

Ohio Geology

A Quarterly Publication of the Division of Geological Survey

Summer 1995

A COAL-MINING HISTORY OF OHIO

by Michael C. Hansen

Coal is entitled to be considered as the mainspring of our civilization. By the power developed in its combustion, all the wheels of industry are kept in motion, commerce is carried with rapidity and certainty over all portions of the earth's surface, the useful metals are brought from the deep caves in which they have hidden themselves, and are purified and wrought to serve the purposes of man. By coal, night is in one sense converted into day, winter into summer, and the life of man, measured by its fruits, greatly prolonged. Wealth, with all the comforts, the luxuries and the triumphs it brings, is its gift. Though black, sooty and often repulsive in its aspects, it is the embodiment of a power more potent than that attributed to the genii in oriental tales. Its possession is, therefore, the highest material boon that can be craved by a community or nation. Coal is also not without its poetry. It has been formed under the stimulus of the sunshine of long past ages, and the light and power it holds are nothing else than such sunshine stored in this black casket, to wait the coming and serve the purposes of man. In the process of formation it composed the tissues of those strange trees that lifted their scaled trunks and waved their feathery foliage over the marshy shores of the carboniferous continent, where not only no man was, but gigantic salamanders and mail-clad fishes were the monarchs of the animated world.

John Strong Newberry, Second State Geologist of Ohio, 1871, Report of Progress of the Geological Survey of Ohio in 1869, p. 33

Coal, perhaps more than any other commodity, has been of integral importance in the industrial development of Ohio and the nation. By the time of Newberry's tenure as State Geologist of Ohio, the state was well into the Industrial Revolution and coal was the principal energy source for the mills and manufacturing plants that stretched from the Ohio River to Lake Erie. The preeminent position occupied by coal would continue for many decades as it became, in the 20th century, the primary fuel for generating electricity. Today, coal is still of vital importance, producing 90 percent of Ohio's electrical power.

The fascinating story of Ohio coal, the miners who extracted it, and the equipment they used has been told in a new book issued by the Division of Geological Survey. This 204-page volume was assembled and written by Douglas L. Crowell, Survey geologist and supervisor of the Coal Geology Group. He tells the coal-mining story with the aid of 186 photographs, 27 drawings, and 9 maps, gathered from photo archives and personal collections. These historic photographs chronicle every aspect of coal mining in Ohio for more than a century and picture the miners at their daily labor and in many other aspects of their lives.

This abundant fossil fuel was not easily won from beneath the hills in eastern Ohio, and it took the efforts of generations of hardy individuals to dig the black rock from narrow shafts, using at first



Miners waiting to start the afternoon shift at the Hanna Coal Company Piney Fork No. 1 mine in 1943. During World War II this drift mine near Smithfield, Jefferson County, employed more than 1,000 men and was one of the country's leading coal producers. It was abandoned in 1959. Photo courtesy of the Ohio Department of Natural Resources, Division of Reclamation, from the Dale Davis collection.



The novelty of smoke rising through fissures in the ground and heat sufficient for cooking radiating from an underground coal-mine fire brought tourists to New Straitsville, Perry County. Tour companies, such as Underground Fires, Inc., and Subterranean Fires Company, competed so fiercely for business that they required armed guards to protect their attractions. Undated photo courtesy of The Plain Dealer.

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Thomas M. Berg, Division
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Ohio Geology

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From The State Geologist...

Thomas M. Berg

THE FUTURE OF TOPOGRAPHIC MAPS

After almost four decades of studying topographic maps in connection with geology, I still enjoy poring over these highly accurate, two-dimensional renditions of Earth's surface. The contoured hills and valleys, ridges and cliffs, or coastal bluffs and glaciated landforms tell fascinating and detailed stories in Earth history. Most importantly, these representations of our land surface provide essential geographic information for planners, farmers, engineers, hikers, developers and builders, geologists, communication businesses, architects, miners, teachers, drillers, land-use policy makers, surface- and ground-water investigators, legislators, foresters, defense authorities, recreation-facility designers, waste-management officials, hunters, transportation managers, fishers, law-enforcement officers, archaeologists, tax assessors, emergency-management authorities, surveyors, pipeline and powerline industries, wildlife managers, historians, mineral and fossil collectors, and many more. The list goes on and on. I also expect that the use of topographic maps would greatly increase if those who enjoy outdoor recreation activities were fully aware of the wonder and power of these maps.

