SUMMER 1989

Ohio Geology Newsletter

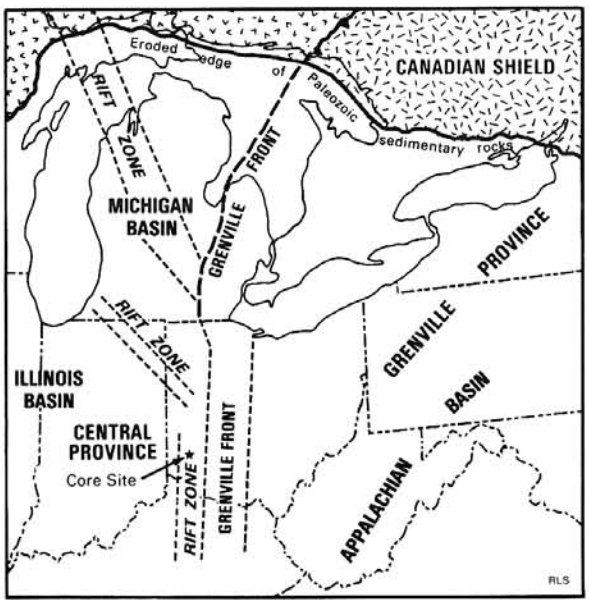
Division of Geological Survey

WARREN COUNTY DEEP CORE

by Douglas L. Shrake and Michael C. Hansen

A mile-high stack of rock from Ohio is impressive. No, an Ohio version of the Grand Canyon has not been discovered. Division of Geological Survey personnel had to get the mile of rock the hard way—by drilling it out of the ground, 10 feet at a time, in a 3-inch-diameter core.

This mile of rock was obtained from the Survey's recently completed deep coring project in Warren County, in southwestern Ohio, which gained considerable public attention for (1) its depth of 5,370 feet (perhaps the deepest continuous core east of the Mississippi), (2) the new rock unit discovered in the lower part of the core, and (3) the use of shredded money to maintain circulation during drilling (see *Ohio Geology*, Spring 1989).



Location of the Warren County core hole and regional geologic features.

This core hole was drilled as part of the Survey's ongoing program to establish a statewide network of subsurface geologic reference points consisting of continuous cores and geophysical logs. The Warren County core site, in the American Aggregates Corp. quarry near the town of Lytle, was selected because it provided the opportunity to collect basic geologic information on the subsurface rocks in this area to support the Survey's county mapping program and because it had a reliable source of water for drilling.

Drilling began in October 1987 with the expectation that this core hole would yield a fairly normal section of Ordovician and Cambrian rocks to a depth of about 3,500 feet, where it was projected that crystalline, Precambrian basement rocks would be encountered. However, after the core bit passed through the Mt. Simon Sandstone, an Upper Cambrian unit that commonly overlies the crystalline basement rocks throughout much of Ohio, it encountered another sandstone unit instead of crystalline rocks.

Initially, Survey geologists thought that this unusual sandstone was an anomalous portion of the Mt. Simon Sandstone, but, after the core bit had passed through several hundred feet of this sandstone, they realized that it was a previously unrecognized unit. Drilling continued and about 670 feet of this new sandstone had been cored when budgetary restrictions prevented the Survey from purchasing additional drill rod necessary to continue the core hole.

The Warren County core hole created considerable interest among industry and academic geologists, and a consortium consisting of the Survey, the University of Cincinnati, Wright State University, Paragon Geophysical, Inc., and Stocker & Sitler, Inc., was formed to generate funds to purchase additional drill rod and to shoot a seismic profile in the vicinity of the drill site. Sufficient funds were generated from a variety of contributors (see Acknowledgments at the conclusion of this article) to purchase an additional 920 feet of drill rod and to run an 8-mile-long seismic reflection profile across the area of the core hole.

After reviewing the west-to-east seismic profile, consortium members concluded that the core bit would have to penetrate at least another 2,000 feet of presumably similar sandstone in order to reach what was thought to be crystalline basement. Thus, crystalline rocks were well beyond the reach of the Survey's Longyear Hydro-44 core rig, which has a drilling capacity of about 5,700 feet. However, two prominent features, known as seismic reflectors, of uncertain origin were readily visible on the seismic profile and were at depths within reach of the core rig. The core hole was therefore deepened in an attempt to reach these reflectors.

Seismic reflectors commonly mark a distinct change in rock types and cause energy to be reflected back to the surface, where it is recorded by instruments. The core hole reached the first reflector, which was revealed in the core to be a reddish siltstone, but drilling was terminated before the second reflector was reached.

In early April 1989, as driller Mike Mitchell and driller's assistant Mark Clary were extracting the drill

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ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Richard F. Celeste, Governor • Joseph J. Sommer, Director

FROM THE STATE GEOLOGIST . . . by Thomas M. Berg

A CHANGING AGENDA

Historically, state geological surveys have been heavily oriented toward serving the mineral industries. The enabling legislation for many of the surveys was specifically geared to assessing the mineral wealth of the individual states. During the last 20 years or so, however, the services provided by the state geological surveys have shifted strongly toward what has been loosely called "environmental geology." More and more geological survey time is being devoted to providing information to solve serious and often critical environmental situations.

