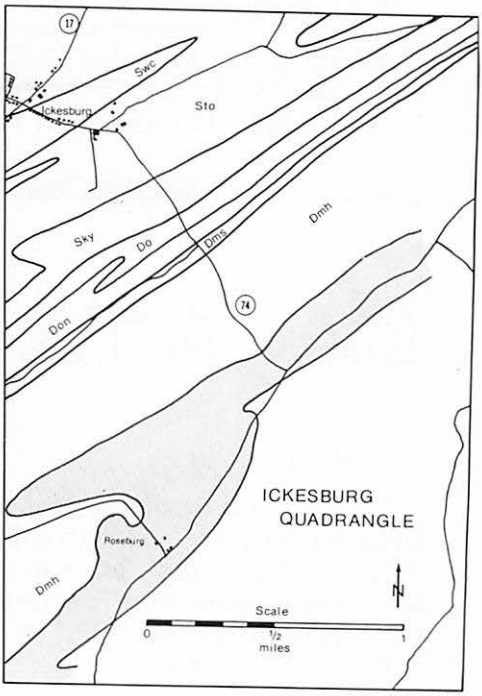
References

Hoskins, D. M. (1969), *Fossil Collecting in Pennsylvania,* Pa. Geol. Survey, Bull. G40, revised, 126 p.

Miller, J. T. (1961), *Geology and Mineral Resources of the Loysville Quadrangle, Perry Co., Pa.,* Pa. Geol. Survey, Bull. A127, 47 p.



A rare find, a large cast of part of the thorax and pygidium of the trilobite Dipleura from the Sherman Ridge Formation, Perry County.



THE ASHCRAFT LIMESTONE MOUND

by S. A. Krajewski & R. J. Cuffey

Upper Devonian rocks of northeastern Pennsylvania are mostly sandstones, siltstones and shales. However, the Ashcraft quarry located near the village of Little Meadows (Figure 1) in northwestern Susquehanna County, Pennsylvania, exposes an unusual limestone deposit.

The limestone exposed in the quarry (Figure 2) is approximately 15 feet thick and 700 feet wide. From drill core data, it was determined that the deposit is about 3000 feet long (Figure 3). The bottom contact of the limestone is flat and rests conformably on top of a gray shale. The limestone consists of a series of overlapping, inclined lenses which are 10 feet thick and 200 feet wide. These lenses are orientated with their long axes parallel to the long axis of the deposit, and dip to either side of the deposit's axial trend at 15°. Fossils found in the limestone are relatively sparse and are usually broken fragments of plants, brachiopods, pelecypods, gastropods and occasional vertebrate bones. The overburden, resting conformably on top of the convex upper surface of the limestone, is a 30 foot sequence of black and olive-brown shales which contain several kinds of fossilized worm tubes and burrows. Occurring near the top of the shale sequence are numerous asymmetrical siltstone lenses that are up to 3 feet thick and have a layer of broken crinoid stems at their base. Above the siltstones is a 1 to 3½ foot layer of cross-bedded sandstone.

Each of the individual limestone lenses within the quarry consists of three distinct parts: a lower half which is cross-bedded with shell debris, an upper massive half formed from suspended sediment, and a topmost, thin veneer of shelly material. The carbonate content of the lenses was provided mostly from shells which were brought in from off-shore, shell-strewn sand bottoms, or derived locally from invertebrates already inhabiting the mound area. The general characteristics of each of the lens parts are illustrated in Figure 4. After deposition, the sediments in the shell lenses were lithified by the solutioning of the invertebrate shells, and, the subsequent reprecipitation of sparry carbonate around the silicate and organic components of the lenses.

The following interpretation is offered for the origin of the limestone deposit. The close of the Devonian Period in North America

