WINTER 1991

Ohio Geology

a quarterly publication of the Division of Geological Survey

CAMPBELL HILL—OHIO'S SUMMIT

by Michael C. Hansen

Ohio is not known for its lofty heights—indeed, most tourists crossing the state, and perhaps most Ohioans, picture the area as one flat corn field after another. Those that have traveled the state are aware that southeastern Ohio has considerable relief, and most would assume that one of the higher hills in this region would lay claim to the title of highest point in Ohio. Surprise characterizes the reaction of many individuals upon learning that the highest point in the state is on the glaciated till plains of western Ohio, in Logan County near Bellefontaine.

Campbell Hill, Ohio's summit, is a singularly unimpressive hill, rising only 40 feet or so above its surroundings to an elevation of 1,549 feet. It is on the south side of Ohio Route 533, about a half mile east of U.S. Route 33, and is adorned with a series of small buildings and silos remaining from a former Air Force weather station. Currently, the hill is on the property of the appropriately named Hi-Point Joint Vocational School. However, Campbell Hill is only a small part of the story, because the hill owes its lofty distinction to the fact that it sits astride an upland known to geologists as the Bellefontaine outlier.

Campbell Hill, Ohio's highest point, is the small hill in the background. The hill is on the property of the Hi-Point Joint Vocational School.

An outlier, geologically speaking, is a surface exposure of rocks isolated from a main, continuous outcrop of similar rocks. The Bellefontaine outlier, which is an elongate body of Devonian rocks surrounded by older Silurian rocks, occupies central Logan County and northern Champaign County. The nearest outcrop of similar rocks is nearly 30 miles to the east. Nowhere else in the state is there an outlier that is so large or so far removed from its main outcrop belt.

Distribution of Devonian bedrock in Ohio. The Bellefontaine outlier is noticeably isolated from continuous outcrops of similar rocks.

The Bellefontaine outlier does not rise from the surrounding till plains like a mist-shrouded plateau from *Lost Horizon;* however, there is a noticeable increase in both relief and elevation as one approaches the area from any direction. The surrounding till plains are relatively flat, except for the hummocky surfaces of scattered recessional moraines, and mostly at an elevation of about 1,000 feet. Topography on the outlier is comparatively steep and many hills rise to 1,400 feet above sea level.

As the great glaciers of the Pleistocene Ice Age swept southward they encountered the topographic barrier presented by the Bellefontaine outlier and split into two lobes, the Miami lobe on the west and the Scioto lobe on the east. As the ice climbed over the upland, it deposited a thick layer of glacial sediment.

Interestingly, if Campbell Hill did not have this thick covering of glacial sediment it probably would not be the highest point in Ohio. Wilber Stout and George F. Lamb noted in their 1938 Ohio Journal of Science paper, "Physiographic features of southeastern Ohio," that Round Knob in Madison Township, Columbiana

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ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

George V. Voinovich, Governor • Frances S. Buchholzer, Director

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

ON THE DISSEMINATION OF GEOLOGICAL INFORMATION

At first glance of the title, readers of this article might say, "Oh boy, this is going to be a dull one!" I hope not. The state geological surveys and the U.S. Geological Survey have the fundamental responsibility of making the results of their work available to the citizens who have paid tax dollars to have it done. Maps showing the geology of an area must be made available to planners, homeowners, engineers, or miners who are considering any kind of change in land use such as construction, development, waste management, or mineral extraction. Reports describing the geology and mineral resources and providing chemical and physical analyses must be made available as well. Without the most up-to-date geologic information, terrible mistakes and unsafe land-use decisions will be made. Homes will be lost to landslides, water supplies will be damaged or destroyed, valuable mineral resources will be permanently excluded, and waste sites will become environmental nightmares. Millions and millions of tax dollars will be needed for remediation. ***It is my view that geologic maps and reports must be made available ASAP—AS SOON AS POSSIBLE!***

Geological surveys have a long-standing tradition of producing some of the most elegant and beautiful maps and reports imaginable. Geologists can rightly take great pride in producing a full-color geologic map of a county or quadrangle. They can take pride in seeing an accompanying 300-page comprehensive, printed report which includes treatment of every aspect of the geology. Unfortunately, those traditions are becoming out-of-touch with the crucial need for rapid geologic mapping and reporting—and the rapidly escalating cost of printing. The state geological surveys are moving toward publication and public release of information that avoid the long editorial, drafting, and printing delays that can sometimes add up to many, many years. Numerous surveys have embarrassing backlogs of maps and reports that should have been released in some other form so as to serve the taxpayers in a more timely manner. In addition to withholding valuable information from citizens, it is most distressing to survey geologists who have to wait years and years to see their work published. I can speak from personal experience, remembering that I am coauthor of a large geologic map and report awaiting publication at another state survey. I began the field investigations for that area back in 1973!

At the Ohio Division of Geological Survey, we are making big changes in the ways we get our geologic maps and reports to our constituents. For example, our large-scale (1:24,000) geologic quadrangle maps will no longer be disseminated as full-color printed maps. Our printing budget and limited editorial and cartographic staff no longer permit that kind of public release. These maps will now be released through a dynamic, open-file system wherein black-and-white copies can be purchased on demand for a minimal charge either over-the-counter or by phone order. The open-file masters are inked on scale-stable mylars which have the additional advantage that they can be revised and updated at any time as additional data are obtained by our geologists. The older, previous concept of full-color, printed maps tends to make them "set in concrete" with little opportunity for revision or updating. The smaller scale (1:100,000, 1:250,000, and 1:500,000 scale) maps used to show large areas and broad relationships serve as powerful regional or statewide planning tools. They are common as wall displays and will continue to be printed as full-color maps.