Here are just a few recent examples of cases where the Ohio Geological Survey helped in solving environmental problems:

- During drilling of a deep, hazardous-waste injection well, unusual levels of an organic compound above the planned injection zone were encountered: The Survey responded in determining whether or not the concentration was natural.
- A pristine wetland was threatened by a suburban development: The Survey responded with an assessment of the aquifer system supplying the wetland.
- Citizens along the Lake Erie shore became concerned that dredging operations in the lake might be affecting erosion patterns along the shoreline: The Survey responded by investigating whether dredging was being done within the limits of permitted dredging areas.
- A southeast Ohio town suffered severe ground-failure problems that may have been due to collapse of old underground coal mines: The Survey responded by providing map information on the extent of deep coal mining, and working with reclamation and municipal authorities to help locate mine voids.
- A proposed landfill raised questions about the impact on domestic water wells: The Survey responded by evaluating the site and providing information on the infiltration characteristics and extent of an unconsolidated sand and gravel aquifer.
- A conservation group sought help investigating the distribution of a potentially endangered species: The Survey responded by providing information on the areal extent of the geological formation to which the species is indigenous.

Questions and concerns like these come into the Ohio Geological Survey on a daily basis. They now constitute approximately half of our service requests. The remainder are still largely mineral-resource requests, but there is also a growing number of "educational" requests. The Ohio Geological Survey is not alone in dealing with these burgeoning environmental requests. State surveys across the nation are faced with this trend. This changing agenda for geological surveys is alarming for two reasons. First, the large increase in requests for environmental services is *not* cushioned by a decrease in mineral-resource and educational requests. In fact, the total number of service requests continues to grow by leaps and bounds. Second, the time spent by geologists answering the requests cuts deeply into the time planned for basic geologic mapping and development of the geologic framework. As the basic mapping and the geologic-framework program of a state survey suffer, so do the environmental responses. When geologic mapping is not complete and accurate, the response to environmental requests is not complete and accurate.

The Ohio Geological Survey is faced with serious budgetary problems and limited human resources. In view of growing environmental concerns, our agenda is rapidly changing, and there are greatly increased demands placed on our time. But we are determined to continue to serve our partner divisions in the Department of Natural Resources, other state and federal agencies, private industry, and all the people of Ohio. We *shall* provide the essential information desperately needed by our mineral industries who are working hard to develop Ohio's rock, mineral, fossil fuel, and ground-water resources. And—we *shall* provide the essential geologic information needed to make sound environmental decisions. I encourage our readers to become fully aware of the changing agenda of their state geological survey, and to share their concern with local, state, and national government representatives.

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News items, notices of meetings, etc. should be addressed to the attention of the editor. Change of address and new subscriptions should be addressed to the attention of the secretary.

CORE OPEN HOUSE

The Survey held an open house on June 28 and 29 at the Division's core and sample repository on the west side of Columbus in order to provide the opportunity for government, industry, and academic geologists to view the core from the recently completed Warren County deep core hole. More than a hundred individuals attended the event, including geologists from the Illinois, Indiana, and West Virginia Geological Surveys, the U.S. Geological Survey, other government agencies, several universities, and the oil and gas industry, including individuals from as far away as Texas and California.

Warren County core on display at Survey open house.

In addition to the actual core, which was displayed in multiple rows of end-to-end core boxes, the Survey exhibited copies of the geophysical logs of the core hole and of the seismic section shot across the area of the core hole. Other displays included interpretive information on the core and its relationships to regional geologic features; photomicrographs of thin sections of the newly discovered pre-Mt. Simon sandstone; and the Survey's Long-year Hydro-44 core rig, which was used to drill the Warren County hole. Project geologist Douglas L. Shrake also presented slide lectures.

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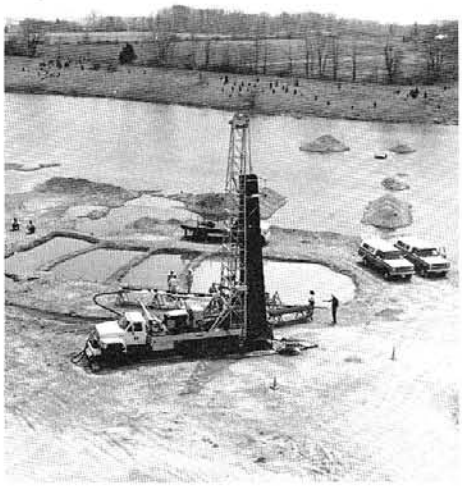


Aerial view of the Survey's Longyear Hydro-44 core rig in the American Aggregates Corp. quarry near Lytle, Warren County.