For the geologist, topographic maps are indispensable. Bedrock geology and surficial materials are mapped using topographic base maps. Even deep subsurface mapping and geophysical mapping require topographic base-map information. The most accurate and commonly used topographic maps in the United States are the 1:24,000-scale (1 inch equals 2,000 feet) quadrangle maps produced by the United States Geological Survey (USGS). Individual quadrangles include areas bounded by 7.5 minutes of latitude and longitude and covering approximately 57 square miles. These maps show political boundaries and cultural features, coordinate and survey grid systems, rivers, streams, and lakes, forested areas, transportation routes, and the contoured land surface. The quadrangle maps are updated on a regular basis by the USGS.

Historically, the Ohio Geological Survey and the Ohio Department of Transportation have cooperated with the USGS in the production of topographic maps for our state, and Ohio was the first state in the nation to have full coverage by 1:24,000-scale quadrangle maps. Today, a new effort is under way at the Center for Mapping at The Ohio State University to digitize all of the state's 7.5-minute quadrangles so that they can be used in computerized geographic-information-system (GIS) applications. This massive project called Geographic Information from Scanning Ohio's Maps (GISOM) involves partnerships among the Center for Mapping, the USGS, and several state departments including the Ohio Department of Natural Resources. It is hoped that Ohio will be the first state in the nation to have full digital topographic-map coverage. This massive digital database will be used in countless geoscientific analyses by organizations like the Ohio Geological Survey and will save taxpayers enormous costs when compared to older hand calculations. At some time in the future, I can also envision ordinary everyday users like those listed above carrying digital map displays in the field to conduct all kinds of investigations.

However, a major concern for the immediate future of the broad spectrum of our customers is that they continue to have the paper versions of USGS topographic maps available to them until the digital versions are fully in place and are as economically accessible as the paper copies. At the 1995 annual meeting of the Association of American State Geologists (AASG), this issue was discussed at some length, and there was serious concern expressed by most state geologists that production of the paper topographic maps might be diminished during program cutbacks at the USGS. A formal resolution was passed by the AASG strongly encouraging the U.S. Department of Interior through the USGS to continue providing 1:24,000 topographic maps in their current form for citizens of the United States until such time that it can be clearly demonstrated that digitally generated maps can be readily accessed and utilized by the entire population in an efficient and effective manner.

New page-size glacial map available

The Division of Geological Survey has produced a new page-size version of the glacial deposits of Ohio map that incorporates recent, more detailed mapping of glacial deposits by the late Richard P. Goldthwait and Richard R. Pavey and other Division geologists. Particularly noticeable on the new map are outwash and lake deposits in the unglaciated southeastern portion of the state. Although recessional moraines of Wisconsinan age have the same general configuration on the new map, many details have been added.

The page-size map, assembled by Deputy State Geologist Dennis N. Hull, is intended only as a generalized portrayal of the distribution of glacial deposits. The data from which the page-size map was compiled are available on black-and-white open-file maps at a scale of 1:250,000. Contact the Division for ordering information on these maps.

The page-size glacial deposits of Ohio map is available from the Division of Geological Survey for 10 cents each. Contact the Survey for tax and mailing charges on quantity orders of this map.

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In 1934, while working in the Megan mine near Cadiz, Ida Mae Stull was found in violation of an old Ohio law that forbade women from engaging in "dangerous" occupations. A court ruling later allowed her to return to her chosen profession. A 1977 article by Sue Gorisek in the *United Mine Workers Journal* gave Stull's description of mining: "First you hack yourself a portal in the side of a hill, bracing it with sturdy timbers of oak and locust. You dig 300 feet below the earth, exposing the vein of prized fuel as you go. To loosen the stubborn rock, you drill a hole, needle in the treacherous black powder, light the squib and while the fuse burns, dancing and jumping crazily—you run out of the mine to wait for the blast." Photo circa 1935, courtesy of Dale Davis.

only pick and shovel. Many miners paid the supreme price from mining accidents. Towns sprang up around the mines, and the miners and their families formed tight-knit communities, commonly living in homes and shopping in stores owned by the mining company. Many of these mining towns still exist in eastern Ohio, although the mines have long since closed.

At the time of Newberry's report, coal production was slightly more than 3 million tons per year, all of it from underground operations. Employment figures are not available from this time of poor record keeping, but by 1884, the first year such figures are available, more than 20,000 Ohioans were laboring to bring coal out of the ground. By 1908, more than 50,000 miners were producing more than 26 million tons of coal per year from 1,051 underground mines. In 1918, during World War I, production reached nearly 48 million tons, produced by more than 50,000 miners from 1,427 mines, most of them deep mines. However, nearly 3 million tons of this production was from surface mines, a harbinger of the future trend in coal mining.