Written reports on specific areas and detailed analytical information will also be released to open file. Reports of broad scope and educational materials will be printed in traditional fashion and disseminated widely throughout Ohio and the nation. Furthermore, open-file releases of maps and reports will be announced through local and regional media as well as in *Ohio Geology*.

We are well into the GIS (geographic information system) age, and I predict that vastly increasing amounts of our Division's geologic-map and geologic-framework information will be released to the public as computer databases. Our geologic databases will interface with other Department of Natural Resources databases, other Ohio departmental databases, county and municipal databases, and the U.S. Geological Survey and other federal databases. The Division needs additional funding to arrive at optimal GIS capability, and we are working in that direction.

We hope our readers and our government policy-makers will appreciate the efforts we are making to streamline, accelerate, and economize in the dissemination of geologic information for Ohio. We will continue to prepare sound geologic maps and reports as we tighten our budgetary belts. *We are determined to fully and aggressively make the science of geology serve our citizens as expeditiously as possible.*

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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.

NEW ODNR DIRECTOR

The Division of Geological Survey welcomes Frances S. Buchholzer as the new Director of the Ohio Department of Natural Resources. Mrs. Buchholzer was appointed to this position, effective January 15, 1991, by Governor George V. Voinovich. She brings considerable experience and interest in natural resources to this position and a tremendous enthusiasm for the difficult tasks ahead.

Director Buchholzer is originally from Northfield, Summit County, where she grew up on a farm. She is a graduate of the University of Akron, where she obtained a bachelor's degree in English and education, and the University of Iowa, where she obtained a master's degree in geomorphology. Her graduate degree reflects her great interest in the geological and environmental sciences.

An extensive and varied involvement with natural-resources-related organizations has provided Mrs. Buchholzer with a unique perspective on the broad scope of responsibilities of the Ohio Department of Natural Resources. She is on the National Park Service Advisory Board and has been a member of the Water Management Association of Ohio, Ohio Air Quality Development Authority, and the National Advisory Council on Adult Education. Director Buchholzer also has served as Director of Environmental Affairs for the Ohio Petroleum Council and Director of State Government Relations for the B. F. Goodrich Company. In addition, from 1975 to 1979 she served on an Advisory Committee to the Director of the Ohio Environmental Protection Agency.

Director Buchholzer is married to Richard Buchholzer of Akron and has two children and one grandchild. Her hobbies include fly fishing, boating, camping, and hunting. She is a member of the Federation of Fly Fishing, Trout Unlimited, and Ducks Unlimited.

Mrs. Buchholzer looks forward to working with the Division of Geological Survey in the Survey's efforts to provide up-to-date geological maps and information to the citizens of Ohio. We welcome her leadership, interest, and support.

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County, reaches an elevation of 1,447 feet above sea level. Campbell Hill would not clear 1,400 feet if the present covering of 150 feet of glacial sediment were stripped from its summit.

ORIGIN OF THE OUTLIER

The sequence of events that eventually led to the formation of the Bellefontaine outlier began long ago, during the Devonian Period about 380 million years ago. At this time a warm, shallow, subtropical sea covered much of the area that is now Ohio, and limy mud was being deposited. This mud would later become the Columbus Limestone, a widespread rock unit that is extensively quarried throughout its outcrop belt in central and northern Ohio and on the Bellefontaine outlier.

The Columbus Limestone on the Bellefontaine outlier is succeeded by a dark-gray to black shale that was deposited in a relatively deep, stagnant sea that covered Ohio and adjacent areas later in the Devonian. This shale, known as the Ohio Shale, is noted for its high organic content and for the fossils of sharks and armored arthrodire fishes that lived in the oxygenated upper waters of the sea. Many of these fossils are found as the nuclei of distinctive spherical concretions that formed in the organic mud on the sea bottom.