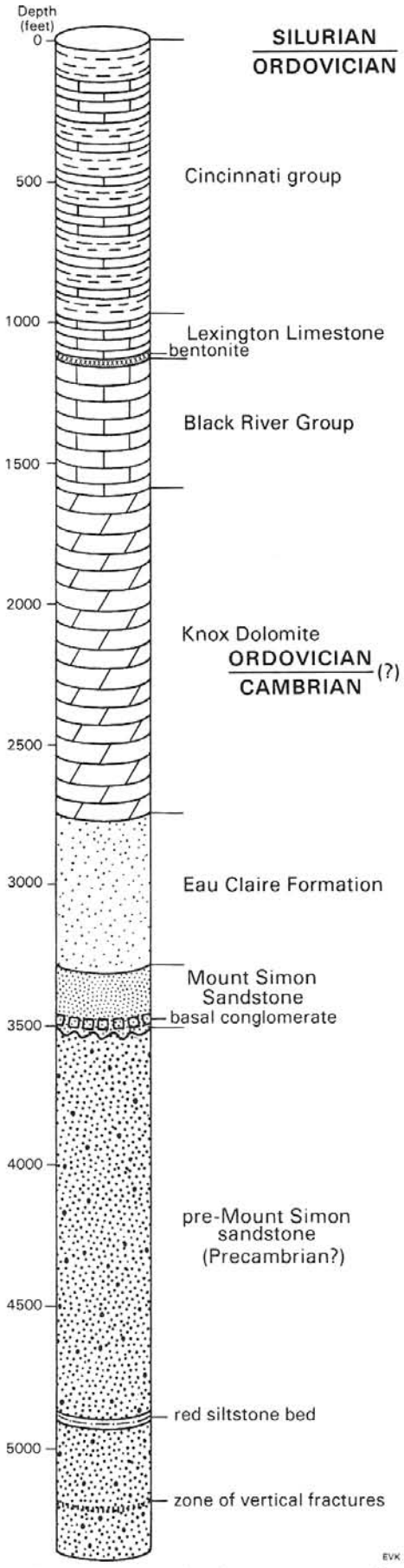
rod from the hole, the rod became wedged near the bottom of the hole owing to caving of rock from the core-hole wall. After several unsuccessful attempts to dislodge the drill rod, a service company was hired to cut off the rod near the point at which the rod was wedged. Fortunately, almost all of the mile-long drill rod was salvaged.

A wealth of geologic information was obtained from the Warren County core hole. In addition to the core, which is housed at the Survey's core and sample repository in Columbus, and the seismic section, which is being analyzed at Wright State University, a suite of geophysical logs was run on the hole. All of this information collectively provides a picture of a previously little known aspect of Ohio's geology and opens new areas of investigation of economic and environmental geology.

This thick sandstone appears to be an accumulation of sediment eroded from upland or mountainous areas in late Precambrian time and deposited in a down-dropped basin known as a rift. This presumed rift basin lies on the western edge of the Grenville Front, a Precambrian structural feature that marks the western limit of rocks deformed during the formation of the Grenville Mountains about a billion years ago (see *Ohio Geology*, Winter 1989). This sandstone is technically a lithic arenite, meaning a sandstone made up of rock fragments. Much of the sandstone core contains readily identifiable pieces of a fine-grained equivalent of granite known as rhyolite.

The practical value of this sandstone is considerable and will be investigated in coming months as the core is subjected to technical analysis. Such sedimentary units have the potential to be reservoirs for petroleum and natural gas, although none has been discovered as yet in this sandstone. The newly discovered sandstone also might serve as a reservoir for storage of natural gas, which would be pumped into the reservoir during the summer when heating demands are low and pumped out during the winter when gas usage is traditionally high. The unit also might serve as a site for disposal of liquid industrial wastes.

The Warren County core serves to illustrate that there is still much to be discovered about Ohio's geology and that such discoveries are commonly serendipitous. The Survey's investigations throughout the last century and a half have been of immense benefit to the state, and the prospects for equally important contributions in the future do not appear to be diminished by a lack of uncharted terrain in which to explore.



Columnar section of rock units penetrated in the Warren County core hole.

ACKNOWLEDGMENTS

The successful completion of the Warren County core hole and the seismic profile across the area were possible only through the generous contributions of the following individuals and organizations. The Division of Geological Survey gratefully acknowledges this assistance. We particularly thank Dr. Paul E. Potter and Dr. J. Barry Maynard of the University of Cincinnati, Dr. Benjamin H. Richard and Dr. Paul J. Wolfe of Wright State University, and Gary W. Sitler of Stocker & Sitler, Inc., for their contributions and support.

Drilling contributors

Ashland Exploration, Inc.
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Columbia Natural Resources, Inc.
CNG Development Co.
Dr. Richard H. Durrell
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Paragon Energy Co.
Petro Evaluation Services, Inc.
Quaker State Corp.
Stone Resource and Energy Corp.

Seismic contributors

The Cincinnati Gas & Electric Co.
The Dayton Power and Light Co.
Columbia Natural Resources, Inc.
Hosking Geophysical Corp.
Paragon Geophysical, Inc.
Stocker & Sitler, Inc.
Stroder and Unruh Geophysical Corp.
Woods Geophysical, Inc.

FURTHER READING

Hansen, M. C., 1989, "How the world was made"—the COCORP traverse across Ohio: Ohio Geology Newsletter, Winter 1989.

Crowell, D. L., 1989, The value of money: Ohio Geology Newsletter, Spring 1989.

TRACE ELEMENTS IN OHIO BRINES

Brine is water with a high dissolved-solids content and occurs naturally in many of the rock formations beneath Ohio. These brines are brought to the surface primarily as a by-product of drilling for oil and gas. There is an environmental concern about the toxicity of brines, but very little in the way of published analytical data is available.