It was not until 1968 that the 1918 production of 48 million tons was again matched. Only two years later, in 1970, Ohio's all-time-high annual coal production of 55 million tons was achieved. Significantly, this record production of coal was from 326 mines that employed a total of 8,466 miners. By this time the balance of underground versus surface mines had changed drastically—there were only 52 underground mines but 274 surface operations. By 1994, after more than two decades of restrictions on burning high-sulfur coal, Ohio production had dropped to 28.6 million tons, a level comparable to that of the early 1940's. Employment in 1994 was 4,049 miners at 192 mines, only 10 of which were underground.

Statistical portrayals of Ohio's coal-mining history are valuable and necessary, and Doug Crowell has stacked his book with detailed and pertinent



Group of miners and several mules at the entrance of the Marchesi mine, about 2.5 miles south of New Philadelphia, Warwick Township, Tuscarawas County. This drift mine of the Marchesi Coal Company mined a 4-foot-thick seam of Middle Kittanning (No. 6) coal. It was abandoned in 1941. Undated photo courtesy of the Tuscarawas County Historical Society.



Early 1900's view from the coal tippie of the Big Five Coal Company looking south across McMahon Creek toward the drift openings of the Big Five coal mine, located near Stewartsville, Richland Township, Belmont County. This mine was abandoned in 1935. Photo courtesy of the Ohio Historical Society, Jeffrey Mining Equipment collection.

statistical information. But statistics do not give the flavor of the mining operations nor of the miners who made production statistics possible. Crowell's bulletin, through its text and particularly its photographs, provides this flavor. Statistics become secondary to the portraits of miners and mining operations that highlight each page. The illustrations span a period of more than 130 years and show mines, tipples, mining equipment, mining towns, animals used in the mines, transportation equipment such as wagons, steamboats, and railroads, as well as the miners themselves.

This volume, Bulletin No. 72, *History of the coal-mining industry in Ohio*, is available from the Division of Geological Survey for \$12.00 plus \$3.00 mailing; orders to Ohio addresses must include 5.75 percent tax (\$0.69). Credit-card (Visa or MasterCard) orders may be placed by calling 614-265-6576.

Mather Medal awarded to Horace R. ("Buzz") Collins

Horace R. ("Buzz") Collins, former State Geologist and Chief of the Ohio Division of Geological Survey, is the 1995 recipient of the Mather Medal of the Ohio Geological Survey. The Mather Award, named for Ohio's first state geologist, William W. Mather (1837-1838), is given to an individual who has made an outstanding contribution to the advancement of knowledge of Ohio geology. The medal was presented to Buzz by current Division Chief and State Geologist Thomas M. Berg at a special ceremony held at the Survey on June 6, 1995.

Collins was awarded the Mather Medal for his contributions to the geology of Ohio during his 30-year career with the Division of Geological Survey; for 20 of those years he served as State Geologist and Division Chief (1968-1988). Buzz is a man of few words who devoted his career to advancing the understanding of Ohio's geology to improve the lives of the citizens of Ohio whom he served.



Horace R. Collins (right) receives Mather Medal from Division Chief Thomas M. Berg during ceremonies held at the Survey offices on June 6, 1995.

Buzz received a Bachelor of Science degree in geology from Ohio University in 1954. He then served two years with the U.S. Army, Corps of Engineers, attending officer and aviation schools. Following his military service Buzz entered

graduate school at West Virginia University, where he received a Master of Science degree in geology.

Buzz joined the staff of the Division of Geological Survey in 1959. He was assigned to the Coal Geology Section, where the field description and mapping of coals were his primary responsibility. Buzz became Supervisor of the Coal Geology Section in 1960, Head of the Areal Geology Section (of which the Coal Geology Section was a part) in 1963, Assistant Chief of the Division in 1966, and Division Chief and Ohio's 10th State Geologist in 1968.

When Buzz assumed the position of Chief, there were approximately 20 people on the staff and an annual budget of just over \$150,000. In the ensuing 20 years, the Division grew to approximately 60 people and an annual budget of almost \$3 million. Along with staff and budget increases, Buzz was able to initiate and complete many major programs and projects during his tenure; the most notable are described below.

In 1971, Buzz acquired funding for a Geochemistry Laboratory, which gave the Division the capability of performing many types of inorganic chemi-

cal analyses. Many important projects were carried out in this lab, including analyses of coal, industrial minerals, and brines.

In response to the energy crisis of the 1970's, Buzz began a coal-characterization program that continues to this day. The program was geared to developing data on deep, unmined, low-sulfur coal resources as well as a detailed database on the chemical composition and physical properties of Ohio coal.