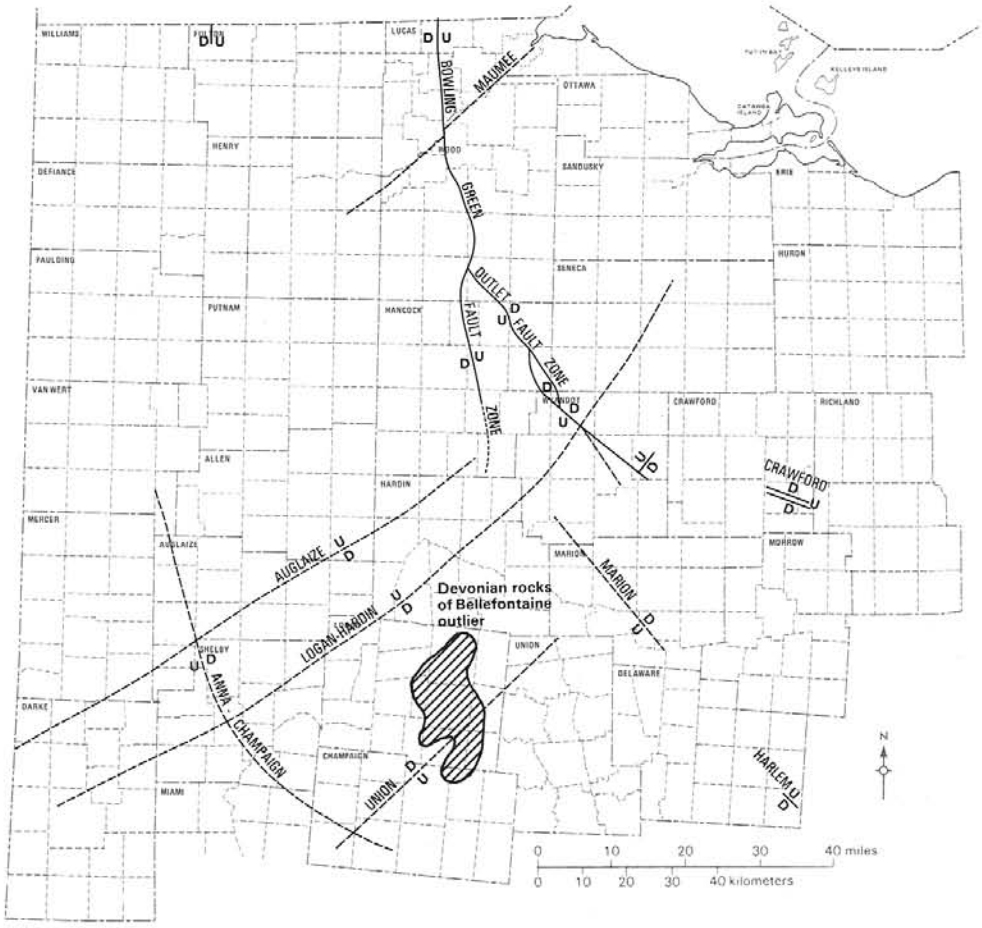
The Columbus Limestone seems to have eventually pinched out to the northwest as the shallow sea in which it was formed encountered a positive area known as the Cincinnati Arch. The Ohio Shale, on the other hand, appears to have formed in a sea of sufficient depth that it crossed the arch into northwestern Ohio and the Michigan Basin. The area of the outlier must have been a positive feature in Middle Devonian time because the Delaware Limestone and the Olentangy Shale, units that are present between the Columbus Limestone and the Ohio Shale to the east, are missing on the outlier. They were either never deposited or were removed during an interval of erosion after deposition of the Columbus Limestone.

It is possible that epeiric seas covering much of Ohio during the succeeding Mississippian and Pennsylvanian Periods deposited sediments in the area of the Bellefontaine outlier; however, later erosion through all of the Mesozoic Era and the Tertiary Period, a span of about 250 million years, removed any of these rocks that may have been deposited in the area. This erosion also stripped away most of the Devonian rocks in western Ohio, leaving only the Bellefontaine outlier and a narrow band of Devonian rocks in the extreme northwestern corner of the state. The outcrop pattern resulting from this erosion is readily apparent on the *Geologic map of Ohio;* older rocks are exposed along the axis of the Cincinnati Arch. The Bellefontaine outlier thus serves as the only record of the former extent of the Columbus Limestone and the Ohio Shale in western Ohio.