Since 1985 the Division of Geological Survey has collected and analyzed 92 brine samples in an ongoing project to characterize the levels of trace metals in Ohio brines. The Survey was assisted in this project by the ODNR, Division of Oil and Gas, which provided partial funding for a new analytical instrument in 1986 and arranged sampling locations in 1988 and 1989.

The samples were collected from the wellhead where possible. Approximately 20 percent of the samples were obtained from storage tanks or other sources where wellhead sampling was not possible. Most of the samples were from the "Clinton" (Silurian) and Berea (Mississippian) formations. Thirty percent of the samples were from other formations and informal drillers' units such as Rose Run, Knox, Black River, and Trenton (Ordovician); "Newburg" (Silurian); Oriskany (Devonian) and Devonian shale; and "Big Injun" (Mississippian).

All samples were checked for eight trace elements—barium, cadmium, chromium, cobalt, copper, lead, nickel, and vanadium. The first 22 samples, from 1985, also were analyzed for mercury, which was determined by flameless atomic absorption spectrophotometry on the brine. Barium was determined by inductively coupled plasma-atomic emission spectrometry (ICP-AES) on diluted brine. The remaining trace metals were concentrated from the brine by reductive coprecipitation and determined by ICP-AES. The range of concentrations for each element is listed below. The elements checked were below detection limits in a number of samples.

Ba 0.1 to 260 mg/L
Cd 0.4 to 180 µg/L
Cr 0.4 to 29 µg/L
Co 0.3 to 150 µg/L
Cu 0.5 to 240 µg/L
Pb 2.2 to 1,300 µg/L
Hg 0.015 to 0.79 µg/L
Ni 0.6 to 240 µg/L
V 0.3 to 28 µg/L

The trace element results for all samples are now available on open file at the Geological Survey. A manuscript containing all analyses, including major and minor elements as well as interpretations, will be prepared for publication in 1990.

—David A. Stith
Head, Geochemistry
Laboratory Section

OHIO'S MINERAL INDUSTRIES TEACHERS WORKSHOP: THREE YEARS OLD AND MORE SUCCESSFUL THAN EVER

How do Ohio's natural resources affect your daily life? That and many more questions on Ohio's natural resources were answered during the third Ohio's Mineral Industries Teachers Workshop. The workshop was conducted June 26-30 by the Division of Geological Survey and the University of Akron at the ODNR Fountain Square complex in Columbus. Grants from the Ohio Aggregates Association and the Ohio Oil and Gas Association paid for field-trip costs and educational materials.

The workshop familiarizes the teachers with Ohio geology and the development of mineral industries in the state so they can more effectively communicate this information to their students. This year 24 elementary, junior and senior high school, and college teachers heard representatives from research, industry, and regulatory agencies present a variety of information on the economics, regulations, uses, and geologic origin of Ohio's mineral resources.

Three days of field trips gave the teachers a firsthand look at the operations of various mineral industries. The first field trip included an overnight stay at Burr Oak State Park Lodge in Morgan County. The teachers visited Waterloo Coal Co., Inc., in Jackson County, where they viewed coal strip mining, limestone and clay mining, and reclamation activities. Lunch was provided by Waterloo Coal Co., Inc. Afternoon activities included a tour of Buckeye Furnace State Memorial, a reconstructed charcoal-iron furnace that operated in the 1800's in Jackson County. The tour included a slide presentation by the Ohio Historical Society which described the historic mining and production technologies used at the time. The last activity of the first day was a tour of American Electric Power's Southern Ohio Coal Co.'s coal-preparation plant in Meigs County—the largest coal-preparation plant in North America.

On the second day of field trip 1 the teachers visited an oil and gas drill rig in Perry County, where they learned the mechanics of drilling for oil and gas. The heavy rainfall this year very effectively demonstrated one of the disadvantages associated with the oil and gas industry—trying to get to the rig through a sea of mud! The group then toured Central Silica Co.'s sandstone quarry and glass-sand processing plant in Perry County. Lunch was provided by Central Silica Co. The day ended with a tour of the brick plant and shale pit of the Bowerston Shale Co. in Licking County.

Teachers collecting samples of the Massillon sandstone (Pennsylvanian) at Central Silica Co.'s sandstone quarry in Perry County.

On the second field trip, in Franklin County, the teachers toured several operations of American Aggregates Corp., including the testing laboratory, Columbus Limestone Quarry, Frank Rd. sand and gravel pit, and Marble Cliff Limestone Quarry. Workshop participants also visited Anderson Concrete Corp.'s portland-cement-concrete mixing plant, Bituminous Concrete Corp.'s asphaltic-concrete mixing plant, the Franklin County Sanitary Landfill, and several reclaimed sand and gravel pits and limestone quarries.

The intent of the workshop is to open the eyes of the teachers, and therefore their students, to the need for Ohio's mineral resources and the responsible way these resources are being extracted in Ohio. All citizens rely on the science of geology and consume mineral resources daily. Mining is a necessary human activity. The land being mined can be reclaimed to be compatible with farming, grazing, commercial and residential development, or recreation. The teachers this year saw many examples of mining and subsequent reclamation. The overwhelming interest and enthusiasm expressed by the group during the week indicated that our efforts were successful. It was a very informative and enjoyable five days.