To complete the coal-resource studies, core drilling was necessary. Contract drilling was expensive, so Buzz acquired monies to purchase the Survey's first core-drilling rig and hire a drilling crew. The drilling program was so successful that two more drill rigs were purchased and another drilling crew was hired.

The accumulation of core samples and sample cuttings (rock chips from rotary drilling) necessitated a core repository for storage and retrieval for Division and public use. Under Buzz's direction a warehouse was leased for this purpose. A petrographic laboratory with sophisticated imaging equipment for thin-section analyses of the core also was created.

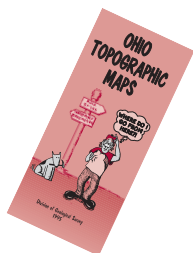
Buzz secured funding for many major studies that not only greatly expanded our knowledge of Ohio geology, but also brought the Division through financial challenges. Examples of these programs are the U.S. Department of Energy Eastern Gas Shales Project, coal washability program, Gas Research Institute Devonian-shale gas study, deep-coal studies, and the abandoned-underground-mines inventory.

However, the most important program implemented by Buzz was the Statewide County Mapping Program. The goal of this program, undoubtedly one of the most important ever initiated during the Survey's history, was to develop detailed maps and reports on the geology and mineral resources of each county in Ohio. Buzz's tireless campaigning led to passage of the enabling legislation for the mapping program in 1981. This legislation allocated a portion of the severance taxes paid by mineral producers to support mapping activities. The long-term benefits from these accomplishments are immense.

In 1985, Buzz also initiated the highly acclaimed Ohio's Mineral Industries Teachers Workshop, run in conjunction with the University of Akron. At the time, the workshop was one of only a few in the nation that promoted the importance of geology and a positive image of mineral industries with the public.

The Division of Geological Survey is honored to have such a devoted geologist and public servant as a Mather Medalist.

—Sherry L. Weisgarber and Robert G. Van Horn



Topographic map brochure and index

The Division has published a new brochure on Ohio topographic maps. The text of the brochure describes many types of information and uses of topographic maps and includes prices and ordering information. The reverse side of the brochure is an index to the 7.5-minute (1:24,000) quadrangles that cover the state. To obtain a copy of this free brochure, please contact the Geologic Records Center at 614-265-6576, or write to the Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362.

Bedrock geology of the Bellefontaine quadrangle available

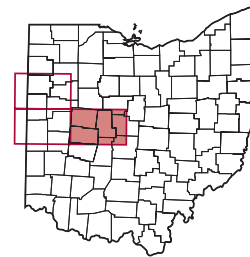
The Division of Geological Survey has published the third map in a series of full-color bedrock geology maps covering the state at a scale of 1:100,000 (1 inch represents about 1.5 miles). The Piqua and Lima 30 x 60 minute quadrangles were published previously. Survey geologists E. Mac Swinford and Ernie R. Slucher prepared this new map, Map No. 8, titled *Regional bedrock geology of the Bellefontaine, Ohio, 30 x 60 minute quadrangle*.

The new map is the first detailed bedrock geology map for this part of west-central Ohio since the 1870's and includes all or portions of Auglaize, Champaign, Clark, Delaware, Franklin, Madison, Marion, Morrow, and Union Counties. Rocks depicted on the map range from Upper Ordovician through Upper Devonian. Their characteristics are described in detail in the map explanation and columnar section. A separate columnar section is given for the Bellefontaine Outlier, a unique area of

Silurian and Devonian rocks in Logan and Champaign Counties.

The extensive text accompanying the map describes, in addition to the bedrock units, the general geology and economic and environmental geology of the area. Accompanying illustrations show the regional structural contours and the bedrock topography of the quadrangle. An extensive list of references is included. This map, and others in the series, are an important resource for the location, development, and protection of mineral resources; the siting of landfills, school, hospitals, highways, and other public and private facilities; and for planning and zoning activities.

Map No. 8 is available from the Division of Geological Survey for \$12.00 plus \$3.00 mailing; orders to Ohio addresses must include 5.75 percent tax (\$0.69). Credit-card (Visa or MasterCard) orders may be placed by calling 614-265-6576.



Location of Bellefontaine 30 x 60 minute quadrangle and previously published maps (Piqua and Lima).

FOSSIL FISH FOUND IN AMERICAN AGGREGATES QUARRY

Roy Wagner, Operations Manager for American Aggregates Corp., noticed an unusual fossil on a slab of Columbus Limestone from the American Aggregates quarry near Ostrander, Delaware County, and brought it to the attention of Patricia Fagan, District 1 supervisor for the ODNR, Division of Reclamation's Industrial Minerals Program. She brought the specimen to the Division of Geological Survey for identification.