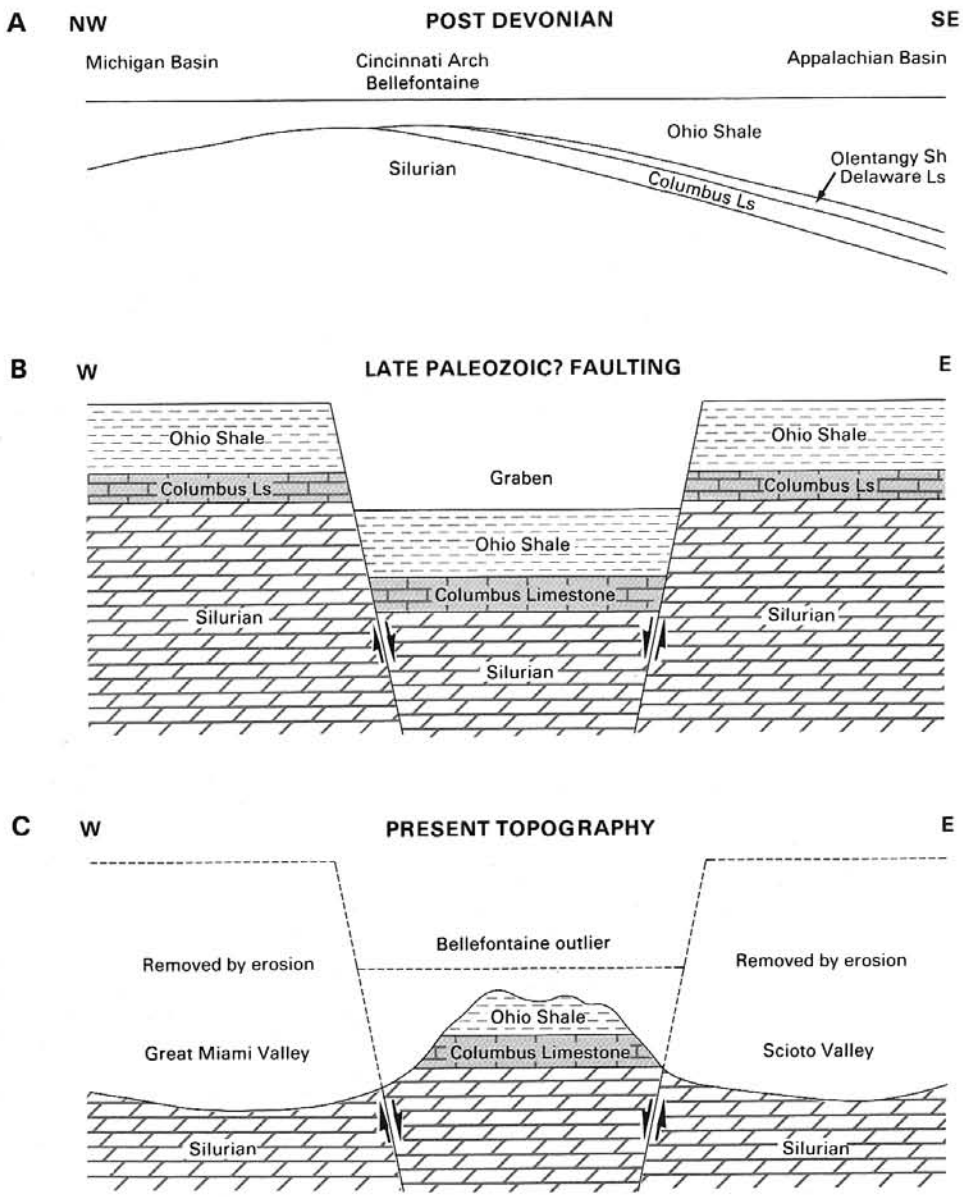
The Bellefontaine outlier could be viewed simply as an erosional remnant—a monadnock—that was left behind in its present location because of the vagaries of a long erosional history in the area, that is, streams followed paths that removed everything around it. This idea was favored by Guy-Harold Smith in a 1935 paper on the relative relief of Ohio. He stated "... it probably is a residual area that escaped erosion because of favorable location in respect to preglacial drainage rather than superior resistance of the underlying formations. The distance from preglacial streams, however, was no greater than for many other areas that were reduced." H. S. Sharp, in a 1932 paper, suggested that the Ohio Shale provided an erosion-resistant cap that maintained an area of moderate relief in an area of generally low relief. But are such scenarios oversimplifications? Does the presence of the Bellefontaine outlier indicate structural relationships that were developed long before the deposition of the rocks that now form the outlier? And why was the outlier preserved astride the Cincinnati Arch, a positive structural feature that has undergone significant erosion?

The answers to these questions are not immediately clear; however, there are structural aspects of the rocks in western Ohio, especially the deeply buried basement rocks, that have been recently discovered and should be considered in any evaluation of the origin of the Bellefontaine outlier. Such new discoveries have been achieved through the aeromagnetic map of Ohio (see *Ohio Geology,* Summer 1984) and the COCORP profile of Ohio (see *Ohio Geology,* Winter 1988).

These studies have demonstrated that in the basement rocks beneath the Bellefontaine area is a north-south-oriented structural feature known as the Grenville Front—a zone of thrust faulting that marks the edge of deformation of Precambrian rocks in eastern and central Ohio during a



Location of probable faults in northwestern Ohio and distribution of Devonian rocks of the Bellefontaine outlier. Solid lines indicate mapped faults; dashed lines indicate inferred faults. Modified from Wickstrom (1990).



Speculative model for origin of the Bellefontaine outlier. **A,** *Generalized northwest-southeast cross section of Ohio showing thinning of the Ohio Shale across the Cincinnati Arch and pinchout of the Columbus Limestone, Delaware Limestone, and Olentangy Shale.* **B,** *Proposed development of a graben in post-Devonian, possibly Late Paleozoic, time. A block of Silurian and Devonian rocks would have been downdropped relative to surrounding rocks.* **C,** *Cross section of the Bellefontaine outlier as it exists today showing present topography and distribution of rock units in relation to bounding faults of the proposed graben. The graben was initially a negative topographic feature but has now been exhumed by erosion to form a positive topographic feature. Diagrams are schematic and not drawn to scale.*

collision between two continental masses about a billion years ago. The Grenville Front divides the basement rocks of Ohio into younger Precambrian rocks to the east and older Precambrian rocks to the west. This structural front also marks the eastern edge of the Cincinnati Arch and rift zones that formed in late Precambrian time.

Recent subsurface mapping of the Trenton Limestone (Ordovician) in northwestern Ohio by Survey geologist Lawrence H. Wickstrom has suggested the presence of several previously unknown faults (in reality, complex fault zones) in the area and clarified the trend of several other hypothesized faults. These faults in Paleozoic sedimentary rocks are probably a reflection of basement faults associated with the Grenville Front and flanking rift basins. Although the location and extent of these faults are highly speculative because of sparse data, they do suggest an intriguing model for the origin of the Bellefontaine outlier.

The general area of the outlier is bounded on the north by the Logan-Hardin fault and on the south by the Union fault, although the suggested location of the Union fault cuts through the southern portion of the outlier. The block bounded by the faults, where most of the Bellefontaine outlier is located, is downdropped, forming a geological feature known as a graben. The age of this faulting is uncertain, but it is probable that the faults in the Paleozoic sedimentary rocks are a reflection of faulting in the Precambrian basement rocks. It is likely that such faults have been reactivated several times in response to crustal stresses generated by major episodes of movement and collision of crustal plates.