The Survey is grateful to all of the teachers that attended the workshop this year for their patience, their good humor and attentiveness throughout the workshop, and their excellent suggestions for next year. Details regarding the 1990 Ohio's Mineral Industries Teachers Workshop will be included in the Winter 1990 issue of *Ohio Geology*.

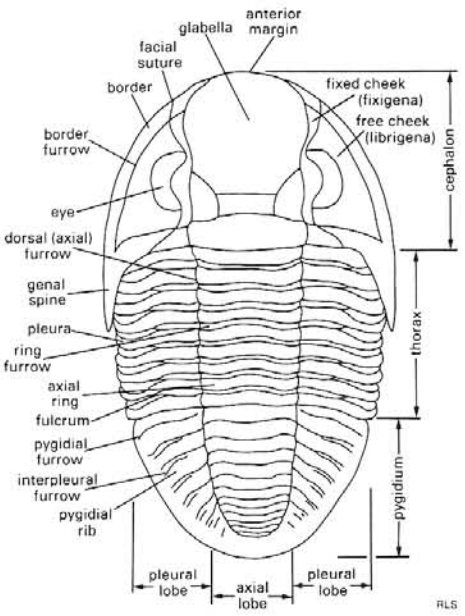
—Sherry W. Lopez
Regional Geology Section

PENNSYLVANIAN TRILOBITES OF OHIO

The Survey recently released Report of Investigations No. 142, *Pennsylvanian trilobites of Ohio,* by David K. Brezinski, Myron T. Sturgeon, and Richard D. Hoare. This 18-page report is one of the most comprehensive publications on trilobites from Pennsylvanian rocks and includes two plates of photographs of specimens. Five species of trilobites, distributed among three genera, are described from 12 marine units at 83 collecting localities in 22 eastern Ohio counties.

The report includes a brief discussion of the stratigraphy of Pennsylvanian rocks in Ohio and discussions of stratigraphic distributions and paleoecology of Pennsylvanian trilobites. In addition, systematic descriptions are given for each species. The list of collecting localities provides information on location, marine units, and species found at each locality.

By Pennsylvanian time, trilobites were near the end of their more than 300-million-year reign in Paleozoic seas; indeed, they became extinct in the succeeding Permian Period. Most Pennsylvanian species of trilobites were diminutive creatures, less than an inch in length, and are not abundant at any locality. The bulk of the specimens described in this report represent the efforts of systematic collecting of Pennsylvanian fossils in Ohio by Dr. Sturgeon and his students during a period of more than 40 years.

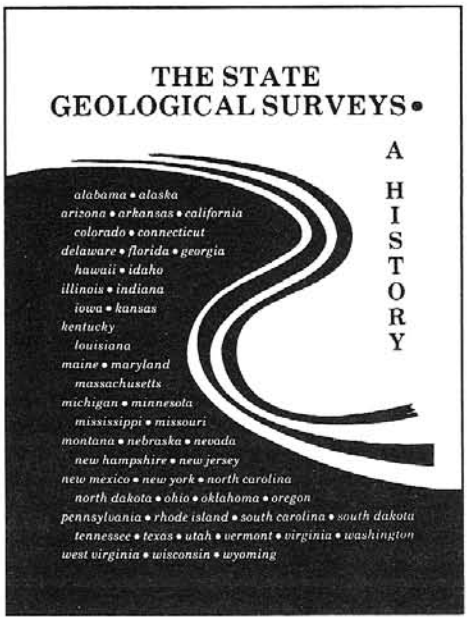


Generalized morphology of the Pennsylvanian trilobite Ditomopyge *(from Report of Investigations No. 142).*

The senior author, Dr. Brezinski, is a stratigrapher and trilobite specialist with the Maryland Geological Survey. This report is another in a Survey series on Pennsylvanian fossils of Ohio coauthored by Dr. Sturgeon (Ohio University) and Dr. Hoare (Bowling Green State University). Previous volumes in this series are on brachiopods (Bulletin 63) and on bivalves (Bulletin 67). A volume on cephalopods should be available in late 1989.

Report of Investigations No. 142 will be of interest not only to professional paleontologists but also to amateur fossil collectors for both collecting and identification of trilobites from Pennsylvanian rocks. This publication is available from the Survey for $3.92, which includes tax and mailing.

HISTORY OF STATE GEOLOGICAL SURVEYS AVAILABLE



A comprehensive, 500-page history of American state geological surveys was published in November 1988 by the Association of American State Geologists. The hard-cover volume, edited by retired Pennsylvania State Geologist Arthur A. Socolow, contains the history, organization, and functions of the 50 state geological surveys. Each survey is described in an individual chapter prepared by the respective surveys.

More than 30 of the state geological surveys originated over 100 years ago. The accounts of the development and activities of America's state geological surveys shed light on a major component of geologic mapping and research in the United States. Geologists in government, academia, and industry, and all who are interested in geologic achievements, will find this illustrated publication informative and thoroughly readable.

This volume is an addition to and an update of G. P. Merrill's out-of-print and hard-to-find 1920 U.S. National Museum Bulletin 109, *Contributions to a history of American state geological and natural history surveys.* The Ohio portion of the new report (p. 344-347) was authored by Survey geologist and *Ohio Geology* editor Michael C. Hansen.