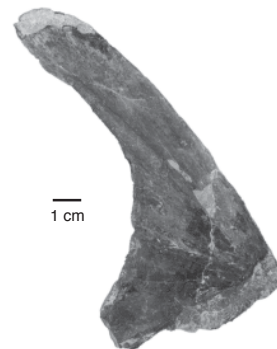
The 5-inch specimen is a bone from the shoulder girdle (which supports the pectoral fin) of a large fish, known as *Onychodus sigmoides*, that was a predatory terror in Middle Devonian seas, about 360 million years ago. *Onychodus* was up to 6 feet long and had jaws studded with long, sharp, conical teeth. At the front of the lower jaws were two pairs of tooth whorls, each of which had an in-line series of long, recurved teeth. These teeth were apparently used to impale prey, and there is some evidence that the tooth whorls could be retracted into the mouth, thus aiding in the ingestion of the prey.

Dr. John A. Long of the Western Australian

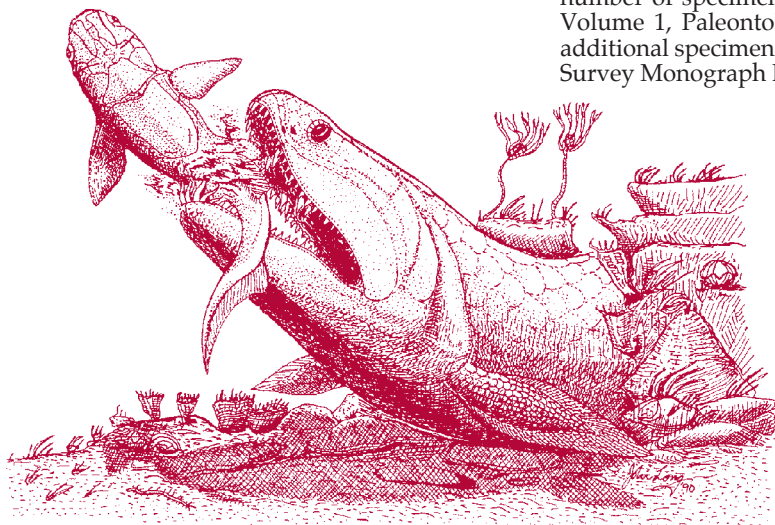
Museum has described a specimen of *Onychodus* from the Gogo Formation of Australia that was fossilized with an arthrodire (armored fish) stuck in its throat. The arthrodire was fully half the length of the *Onychodus* specimen. Long has suggested that *Onychodus* may have lurked in crevices in Devonian reefs and lunged at unsuspecting prey that swam by, similar to the feeding behavior of the present-day moray eel.

The Devonian Period commonly is referred to as the Age of Fishes because in this period of Earth history fishes were the dominant vertebrates and underwent a rapid diversification. *Onychodus* belongs to a subclass known as crossopterygians, a group that gave rise to amphibians. Despite their success in the Devonian and later Paleozoic periods, the crossopterygians are all extinct except for *Latimeria chalumnae*, a surviving member of a subgroup known as coelacanths, that was discovered in 1938 off the east coast of Africa.

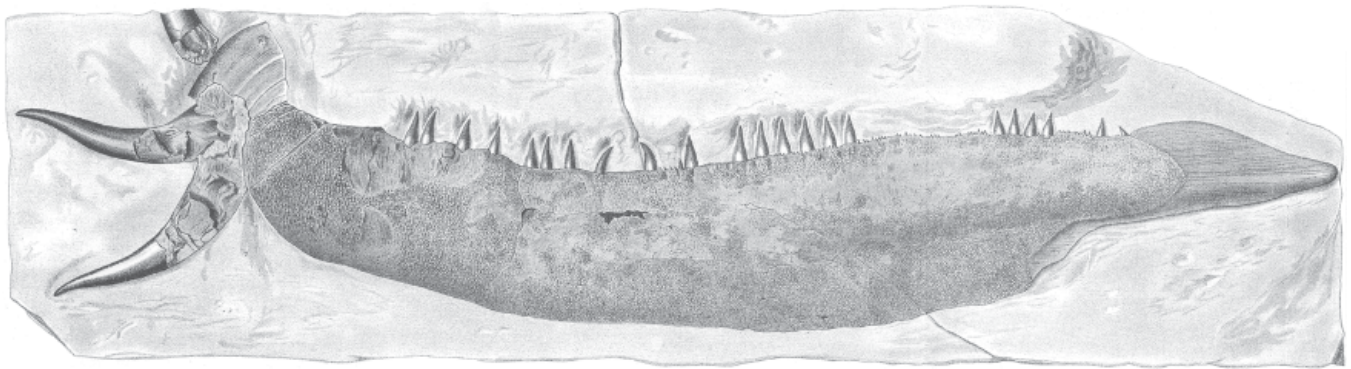
Bones of *Onychodus sigmoides* were named and described in the last century by Ohio's second State Geologist, John Strong Newberry. He illustrated a number of specimens in Ohio Geological Survey Volume 1, Paleontology, published in 1873, and additional specimens in his classic U.S. Geological Survey Monograph No. 16, *Paleozoic fishes of North*