A scenario for formation of the Bellefontaine outlier might begin with active faulting in post-Devonian time downdropping a block in Logan County. It is uncertain whether later Paleozoic sediments blanketed the area and filled in the graben; however, the scenario would proceed with erosion during the Mesozoic and the Tertiary removing large amounts of rock from the Cincinnati Arch. Devonian and later rocks would have been stripped away, leaving Devonian rocks preserved in the down-dropped graben.

Continued erosion in preglacial time may have been concentrated in areas adjacent to the outlier in the regions now occupied by the Scioto and Great Miami Rivers. Several episodes of glaciation may have further deepened and eroded these flanking lowlands as the ice was deflected by the outlier and divided into separate lobes. Although the outlier was completely covered by comparatively thick ice (as much as 150 feet of till is preserved on the summit of the outlier), the erosive power of the glaciers was concentrated in the flanking lowlands, where ice would have been even thicker than on the outlier.

As erosion proceeded, the comparatively resistant Ohio Shale would be exposed only on the outlier, thus protecting weaker rocks beneath. Flanking areas would have been carbonates, which are less resistant to erosion and therefore would be eroded more quickly, leaving the shale-capped graben as a topographic high.

There is, of course, the possibility that the faults and the graben had little or nothing to do with the development of the Bellefontaine outlier. This unique feature could simply be a product of a long period of erosion stripping away younger rocks, leaving only the outlier, by chance, as a remnant of formerly more extensive beds. However, most geologic features are not products of random processes. They are where they are and have a specific configuration for very definite reasons, although such reasons are not always readily apparent. It seems unlikely that the graben and the outlier are mutually exclusive, that is, in the same area as a matter of pure coincidence.

This model of formation of the Bellefontaine outlier is highly simplified because in reality the faulting and erosional history are probably significantly more complex. Much more detailed work will be required to correctly evaluate the origin of this feature. New information and concepts on one aspect of geology commonly cause us to reevaluate our ideas on other aspects of the science. This is perhaps the case with the Bellefontaine outlier as we begin to realize that Ohio is not the structurally simple area that has been commonly perceived for so long.

ACKNOWLEDGMENTS

I thank Dr. Arie Janssens, consulting geologist, and E. Mac Swinford and Lawrence H. Wickstrom, Survey geologists, for their comments on this article.

FURTHER READING

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OHIO ACADEMY OF SCIENCE MEETING

The annual meeting of the Ohio Academy of Science (OAS) will be held on April 26-28, 1991, at The Ohio State University in Columbus. The 1991 meeting marks the centennial of the Academy. The Geology Section of the Academy is marking the 100th anniversary celebration by sponsoring a symposium, "Geology in the 21st Century." Invited speakers will address a variety of geological subjects ranging from the changing fields of the consultant and regulatory geologist to the utilization of computers to restudy the Teays River.

The geology symposium will take place at The Ohio State University on the afternoon of April 26th. The regular technical session of the Geology Section will be held on April 27th and will feature more than 40 oral presentations on a wide variety of geological topics. The Division of Geological Survey will co-host the field trip on April 28th. Tentatively, the trip will include a visit to the Survey's core repository as well as a visit to a local outcrop.

Additional information on the annual meeting and registration forms may be obtained from The Ohio Academy of Science, 445 King Ave., Columbus, OH 43201 (telephone 614-424-6045).

—Michael P. Angle
Vice President,
OAS Geology Section

DR. AURELE LAROCQUE, 1909-1990

It is with regret that we note the death of Dr. Aurele LaRocque on November 5, 1990, at the age of 81, at his home in Columbus. Dr. LaRocque was a professor of geology at The Ohio State University from 1948 until 1976, when he became Emeritus Professor in the Department of Geological Sciences.

Dr. LaRocque was known to many thousands of Ohioans through Survey Bulletin 54, *Ohio fossils,* which he coauthored with Mildred Fisher Marple in 1955. This publication is now in its 13th printing; nearly 60,000 copies have been sold in 35 years. Without question, Bulletin 54 has been the most popular Survey publication ever printed. Several generations of students received their first introduction to fossils and Ohio's geologic past through use of this bulletin.

Dr. LaRocque was born in Ottawa, Ontario, and received his primary, secondary, and undergraduate education there. For a period of 20 years he was employed as a museum assistant by the Geological Survey of Canada. He became an expert on Pleistocene and Recent mollusks and authored numerous papers on this topic. In 1945 he began graduate work at the University of Michigan, receiving the Ph.D. degree in 1948 and joining the faculty of the Department of Geological Sciences at The Ohio State University immediately thereafter.

Research on Pleistocene and Recent mollusks continued to be of intense interest to Dr. LaRocque during his tenure at The Ohio State University. He published numerous papers on these creatures, including Pleistocene mollusks from a number of Ohio sites. He founded, edited, and published *Sterkiana,* a journal devoted to the study of mollusks. In 1966, the Survey published the first of four parts of Bulletin 62, *Pleistocene Mollusca of Ohio.* The remaining three parts of this bulletin, each devoted to separate molluscan groups, apeared in 1967, 1968, and 1970, respectively. This comprehensive monograph serves as the definitive work on Pleistocene mollusks in Ohio and many other areas of the country.

Many theses on Ohio geology were carried out under the direction of Dr. LaRocque, and he served as an inspiring teacher until his retirement in 1976. He is survived by his wife, Jeanette. Dr. LaRocque will be missed by his many friends and colleagues, but his important research will continue to be of service to present and future generations of Ohio geologists.