The state geological surveys—A history, may be ordered from the Geological Survey of Alabama, P. O. Box O, Tuscaloosa, AL 35486. The price is $20 (which includes shipping). Make checks payable to: Association of American State Geologists.

DRIFT-THICKNESS MAP OF OHIO AVAILABLE

The Division of Geological Survey now has available for sale U.S. Geological Survey Map MF-1862, *Preliminary map showing the thickness of glacial deposits in Ohio,* by David R. Soller. This isopach map is at a scale of 1:500,000 and depicts the distribution of unconsolidated sediments greater than 50 feet in thickness in the glaciated portion of Ohio. Much of the data used to construct this map came from Division of Geological Survey drift-thickness maps (see *Ohio Geology,* Winter 1988) compiled as part of the Survey's statewide county geologic mapping program and from earlier Survey reports.

This map provides an overview of the thickness of unconsolidated sediments in the glaciated portion of the state and will be of value to individuals and organizations involved in planning, construction, and mineral-extraction activities. USGS Map MF-1862 is available from the Division of Geological Survey for $2.86, which includes tax and mailing.

FOSSIL INSECT LOCALITY REDISCOVERED

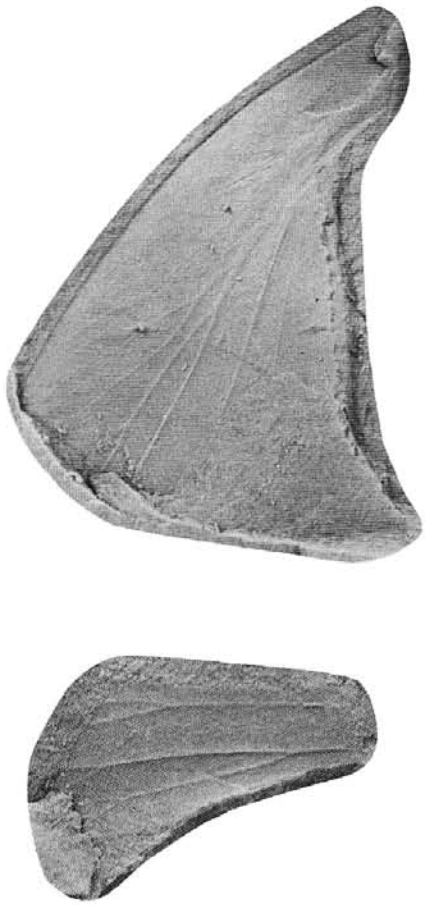
The relative rarity of insect fossils makes each and every occurrence a valuable cache of information. During the late 1800's, several deposits of fossil insects were discovered in Pennsylvanian-age rocks in eastern Ohio. At one such locality in Jefferson County the wings of

cockroachlike insects, called blattoids, were discovered along Wills Creek north of Steubenville. However, the exact location of this fossil deposit has remained a mystery for nearly 100 years. Field work conducted in Jefferson County as part of the Survey's statewide mapping program led to the rediscovery of this important fossil locality.

The fossil deposit appears to have been discovered in the early 1880's by Samuel Huston of Steubenville. Huston was employed by the Jefferson County Surveyor's Office and supplemented his income by supplying the geologic community with a variety of fossil specimens. Many of the fossils that Huston collected from this locality now reside in the R. D. Lacoe collection at the Smithsonian's National Museum of Natural History in Washington, D.C.

Discussions with Dr. Robert W. Hook shed new light on the approximate location of Huston's insect locality. During his tenure at the Smithsonian Institution, Dr. Hook located an 1885 letter written by Huston to Lacoe. This letter, found among the notes and correspondence pertaining to the Lacoe collection, indicated the insect deposit was located in section 15 of Island Creek Township along a tributary to the North Fork of Wills Creek. Furthermore, the letter indicated that the rocks that contain the cockroachlike fossils were approximately 90 feet above the Ames limestone, a well-known marker bed in the Conemaugh Group. This information, combined with my knowledge of the local geology, facilitated the rediscovery of this insect-fossil locality.

Stream-cut exposure of blattoid-bearing shale along a tributary to the North Fork of Wills Creek in Jefferson County.



Blattoid wing fragments collected from the rediscovered "Richmond" locality in 1988 (from Caudill and Schumacher, 1989).

Huston's letter indicates that the locality actually consisted of two sites. Most of the fossils he collected were wing fragments obtained from his primary site. This rediscovered site recently produced two blattoid wing fragments (see photos). The second, less productive site was quickly located and the authenticity of the primary site was further verified after Dr. Hook provided a copy of the sketch map that accompanied Huston's letter.