Clavicle of *Onychodus sigmoides* collected by Roy Wagner from the American Aggregates Corp. quarry at Ostrander, Delaware County.



Reconstruction of *Onychodus* capturing a small arthrodire. Based on a specimen from the Gogo Formation of Australia. Courtesy of Dr. John A. Long, Western Australian Museum.



Lower jaw (mandible) of *Onychodus sigmoides* from the Columbus Limestone near Delaware, Delaware County. This illustration was one of Newberry's plates (plate 27) in *Ohio Geological Survey Volume 1, Paleontology* (1873). The jaw, which is shown in outer view, is more than 12 inches in length, excluding the recurved teeth. An interesting historical sidelight is that the delineator (illustrator) who drew this figure of the *Onychodus* jaw was Grove Karl Gilbert, who was a young assistant during part of the Second Geological Survey of Ohio. Gilbert later became a world-famous geologist with the U.S. Geological Survey.

America, published in 1889. The most common remains of *Onychodus* are isolated teeth in the Columbus and Delaware Limestones. These teeth are particularly common in the so-called bone beds of these formations. The bone beds represent storm deposits of phosphatic material (bones, scales, teeth) of fishes.

The bones of *Onychodus* were loosely joined and were quickly dispersed after the death of the fish. Consequently, they are almost always found as single, isolated elements. *Onychodus* bones cannot be considered common and each new discovery adds to our knowledge of this fish.

Bones of *Onychodus*, and a number of other species that lived in the Devonian seas, are brown to gray, have a definite symmetry, and commonly have an ornamentation of small bumps or lines on the surface. Broken edges may reveal a spongy bone texture. Division of Geological Survey staff will identify fossil fish or other unusual fossils.

The *Onychodus* specimen found by Mr. Wagner has been donated to Orton Geological Museum at The Ohio State University. It will be available to researchers and may one day contribute to our knowledge of these ancient fish.

—Michael C. Hansen

Ohio Earth Science Teachers Association

OESTA, the Ohio Earth Science Teachers Association, invites earth science teachers, or anyone who teaches about the Earth, to join their organization. Members receive a newsletter that contains classroom activities, announcements of upcoming activities, field trips, and other teaching tips.

Annual dues are only \$7.00 per year.

Contact Rose Blanchard, OESTA Treasurer, 14 South Vine Street, Westerville, OH 43081.

Symposium on oil and gas reservoir structure

The Ohio Geological Society, in conjunction with the Ohio Oil and Gas Association and the Ohio Geological Survey, is sponsoring its third annual technical symposium (the "Canton Symposium"), titled Structural Influences on Oil and Gas Reservoirs, on October 25, 1995, in Canton. For additional information contact Jay Henthorne, General Chairman, Petro Evaluation Services, Inc., 3927 Cleveland Rd., Wooster, OH 44691-1223, telephone 216-264-4454, FAX 216-345-6617, or Tom Berg or Larry Wickstrom, Ohio Department of Natural Resources, Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362, telephone 614-265-6988, FAX 614-447-1918.

Careers in the geosciences

The American Geological Institute has produced a full-color leaflet that provides basic information to students considering a career in the geological sciences. *Careers in the geosciences* describes the various kinds of jobs performed by geologists, future job prospects, salary figures, and sources of additional information. Up to 10 copies of the leaflet are available at no charge from the National Center for Earth Science Education, American Geological Institute, 4220 King St., Alexandria, VA 22302-1507, telephone 703-379-2480, FAX 703-379-7563. For more than 10 copies, contact the AGI Publications Center at 301-953-1744.

GEOLOGIC RECORDS CENTER A BUSY PLACE

The Geologic Records Center, the Survey's outlet for geologic information, distributed more than 107,000 publications and maps during 1994, averaging more than 400 per working day. The Center recorded nearly 9,000 visitors and 8,000 telephone inquiries in 1994, as well as a large volume of mail orders. The Geologic Records Center is headed by Garry Yates and staffed by Angie Bailey and Madge Fitak.