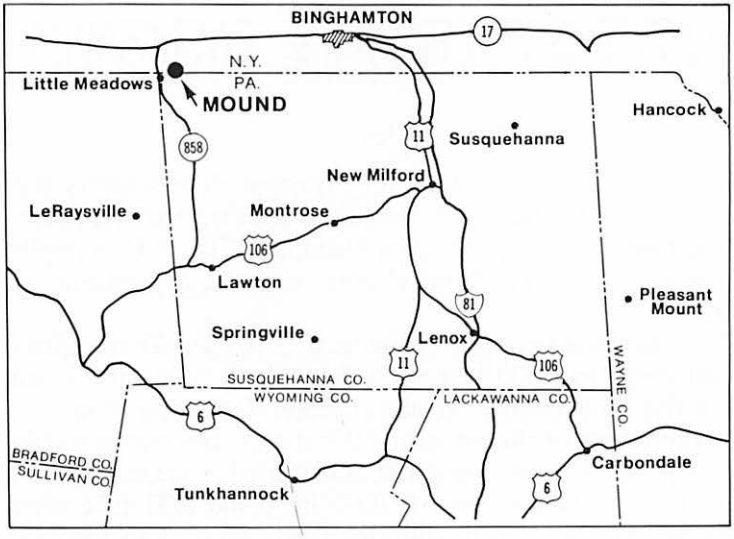


Figure 1

Figure 2

was marked by uplifting throughout much of the eastern United States and Canada. Rivers draining the newly formed Acadian Mountains actively built complex delta systems into the subsiding Appalachian Basin. As these environments moved westward, they left behind a sequence of interfingered sandstones, siltstones and shales. These were the result of a deltaic environment that existed in the area during the close of the Devonian. It is thought that the limestone deposit formed in the area in front of the delta as is indicated in the paleogeographic sketch (Figure 5).

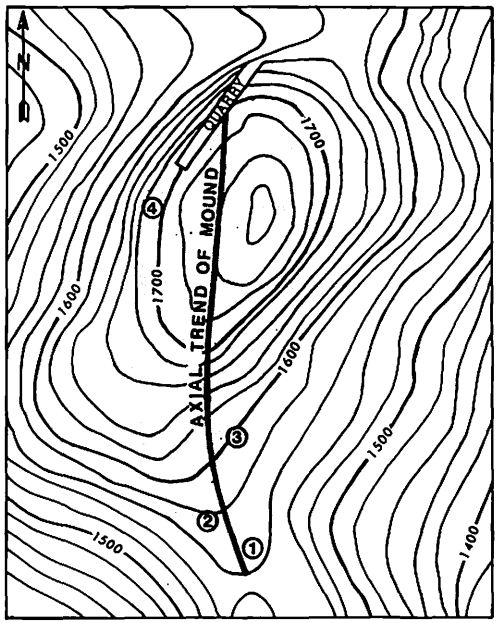


Figure 3

The fossils found in the limestone provide the key to the origin of the deposit. They imply a marine environment of deposition. Since the limestone contains only a low diversity of fossil invertebrates and no fully marine types such as crinoids, the water in which the limestone was deposited appears to have been somewhat brackish. The nearshore, brackish setting is further indicated by the presence of much sand, silt, clay, shale-chip interclasts, and large plant fragments mixed in with the shells. Finally, since the limestone contains only the above invertebrates but no corals or bryozoans, the deposit appears to represent a shell-mound rather than a framework-type reef.