Blattoid fossils from the primary locality have been included in several past studies that variously refer to it as the "Steubenville," "Richmond," or "Wills Creek" locality. Richmond is a village about 8 miles northwest of Steubenville and about 4½ miles northwest of the blattoid site. Samuel Scudder was first to report on this locality in his 1895 monograph published as U.S. Geological Survey Bulletin 124. Anton Handlirsch included this locality in his *Revision of American Paleozoic insects* published in 1906 in the Proceedings of the U.S. National Museum. Collectively, Handlirsch and Scudder recognized a total of 27 species from the "Richmond assemblage." These early taxonomic works, in which species were designated on the basis of arbitrary size differences, were more recently evaluated by Dr. Christopher Durden. In a 1969 article published in the Canadian Journal of Earth Sciences, Durden revised blattoid taxonomy such that the "Richmond assemblage" now includes only 10 species in 9 genera. Nevertheless, the fossil specimens from the "Richmond" locality remain one of the most diverse assemblages of blattoid insects from a single deposit.

At the primary site the blattoid fossils are preserved in a gray calcareous shale. This unit also contains root traces, abundant plant fossils, and bivalves. The blattoid-bearing shale overlies 8 to 10 inches of shaly coal that lies just above stream level. This same shale unit is similarly disposed at the secondary site. This site, which Huston labeled "less productive," failed to produce blattoid fossils during my brief visit. It remains largely uncollected.

The rocks containing the blattoid fossils were deposited approximately 300 million years ago in the quiet backwater reaches of a coal swamp. Throughout the area of eastern Ohio in Pennsylvanian time, coal swamps were interspersed with and covered portions of deltas scattered along the shoreline of a shallow inland sea. The cockroachlike insects lived and died among the lush vegetation that flourished in the tropical swamp forest. Wings liberated from the decaying carcasses of blattoid insects were buried beneath layers of mud as the coal swamp was slowly flooded.

Previous workers have proposed regional stratigraphic correlations for the blattoid-bearing shale at the "Richmond" locality. Recent field mapping indicates the blattoid-bearing shale is locally developed. It cannot be reliably correlated beyond the immediate vicinity of the "Richmond" locality.

Fossil localities like the "Richmond" are windows through which we can look back in time at the puzzle of life. New localities may yet be discovered in this area. A second blattoid fossil locality, persumably discovered by Huston, may remain lost to this day. Specifically, the confusion that appears to stem from the use of multiple names for the "Richmond" locality may have its origin in the existence of a second, very distinct locality. Clara Mark Gould, in D. D. Condit's 1912 *Conemaugh Formation in Ohio,* wrote of two Jefferson County blattoid localities. She described them as "not more than 12 or 15 miles apart." Such a distance would clearly eliminate the possibility that the second locality corresponds to the secondary site at the "Richmond" locality; at the

"Richmond" locality the primary and secondary sites are less than 1 mile apart. Thus, it appears that at least one more blattoid fossil locality lies hidden in Jefferson County.

—Michael R. Caudill
Regional Geology Section

FURTHER READING

Caudill, M. R., and Schumacher, G. A., Ohio blattoid (Insecta) fossil locality, rediscovered: Journal of Paleontology, v. 63, p. 121-123.

Condit, D. D., 1912, Conemaugh Formation in Ohio: Ohio Division of Geological Survey Bulletin 17, 363 p.

Durden, C. J., 1969, Pennsylvanian correlation using blattoid insects: Canadian Journal of Earth Sciences, v. 6, p. 1159-1177.

Handlirsch, Anton, 1906, Revision of American Paleozoic insects: Proceedings of the U.S. National Museum, v. 29, p. 661-820.

Scudder, S. H., 1895, Revision of the American fossil cockroaches, with descriptions of new forms: U.S. Geological Survey Bulletin 124, 176 p.

GARRY YATES, 1988 SURVEY EMPLOYEE OF THE YEAR

Garry Yates (right) receiving the 1988 "Employee of the Year" award from then-Acting Chief Dennis N. Hull.

Garry Yates, Environmental Technology Supervisor in the Subsurface Geology Section, was selected as the 1988 Survey "Employee of the Year." This award recognizes superior efforts and contributions by an employee and has special significance because awardees are selected from nominations submitted by fellow employees.

Garry is originally from New Zealand and grew up in the resort town of Taupo on North Island. He studied geology at the New Zealand Technical Institute and worked as a geological technician at the University of Waikato before coming to the United States on a tour with a New Zealand rugby team.

Garry began his career with the Survey in 1976 as an environmental technician in the Subsurface Geology Section. He now holds the position of Environmental Technology Supervisor. In this capacity, Garry oversees the processing of all Subsurface Geology Section records and samples from oil and gas wells and manages the Survey's core and sample repository.

Competence, dedication to his job, and the ability to cooperate cheerfully with any individual or group are characteristics for which Garry is admired by his fellow employees. His good humor and pleasant attitude toward his job have earned him the respect of his peers.

MOVING?

Please take a moment to let us know your new address if you are moving. You will then continue to receive *Ohio Geology*. Contact Donna Schrappe, Division of Geological Survey, Fountain Square, Building B, Columbus, OH 43224 (telephone: 614-265-6605).

SURVEY STAFF NOTES

Michael R. Caudill

Barbara M. Cain

Mike Caudill is a geologist in the Regional Geology Section and is currently mapping Pennsylvanian rocks in Jefferson County as part of the Survey's statewide county geologic mapping program. He is also investigating the potential for extracting methane gas from Ohio coal beds and maintains a research interest in sedimentology and tectonics. Mike enjoys the opportunity for field work in his Survey job.