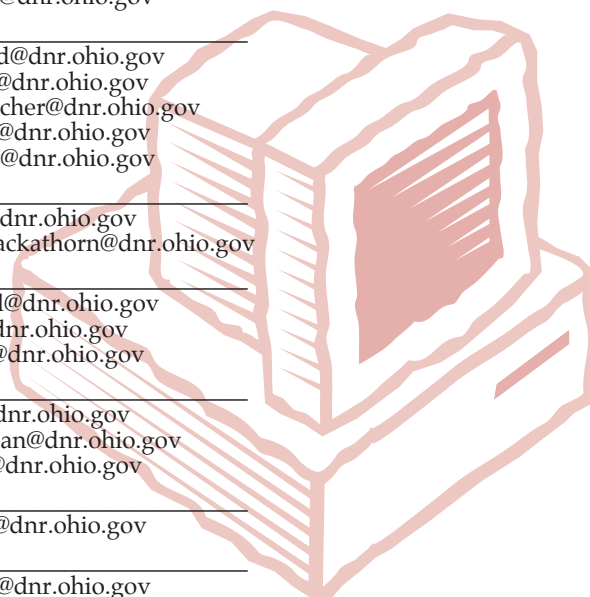
MITCHELL ENERGY DONATES CORE

Mitchell Energy Corp., a petroleum exploration company, has donated five cores, totaling approximately 5,000 feet, from holes drilled in Lawrence County. Each core is continuous from the ground surface to the base of the Pennsylvanian System. These cores will be particularly valuable to the Survey's mapping program and will be of interest to mineral and fuel explorationists. These cores are available for public inspection at the Survey's core repository.

SURVEY E-MAIL

As part of the Survey's ongoing computerization program, most staff members of the Division now have e-mail business addresses. In addition, there is a general Survey e-mail address through which any employee can be contacted, questions can be asked, or publications ordered. Publication orders must be accompanied by name, mailing address (street address, not P.O. Box), daytime telephone number, and credit-card number and expiration date. Questions concerning *Ohio Geology* should be sent to mike.hansen@dnr.ohio.gov. Additions or corrections to the *Ohio Geology* mailing list should be addressed to sherry.weisgarber@dnr.ohio.gov. Of course, we still welcome letters, telephone calls, or visits.

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GUIDE TO OHIO'S BEST PUBLIC NATURAL AREAS

Ohio has a surprisingly large number of significant natural areas scattered across the state, many of them under public ownership as state parks, natural areas and preserves, reservations, and metroparks. In his book, *Natural acts: Ohio*, freelance writer Stephen Ostrander has provided the public with a handy 241-page guide to the 100 best natural areas in the state.

Ostrander divides the state into five sectors—four quadrants and central Ohio—and discusses significant areas within each sector. He has a separate section on scenic rivers and lists the top 12 wildflower preserves, best scenic overlooks and views, best birding preserves, best trails for the physically challenged, best outings for children, top 10 sites for geological wonders, and best places for silence and solitude.

Each natural area featured in the book is discussed in terms of its ownership, flora and fauna, geology, history, and location. Ostrander provides very detailed directions to each area, some of which are well off the main highways and lack bold directional signs. The description of the geology of each area is welcome, as most similar works only briefly mention the geology of the area.

The book is in a convenient 5-inch by 10-inch format. The text is accompanied by numerous line drawings of plants and animals. Unfortunately, there are no maps in the book. *Natural acts: Ohio* was published by Orange Frazer Press, Box 214, Wilmington, OH 45177 and is available in most bookstores or from the publisher for \$16.95 plus 6 percent sales tax and \$3.00 shipping (\$20.97 total). Telephone orders may be placed by calling the publisher's toll-free number: 1-800-852-9332.

1994 REPORT ON OHIO MINERAL INDUSTRIES

The 1994 *Report on Ohio mineral industries*, which will be available in fall 1995, features statistics and directories of operators for each mineral commodity produced in Ohio (excluding oil and gas) plus an article on Ohio coal miners.

In 1994, coal was produced by 74 companies at 192 mines in 22 counties. Production totalled 28,598,415 tons (3.7 percent increase from 1993); 14,983,978 tons were produced at 182 surface mines, and 13,614,437 tons were produced from 10 underground mines. The total value of coal sold was \$767,014,211; average price per ton was \$26.74. The five leading counties for 1994 coal production were Belmont, Meigs, Monroe, Vinton, and Harrison. Ohio is the 11th-largest coal-producing state in the nation.¹ Wyoming, West Virginia, Kentucky, Pennsylvania, and Illinois rank first through fifth, respectively.