—Michael C. Hansen

OHIO MINERALS ARTICLE AVAILABLE

The Survey has for sale a limited supply of the November/December 1990 issue of *Rocks & Minerals* magazine, which contains a 28-page article on Ohio mineral localities. The article, "Ohio mineral locality index, Findlay Arch and Serpent Mound districts," was authored by Dr. Ernest H. Carlson of the Department of Geology at Kent State University. Dr. Carlson has studied the occurrence of minerals in Ohio for a number of years and has prepared an extensive report on this topic for publication by the Survey. This book, *Minerals of Ohio,* will be available in spring 1991.

Dr. Carlson's article in *Rocks & Minerals* magazine is profusely illustrated with 67 figures, most of which are photographs of mineral specimens and localities. Included are four color plates of Ohio mineral specimens. Twenty-eight localities are described.

Copies of this issue of *Rocks & Minerals* magazine are available from the Survey for $5.48, which includes tax and mailing.

OUT-OF-PRINT SURVEY PUBLICATIONS

The Division of Geological Survey would welcome the donation of older, out-of-print Survey publications, especially volumes from the Newberry and Orton Surveys of the last century and bulletins from this century. These publications are needed for use by staff and by researchers who visit the Survey. Please contact Merrianne Hackathorn in care of the Survey (telephone: 614-265-6590).

ANGELENA M. BAILEY 1990 SURVEY EMPLOYEE OF THE YEAR

Angelena M. Bailey, an Administrative Assistant in the Subsurface Stratigraphy and Petroleum Geology Section, was named the 1990 Employee of the Year in ceremonies held in conjunction with the Survey's annual Christmas luncheon. This award recognizes superior efforts and contributions by an employee and has special significance because awardees are selected from nominations submitted by fellow employees.

Angie, who has been with the Survey since 1978, functions as the office manager of the Subsurface Section. She is known for her dedication, dependability, accuracy, and courteous manner to both the public and other Survey employees. Angie deals with a myriad of administrative and public-service tasks and can always be counted on to do the job effectively. She is an expert on several word-processing programs and has taught a course on word processing to Survey employees. Angie has also been active in many charitable causes, including serving as Division coordinator for the ODNR blood-donor drives.

Angie lives in Westerville and has two daughters. She enjoys camping, crafts, reading, and walking as hobbies.

Angie Bailey receives 1990 Employee of the Year award from Division Chief Thomas M. Berg.

NORTH-CENTRAL GSA MEETING IN TOLEDO

The University of Toledo will host the 25th annual meeting of the North-Central Section of the Geological Society of America on April 18-19, 1991. In addition to numerous technical papers on a wide variety of topics, there will be postmeeting field trips and eight symposia including the geology of radon, Quaternary paleoecology of the lower Great Lakes, tectonics of the northern Cincinnati Arch, educational services of state geological surveys and museums, Quaternary time classification in the Great Lakes region, consultants' techniques in environmental investigations, Silurian systems of cratonic North America, the biological underpinning of global diversity trends, scientific drilling and geophysical investigation in the midcontinent, and utilization of high-sulfur coals of the eastern United States.

Registration forms and additional information on this meeting can be obtained from the Department of Geology, University of Toledo, Toledo, OH 43606 (telephone: 419-537-2009).

OHIO'S MINERAL INDUSTRIES TEACHERS WORKSHOP

Are you a teacher who wants to learn about the mining industries in Ohio? Then the fifth annual Ohio's Mineral Industries Teachers Workshop is for you. The workshop is conducted by the Division of Geological Survey and the University of Akron and carries two semester hours of graduate credit. The 1991 workshop will be held July 8-12.

The purpose of the workshop is to familiarize participants with the geology of Ohio and the development of mineral industries in the state so that teachers can more effectively communicate this information to their students. Teachers will hear representatives from research, industry, and regulatory agencies present information on the geologic origin, economics, and regulation of mineral resources in the state. Three days of field trips give teachers a firsthand look at the operations of various mineral industries in Ohio.

For more information on the 1991 Ohio's Mineral Industries Teachers Workshop, contact Dr. Jim L. Jackson, University of Akron, 4570 Akron-Peninsula Rd., Peninsula, OH 44264 (telephone 216-657-2815 or 216-972-7991), or Sherry W. Lopez, ODNR, Division of Geological Survey, 4383 Fountain Square Dr., Columbus, OH 43224-1362 (telephone 614-265-6588).

—Sherry W. Lopez
Mineral Resources and
Geochemistry Section

SURVEY COMPLETES SECOND NCRDS GRANT

The Division of Geological Survey recently completed a cooperative agreement with the U.S. Geological Survey to enter coal stratigraphic data for Belmont County into the National Coal Resources Data System (NCRDS). The NCRDS is made up of two interactive subsystems—one to store the raw coal data and another to create contour plots and to estimate coal tonnages for an area. For this second NCRDS grant, 715 coal locations and stratigraphic descriptions were formatted for encoding into the NCRDS. This year's project has concentrated on entering coal data for Belmont County—the largest coal-producing county in Ohio.

Eventually, the Division of Geological Survey will establish a telecommunication link with the NCRDS in Reston, Virginia. When this task is completed, the coal data will be edited and used to construct preliminary maps for calculating coal reserves in Belmont County.