Mike came to the Survey in 1985 after receiving a bachelor's degree in geology from Marshall University in Huntington, West Virginia, and completing most of the work for a master's degree in geology at Ohio University. He is now completing his master's thesis, on Carboniferous rocks in New Brunswick, and expects to receive his degree in January 1990.

Mike is originally from Fort Gay, West Virginia, and now lives in Lancaster in Fairfield County. He and his wife, who is an environmental scientist with the ODNR, Division of Reclamation, are expecting their first child in the near future. Mike enjoys camping, running, and reading as hobbies.

Barb Cain is the Survey's new administrative secretary, a position in which she serves as secretary to the Chief and other administrative personnel. She also maintains all Survey administrative and payroll records.

Barb is from Columbus and began her career with the Department of Natural Resources in 1986 with the Division of Reclamation. She joined the Survey in May 1989 and has been particularly impressed with the professionalism of the Survey staff.

Barb has attended Columbus State Community College on a part-time basis studying personnel management. She is also a member of the Ohio National Guard, serving as a personnel records specialist. Barb and her husband, who is a student at The Ohio State University, are expecting their first child in November. Her hobbies include jogging and teaching aerobics.

OHIO'S PLACE IN NONFUEL MINERAL PRODUCTION

The U.S. Bureau of Mines recently released preliminary data on Ohio's nonfuel (excludes coal, oil, and gas) mineral production. The report indicates that Ohio ranked 14th overall in production of nonfuel minerals in 1988. Total value of Ohio's nonfuel minerals was $730 million. Ohio accounted for 2.4 percent of the national value in 1988. (Note: These statistics are preliminary and incorporate estimates of fourth-quarter production. U.S. Bureau of Mines figures for Ohio may differ from those compiled by the Division of Geological Survey owing to estimating, confidential data, and different categorization of mineral commodities).

Many states that had higher total values for nonfuel minerals produced significant quantities of metallic minerals, such as copper, gold, iron ore, lead, and silver, which have vastly higher value per unit volume than do industrial minerals such as those produced in Ohio.

Ohio ranked first in the production of lime and common clay, second in fire clay, third in sand and gravel, fourth in salt, seventh in industrial sand, ninth in crushed stone, and tenth in masonry cement. Demand for industrial minerals was strong in Ohio in 1988; production tonnages increased 11 percent for salt and 18 percent for sand and gravel. Declines in production of crushed stone and cement and declines in prices for crushed stone and sand and gravel resulted in a decrease in total value of nonfuel minerals from a high of $769 million in 1987. Although 1988 was the first decrease in nonfuel mineral value since 1982, the $730 million value was still greater than the value prior to 1987.

Single copies of reports summarizing nonfuel mineral production for the United States (*State mineral summaries 1989*) or for Ohio (*Mineral industries of Ohio*) are available free of charge from: U.S. Bureau of Mines, Publication Distribution, Cochrans Mill Road, P. O. Box 18070, Pittsburgh, PA 15236 (telephone: 412-892-4338).

ERRATA

The article, "Coal-bed analyses: ash and sulfur," in the Spring 1989 issue of *Ohio Geology* contained an error that requires correction. The column headings for sulfur and ash percentages were inadvertently transposed, thus providing incorrect values for ash and sulfur. The corrected table is given below. We regret the error.

—Editor

TABLE 2.—SULFUR AND ASH DATA FOR THE MOST PRODUCTIVE COAL BEDS IN OHIO

Number of samples used to determine the averages are shown in table 1

Seams, in order of decreasing production (1986)	Average percent				Pyritic/organic sulfur ratio	Estimated recoverable reserves (tons)
	Ash	Total sulfur	Pyritic sulfur	Organic sulfur		
Pittsburgh (No. 8)	10.58	4.24	2.56	1.67	1.53	1.9 billion
Middle Kittanning (No. 6)	9.12	3.48	2.07	1.47	1.41	3.5 billion
Meigs Creek (No. 9)	13.04	4.00	1.69	1.85	0.91	1.1 billion
Clarion (No. 4A)	12.89	4.19	2.41	1.59	1.52	0.5 billion
Lower Kittanning (No. 5)	11.19	4.50	3.16	1.44	2.19	1.4 billion
Lower Freeport (No. 6A)	11.82	3.72	2.51	1.19	2.41	1.0 billion
Waynesburg (No. 11)	17.31	2.93	1.64	1.12[1]	1.46	0.02 billion
Brookville (No. 4)	12.60	3.15	1.87	1.35	1.39	0.2 billion
Upper Freeport (No. 7)	11.01	3.11	2.21	0.91	2.43	4.0 billion
Redstone (No. 8A)	12.34	3.52	2.44	1.15	2.12	0.3 billion
Washington (No. 12)	28.30[1]	2.41[1]	1.42[1]	0.82[1]	1.73	0.3 billion
Harlem	8.72[1]	0.97[1]	0.50[1]	0.49[1]	1.02	0.02 billion
Sharon (No. 1)	10.01[1]	0.84[1]	0.50[1]	0.38[1]	1.32	0.03 billion

[1]Averages based on fewer than 20 samples.

The *Quarterly mineral sales, January-February-March 1989* table will be published in the next issue of *Ohio Geology*.

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DIVISION OF GEOLOGICAL SURVEY

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