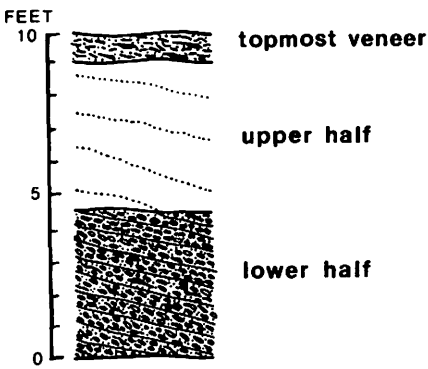


Figure 4

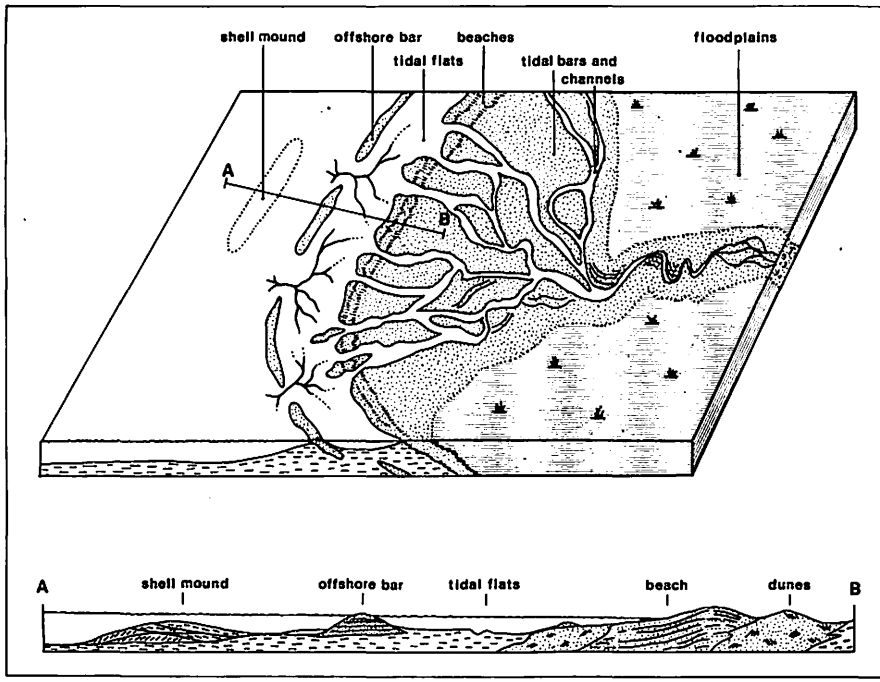


Figure 5

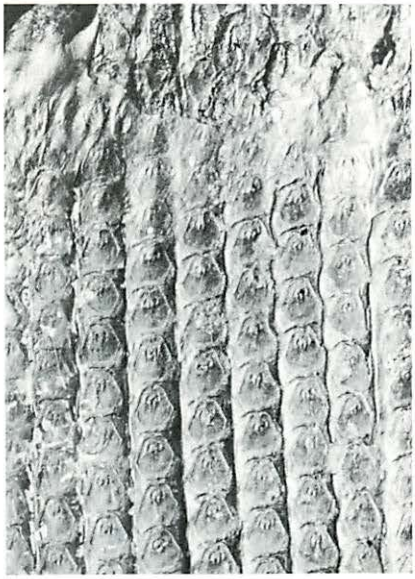
The paleoenvironmental analysis of the Ashcraft limestone mound has more than just academic importance. The mound is currently being quarried as a source of riprap and aggregate. The accurate description and interpretation of the origin of the mound, its compositional and textural characteristics, and its spatial geometry will ensure the efficient quarrying of the limestone. It was determined from outcrop and drill core data, and confirmed by strike and dip measurements, that the initial quarrying operation exposed an end of the mound (Figure 2). Additional observations enabled the delineation of an axial trend and subsurface extent of the mound. Using this data, it is estimated that there are approximately 500,000 cubic yards of recoverable aggregate in the mound. With its strategic location close to the metropolitan area around Binghamton, New York, the limestone mound should continue to provide the area with a valuable source of industrial minerals for future growth.

Edward S. Jones Fossil Plant Collection Curated -

by William F. Klose II

The Mineralogical Society of Northeastern Pennsylvania has undertaken the curation of the Edward S. Jones Collection of Rocks, Minerals and Fossils for the Lackawanna Historical Society in Scranton, Pennsylvania. The first section of the collection cleaned, identified, numbered, and cataloged consists of 140 exceptional Pennsylvanian Age Fossil plants collected from coal mines in the Scranton area between 1900 and 1920. Included are magnificent display slabs of the Lycopod Barks *Lepidodendron modulatum* Lesquereux, *Sigillaria mammilaris* Brongniart, *Sigillaria laevigata* Brongnart, and *Sigillaria reniformis* Brongniart, the Lycopod Cones *Lepidostrobus oblongifolius* Lesquereux and *Lepidocarpon linearifolium* (Lesquereux), the Lycopod root, *Stigmaria ficoides* Sternberg, the Lycopod Branch Scars *Caulopteris* and *Ulodendron puntatum* Sternberg, the Sphenophyllid *Sphenophyllum emarginatum* Brongni-

Horizontal section of Lycopod cone *Lepidostrobus oblongifolius* on shale from near Scranton, Pennsylvania. Edward S. Jones Collection #J120. Photo by H. Michaels.



Lycopod bark *Sigillaria mammilaris* Brongniart from Olyphant, Pennsylvania, illustrating characteristic aberrant scars (at top) Edward S. Jones Collection #J43. Photo by H. Michaels.

art, and the seed ferns *Alethopteris serlii* (Brongniart), *Mariopteris nervosa* Brongniart, *Neuropteris clarksoni* Lesquereux, and *Pecopteris* to name a few.

Edward S. Jones was the youngest child of Edward Jones, a pioneer Scranton Area Coal Mine operator and banker. After graduation from Wyoming Commercial College in Kingston, Pennsylvania, Edward S. Jones became Assistant Manager of the Archbald Mines and upon the death of his Father, General Manager of Jones, Simpson and Company, the mines' owner. In the years to follow Mr. Jones became a well known and respected Banker, Coal Mine Operator, Capitalist, Business Leader, Philanthropist, world traveler, and Lecturer. He kept his rock and fossil collections on display at his home Tyn-y-vron at Blakely, Pennsylvania, until his death in 1947. The collection was then transfered to the Lackawanna Historical Society at 232 Monroe Street in Scranton, Pennsylvania, where a small portion has been on display since.

It is indeed fortunate for us that through the thoughtfullness of men like Edward S. Jones some of the relics of our early coal mining era have been preserved for future generations to see, study, and enjoy.

Reference

Weyburn, S. Fletcher (Editor), 1929. Origin and History of the Famous Archbald Pot-hole, Archbald, Lackawanna County, Pennsylvania Lackawanna Historical Society Series 10, pp. 15-17. (Contains Biographies of Edward Jones, Esq. and Edward S. Jones Esq.)

Lycopod bark *Lepidodendron modulatum* Lesquereux from Olyphant, Pennsylvania. Edward S. Jones Collection #J80. Photo by H. Michaels.

MEET THE STAFF...