—Richard W. Carlton
Mineral Resources and
Geochemistry Section

SURVEY PRODUCES GEOLOGIC QUADRANGLE MAPS

As part of the Survey's effort to produce a new state geologic map (see *Ohio Geology*, Spring 1990), Division geologists are inking geologic contacts and other geologic information on mylar copies of U.S. Geological Survey 7½-minute (1:24,000) topographic quadrangle maps or on overlays. As they are completed, these maps are placed on open file in the Regional Geology Section of the Survey. Paper copies can be reproduced on a blueline copier for public distribution.

These quadrangle maps provide geologic information in many areas of the state that have not been previously mapped. Types of information available include bedrock geology, bedrock topography, and structure contours. In the interest of quickly providing this information to the public, much of the mapping is on a reconnaissance basis and therefore subject to future revision and refinement. Reproduction by blueline copier makes the information available to the public soon after the geologist completes the mapping.

Blueline copies of the quadrangle maps listed below are now available from the Survey for $5.48 per map, which includes tax and mailing. Add $1.00 per order for mailing in a tube. Please order by quadrangle name and map title. An index to topographic quadrangle maps in Ohio is available at no charge from the Survey. New maps produced in this series will be listed in future issues of *Ohio Geology*.

Alliance *(Columbiana, Mahoning, Portage, and Stark Cos.)* bedrock geology; bedrock topography; structure contours on base of Lower Mercer limestone; structure contours on base of two uppermost coal beds in Clarion coal zone; structure contours on base of Putnam Hill-Vanport marine complex; structure contours on base of Lower Kittanning coal bed; structure contours on base of Middle Kittanning coal bed.

Batavia *(Clermont Co.)* bedrock geology; bedrock topography; structure contours on top of Bellevue Member of Grant Lake Formation; structure contours on top of Fairview Formation; structure contours on top of Kope Formation.

Bethel *(Brown and Clermont Cos.)* bedrock geology; bedrock topography; structure contours on top of Corryville Member of Grant Lake Limestone; structure contours on top of Fairview Formation; structure contours on top of Bellevue Member of Grant Lake Limestone.

Big Plain *(Madison Co.)* bedrock topography.

Delaware *(Delaware Co.)* bedrock geology.

East Palestine *(Columbiana Co.)* bedrock geology; bedrock topography; structure contours on base of Mahoning coal; structure contours on base of Upper Freeport coal; structure contours on base of Brush Creek marine zone; structure contours on base of Lower Kittanning coal.

Florence *(Clark and Madison Cos.)* bedrock topography.

Glendale *(Butler and Hamilton Cos.)* bedrock geology; bedrock topography; structure contours on base of Fairview Formation and Kope Formation (Hamilton Co. portion); structure contours on base of Bellevue Member and Corryville Member of Grant Lake Formation (Hamilton Co. portion); structure contours on base of Mount Auburn Member of Grant Lake Formation and Waynesville/Arnheim undifferentiated (Hamilton Co. portion); structure contours on base of Miamitown Shale (Hamilton Co. portion).

Goshen *(Clermont Co.)* bedrock geology; bedrock topography; structure contours on top of Kope Formation; structure contours on top of Corryville Member and Straight Creek Member of Grant Lake Limestone; structure contours on top of Fairview Formation; structure contours on top of Bellevue Member of Grant Lake Limestone.

Harrison *(Butler and Hamilton Cos.)* bedrock geology; bedrock topography; structure contours on base of Fairview Formation and Kope Formation (Hamilton Co. portion); structure contours on base of Grant Lake Formation and Miamitown Shale (Hamilton Co. portion); structure contours on base of Mount Auburn Member of Grant Lake Formation and Arnheim/Waynesville undifferentiated (Hamilton Co. portion).

Homeworth *(Columbiana and Stark Cos.)* bedrock geology; bedrock topography; structure contours on base of Putnam Hill-Vanport marine zone; structure contours on base of No. 5 coal bed; structure contours on base of No. 6 coal bed; structure contours on base of No. 6A coal bed and Brush Creek (?) marine zone; structure contours on top of No. 7 coal bed/Allegheny-Conemaugh contact.

London *(Madison Co.)* bedrock topography.

Magnetic Springs *(Union Co.)* bedrock geology.

Milford Center (NE portion only) *(Union Co.)* bedrock geology.

New Middletown *(Columbiana and Mahoning Cos.)* bedrock geology; bedrock topography; structure contours on base of Lower Mercer marine zone; structure contours on base of Vanport marine zone; structure contours on base of Lower Kittanning coal bed; structure contours on base of upper and lower coals of Middle Kittanning coal zone; structure contours on base of Lower Freeport coal bed; structure contours on base of Upper Freeport coal bed.

Newtonsville *(Brown and Clermont Cos.)* bedrock geology; bedrock topography; structure contours on top of Fairview Formation; structure contours on top of Bellevue Member of Grant Lake Formation; structure contours on top of Corryville Member of Grant Lake Limestone; structure contours on top of Straight Creek Member of Grant Lake Formation.

Ostrander *(Delaware Co.)* bedrock geology.

Prospect *(Delaware and Marion Cos.)* bedrock geology.

Richwood *(Union Co.)* bedrock geology.

Salineville *(Carroll, Columbiana, and Jefferson Cos.)* bedrock geology; bedrock topography; structure contours on base of Lower Freeport coal; structure contours on base of Upper Freeport coal; structure contours on base of Mahoning coal; structure contours on base of Brush Creek marine zone; structure contours on base of Ames limestone.