Limestone and dolomite were sold or produced by 82 companies at 125 operations in 50 counties in 1994. Sales totalled 63,169,439 tons (4.1 percent increase from 1993). The total value of limestone and dolomite sold was \$276,119,905; average price per ton was \$4.37. The five leading counties for 1994 limestone and dolomite production were Erie, Franklin, Ottawa, Wyandot, and Sandusky. Ohio ranks first nationally in the production of lime, followed by Missouri, Alabama, Pennsylvania, and Kentucky. Ohio also ranks seventh in the production of crushed stone, which includes crushed sandstone; Texas, Pennsylvania, Florida, Illinois, and Missouri rank first through fifth, respectively.

In 1994, sand and gravel were sold or produced by 257 companies at 332 operations in 66 counties plus Lake Erie. Sales totalled 51,573,324 tons (8.0 percent increase from 1993). The total value of sand and gravel sold was \$191,699,824; average

price per ton was \$3.72. The five leading counties for 1994 sand and gravel production were Butler, Hamilton, Franklin, Portage, and Stark. Ohio ranks third nationally in the production of construction sand and gravel. California and Michigan are first and second, and Arizona and Washington rank fourth and fifth, respectively.

Sandstone and conglomerate were sold or produced by 22 companies at 31 operations in 18 counties in 1994. Sales totalled 1,819,421 tons (5.9 percent decrease from 1993). The total value of sandstone and conglomerate sold was \$32,773,396; average price per ton was \$17.80 for crushed stone and \$31.59 for dimension stone. The five leading counties for 1994 sandstone and conglomerate production were Geauga, Perry, Knox, Tuscarawas, and Lake. Ohio ranks 11th nationally in the production of dimension (building) stone. Georgia, Indiana, Massachusetts, Wisconsin, and Vermont rank first through fifth, respectively. However, Ohio ranks first nationally in the production of sandstone dimension stone.

Clay was sold or produced by 49 companies at 60 operations in 30 counties in 1994. Clay sales (including material for captive use) totalled 1,835,690 tons (7.3 percent increase from 1993). The total value of clay sold was \$8,643,483; average price per ton was \$4.71. The five leading counties for 1994 clay production were Tuscarawas, Stark, Coshocton, Paulding, and Ottawa. Ohio ranks seventh nationally in the production of clay and shale; Georgia, Alabama, Wyoming, North Carolina, and Texas rank first through fifth, respectively.

Shale was sold or produced by 27 companies at 37 operations in 20 counties in 1994. Shale sales (including material for captive use) totalled 3,135,729 tons (140.9 percent increase from 1993; the large increase is due to increased use for landfill cover). The total value of shale sold was \$8,123,123; average price per ton was \$2.59. The five leading counties for 1994 shale

production were Stark, Tuscarawas, Cuyahoga, Marion, and Mahoning.

Salt was produced by 3 companies at 5 operations in 5 counties: two rock salt mines, one each in Cuyahoga and Lake Counties, and three brining operations, one each in Licking, Summit, and Wayne Counties. Salt sales totalled 4,445,918 tons (24.8 percent increase from 1993). The total value of salt sold was \$75,109,758; average price per ton was \$17.39 for rock salt and \$14.29 for salt in brine and evaporated salt. Ohio ranks second nationally in the production of salt following New York; Louisiana, Michigan, and Kansas rank third through fifth, respectively.

Gypsum was produced by 1 company at 1 operation in Ottawa County. Gypsum sales (all material was for captive use) totalled 259,105 tons (11.1 percent increase from 1993). The total value of gypsum sold was \$2,461,499; average price per ton was \$9.50. Ohio ranks 14th nationally in the production of gypsum. Oklahoma, Iowa, Texas, Michigan, and Nevada rank first through fifth, respectively.

Peat production was reported by 4 companies at 4 operations in 3 counties (Champaign, Portage, and Williams). Peat sales (including material for captive use) totalled 7,035 tons (60.6 percent decrease from 1993). The total value of peat sold was \$49,812; average price per ton was \$7.08. Ohio ranks 12th nationally in the production of peat. Michigan, Florida, Minnesota, Illinois, and Wisconsin rank first through fifth, respectively.

Copies of the 1994 *Report on Ohio mineral industries* are available from the Division of Geological Survey for \$7.50 plus \$2.00 mailing; orders to Ohio addresses must include 5.75 percent tax (\$0.43). Credit-card (Visa or MasterCard) orders may be placed by calling 614-265-6576.

—Sherry L. Weisgarber

¹ National standings were provided by the U.S. Bureau of Mines and U.S. Department of Energy, Energy Information Administration.

Ohio Geology

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