Bernard J. O'Neill, Jr., Chief
Mineral Resources Division

Bernard "Buck" O'Neill, Jr. joined the Survey Staff as an economic geologist in 1972, and on January 2, 1975 was appointed to the position of Chief of the Mineral Resources Division. His current responsibilities include planning and supervising regional and statewide geological investigations and evaluations of mineral resources in the Commonwealth.

Besides planning and guiding the Division, Buck has been involved actively in numerous projects dealing with Pennsylvania's non-metallic minerals, commonly referred to as industrial minerals. During the past few years his attention has focused on some important industrial mineral commodities – sand and gravel, crushed stone, clay and shale, and the carbonate rocks (limestone and dolomite). Recent publications by the Bureau of Topographic and Geologic Survey which report the results of his work include "Greater Pittsburgh Region construction aggregates" (1974), and "Potential high-calcium limestone resources in the Mt. Joy area, Lancaster County, Pennsylvania" (1975). In press are two other reports which cover: (1) properties and uses of clays and shales in the Greater Pittsburgh region, and (2) the distribution of limestones containing at least 90 percent $CaCO_3$ in Pennsylvania.

Before joining the Pennsylvania Geological Survey in 1972, Buck gained valuable experience in industry by working as Chief Geologist for the Foote Mineral Company, and as exploration geologist, mine geologist, and as mine supervisor for The New Jersey Zinc Company. He was employed also as a staff geologist with the Earth Sciences Department at Stanford Research Institute in Menlo Park, California. His work portfolio shows that he has done geological work in at least 20 states of the United States as well as in Venezuela and Brazil in South America, and in different provinces of Canada.

Buck was born in Paterson, New Jersey, obtained his B.S. degree in geology from Franklin and Marshall College in Lancaster, Pennsylvania, and his M.S. degree in geology from the California Institute of Technology in Pasedena, California. He is a member of numerous professional organizations including the Geological Society of America, the Society of Economic Geologists, and the Society of Mining Engineers of AIME.

A most interesting hobby that he enjoys during the November-March period each year is curling – the old Scottish game played on ice with stones and brooms. According to Buck, curling is a great sport for geologists because one really learns how to handle stones.

Multiple Land Use

An excellent example of multiple land use can be found in Lebanon County, Jackson Township, near the village of Millardsville where an abandoned quarry in the Annville Formation has been turned into a private swim club. The former Millards Quarry is also used by SCUBA divers for training and practice sessions. The Annville Formation is a high-calcium limestone which is a valuable source of pure limestone for the manufacture of cement, blast furnace flux, chemical lime and agricultural lime.

PENNSYLVANIA GEOLOGICAL SURVEY STAFF

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Donald M. Hoskins, *Assistant State Geologist*

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John C. Benson, *Typist*
Leslie T. Chubb, *Laboratory Technician*
Robert C. Smith, *Geologist*

OIL AND GAS DIVISION

1201 Kossman Bldg.
100 Forbes Ave., Pittsburgh, Pa. 15222
William S. Lytle, *Division Chief*

Lajos Balogh, *Draftsman*
Cheryl Cozart, *Stenographer*
Elizabeth A. Eberst, *Typist*
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In Cooperation with The U.S. Geological Survey

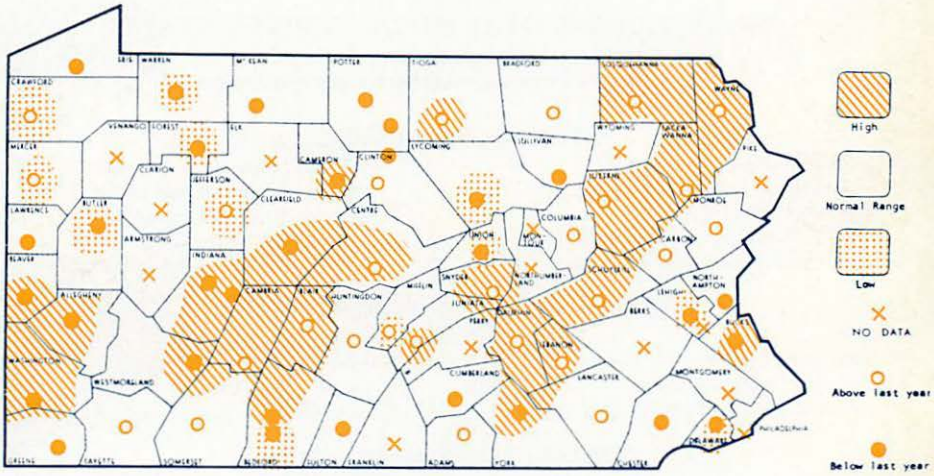
GROUND WATER DIVISION

In Cooperation with The U.S. Geological Survey

GROUND-WATER LEVELS

FOR

SEPTEMBER 1976



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