Shandon *(Butler and Hamilton Cos.)* bedrock geology (Hamilton Co. portion); bedrock topography (Hamilton Co. portion); structure contours on top of Point Pleasant Tongue of Clays Ferry Formation (Hamilton Co. portion); structure contours on top of Kope Formation (Hamilton Co. portion); structure contours on base of Miamitown Shale (Hamilton Co. portion); structure contours on base of Grant Lake Formation (Hamilton Co. portion); structure contours on top of Mount Auburn Member and Corryville Member of Grant Lake Formation (Hamilton Co. portion).

Vienna *(Clark and Madison Cos.)* bedrock topography.

Waldo *(Delaware, Marion, and Morrow Cos.)* bedrock geology.

Walnut Run *(Madison Co.)* bedrock topography.

West Jefferson *(Madison Co.)* bedrock topography.

Williamsburg *(Brown and Clermont Cos.)* bedrock geology; bedrock topography; structure contours on top of Kope Formation; structure contours on top of Fairview Formation; structure contours on top of Bellevue Member of Grant Lake Limestone; structure contours on top of Corryville Member and Straight Creek Member of Grant Lake Limestone.

SURVEY STAFF NOTES

William R. Dunfee

Mark E. Clary

Bill Dunfee is Assistant Driller on the Survey's Mobile B-61 core-drilling rig. Bill assists in the operation and maintenance of the rig and support vehicles and is responsible for boxing and labeling core. During lulls in drilling projects, he also works in the Survey's core storage facility.

Bill joined the Survey's drilling team in 1986 after working in the oil fields of Ohio. He particularly enjoys the opportunity to be outdoors during drilling projects.

Frazeysburg is now home to Bill and his wife and two children. He is originally from Warsaw. His hobbies include hunting, fishing, and softball.

Mark Clary is Assistant Driller on the Survey's Longyear Hydro-44 core-drilling rig. In addition to the many duties associated with maintenance and operation of the rig, Mark assists with operation of the Survey's core-storage facility.

Mark came to the Survey in 1986 after 10 years of drilling experience in the Ohio oil fields. He enjoys being outdoors and the spirit of cooperation among Survey employees.

Mark is originally from Cambridge and now resides there with his wife and two children. They recently built a new house. Mark likes outdoor activities, especially stock-car racing and hunting.

DR. TOM DUTRO TO AID SURVEY'S COGEOMAP EFFORT

Dr. Tom Dutro of the U.S. Geological Survey Branch of Paleontology and Stratigraphy in Washington, D.C., will be sharing his expertise in Silurian biostratigraphy with the Ohio Geological Survey. His knowledge will help facilitate the generation of a new bedrock geology map of the state to be produced by the Ohio Geological Survey. The work will be performed under a cooperative geologic mapping agreement (COGEOMAP) between the Ohio Geological Survey and the U.S. Geological Survey (USGS). The Ohio Survey has received a $50,000 grant from the USGS COGEOMAP fund to assist with the study. Dr. Dutro visited the Ohio Survey last summer to meet with geologists participating in the mapping project and discuss how he might contribute to the program.

After meeting with Survey geologists, Dr. Dutro and several staff geologists visited selected quarries in west-central Ohio during a two-day field trip. Bedrock exposures in these quarries allowed field-trip participants to view a nearly complete stratigraphic sequence of the Silurian-age rocks which will be encountered during the first year of the COGEOMAP initiative. The rocks exposed in the quarries visited were the focus of stimulating geologic discussions on how to approach some of the difficult problems with correlation, regional relationships, facies changes, and nomenclature to be encountered in mapping these rocks.

Attending the field trip along with Dr. Dutro were staff geologists Dennis Hull, Ernie Slucher, Glenn Larsen, Greg Schumacher, Doug Shrake, Joel Vormelker, and Mac Swinford of the Regional Geology Section and Dave Stith of the Mineral Resources and Geochemistry Section. The field trip included visits to quarries in Miami, Darke, Mercer, Auglaize, and Allen Counties Ohio, and Wayne County, Indiana. The attendees agreed the field trip was beneficial and are anticipating a successful COGEOMAP program between the U.S. Geological Survey and the Ohio Geological Survey.

QUARTERLY MINERAL SALES, JULY—AUGUST—SEPTEMBER 1990

compiled by Sherry W. Lopez

Commodity	Tonnage sold this quarter[1]	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	7,802,472	155	$232,737,062
Limestone/dolomite[2]	14,121,280	100[3]	54,398,285
Sand and gravel[2]	13,235,989	172[3]	45,669,526
Salt	903,825	5[4]	8,976,766
Sandstone/conglomerate[2]	487,062	21[3]	6,954,723
Clay[2]	240,101	21[3]	720,303
Shale[2]	180,175	14[3]	331,595
Gypsum[2]	51,978	1	493,791
Peat	4,193	1	18,743

[1]These figures are preliminary and subject to change.
[2]*Tonnage sold* and *Value of tonnage sold* include material used for captive purposes. *Number of mines reporting sales* includes mines producing material for captive use only.
[3]Includes some mines which are producing multiple commodities.
[4]Includes solution mining.

The Survey thanks Greg Klosterman and Ken Coates of American Aggregates Corp., Don Jolly of National Lime & Stone Co., and Ross Donovan of Piqua Minerals for permitting access to the quarries.

—E. Mac Swinford
Regional Geology Section

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OHIO DEPARTMENT OF NATURAL RESOURCES
DIVISION OF GEOLOGICAL SURVEY

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