WINTER 1990

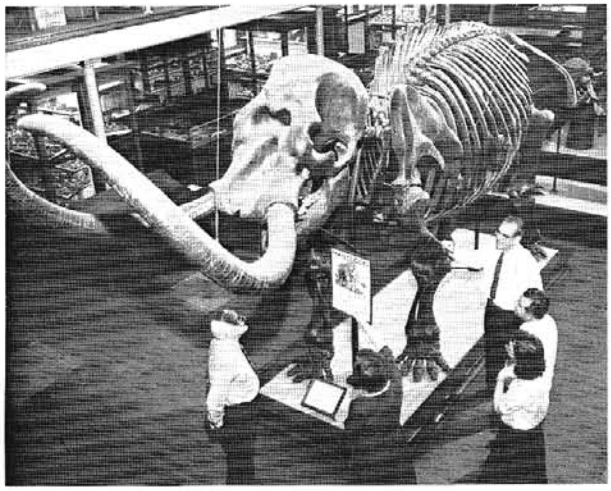
Ohio Geology Newsletter

Division of Geological Survey

MASTODON SKELETON DISCOVERED IN LICKING COUNTY

by Michael C. Hansen

Skeletal remains of the American mastodon, *Mammut americanum,* are perhaps the most commonly discovered vertebrate fossils from Pleistocene sediments in the north-central United States, including Ohio. Most occurrences are marked by the discovery of a single bone, or more commonly a tooth; however, more than a dozen complete or nearly complete skeletons have been discovered since the early 19th century.



The Conway mastodon, found in Clark County in 1875. This photograph, taken in 1956, shows the specimen in Orton Museum at The Ohio State University. This skeleton was moved to The Ohio Historical Center in Columbus in the early 1970's. Pictured with the skeleton are, left to right, Survey geologist Walter Brown; Dr. Mildred Marple, curator of Orton Museum; and Survey geologists Carolyn Farnsworth, George Shearrow, and Ralph Bernhagen. The Conway mastodon is regarded as one of the largest and finest skeletons of Mammut americanum *in the United States.*

Another specimen was added to the list on December 12, 1989, by the efforts of Sherman Byers, owner of the Burning Tree Golf Course near Heath, in Licking County. Excavations by the Flowers Excavating Company for a pond on the golf-course property revealed the mastodon remains when a dragline struck the skull of the animal. Mr. Byers notified archeologists Paul Hooge (Licking County Archeology and Landmarks Society) and Dr. Bradley T. Lepper (Ohio Historical Society) of the discovery. Through the efforts of these individuals and many other volunteers, within three days nearly the entire skeleton was recovered from the wet, muddy site. Air temperatures in the low 20's, snow, and the need to extract the skeleton so that construction work could proceed increased the difficulties in the salvage operation.

Preliminary analysis suggests that this mastodon skeleton is nearly complete—only long bones from the right rear leg, the tail, and toe bones have not been found to date. The specimen appears to be a young but mature individual that met its demise in a small kettle lake, probably in early postglacial time. Radiocarbon dates on conifer wood found in association with the skeleton indicate that the animal died about 11,700 years ago. Hooge and Lepper are awaiting a date on a bone sample, which will be obtained by the accelerator mass-spectrometry technique for radiocarbon dating.

Mastodon specialist Dr. Daniel C. Fisher of the Museum of Paleontology at the University of Michigan viewed the specimen soon after its discovery. His preliminary assessment indicates some of the vertebrae of this mastodon are fused together and that some of the ribs show evidence of having been broken and healed before the death of the animal. Such injuries suggest aggressive altercations, probably during mating activities. Similar injuries were noted on the Johnstown mastodon (see accompanying article).

Dr. Fisher also noted grooves on some of the ribs that may have been caused by butchering activities of Paleo-Indians. Further analysis will be necessary to confirm this observation, but Fisher has found similar evidence on mastodon skeletal material from Michigan. An alternative explanation of the grooves on the ribs is that they are gnaw marks from the teeth of scavengers.

The final repository for the skeleton is uncertain at this time. There is strong sentiment among many residents of Licking County to mount and display the remains of the mastodon in the county as both a tourist attraction and a focus for educational programs about the rich geological and archeological history of the area. The final decision in this matter rests with Mr. Byers, who, by law, is owner of the skeleton.

Many local people were surprised to learn that Ohio has no laws governing ownership of paleontological remains. They assumed that such scientific treasures were automatically relegated to the public domain for common benefit of knowledge and education. But these remains are, like timber or minerals, the property of the landowner. Fortunately, most such remains are donated to a scientific institution for study and display. There have been several cases in the past, however, where the financial fantasies of a landowner have resulted in the eventual destruction, and loss to science, of an important specimen. It is a little-appreciated fact that most natural history museums have meager budgets and little money for acquisition of costly specimens (see accompanying article on the Johnstown mastodon).

Although museums may have severe financial limitations, they do have the ability to ensure preservation of

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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

OF MINES AND MINING—EVERY DAY IS EARTH DAY!

Many of us are aware of the sometimes tragic results of past mining practices. I vividly recall driving through towns in the Pennsylvania anthracite fields and seeing old wood-frame houses leaning against each other because of subsidence in abandoned underground coal mines. I remember the public outrage because of an underground inferno out of control at Centralia, Pennsylvania. I remember the devastated landscape and ruined streams left by the gold and silver miners near Central City, Colorado. I remember picking through miners' 100-year-old trash heaps in search of antique bottles while mapping the high mountain wilderness of the Mosquito Range in Colorado.

Americans seem to be well-aware of horror stories connected with *past* mining practices. However, two prevailing circumstances disturb me: (1) too many Americans have no idea what life would be like if there were *no* mining; (2) too few Americans realize how much effort today's miners put into reclaiming the land and complying with environmental regulations. To appreciate awareness (or lack of awareness) of the need for mining, try this exercise: Ask your friends, neighbors, or family members to tell you where things come from. "Where do we get electricity for our lights?" A common answer: ". . . from the power company." "Where do we get glass for our windows?" A common answer: ". . . from the glass store." "Where do we get nails to build our homes?" A common answer: ". . . from the hardware store." "Where do we get kitty litter?" A common answer: ". . . from the grocery store." Too few people clearly realize that an efficient coal mine provided energy for the lights; an extensive sandstone quarry provided silica for the glass; a Michigan iron mine yielded ore to make the nails; a clay mine in a southeastern state produced the raw material for the kitty litter. Very few people stop to think about the *critical importance of mining in our everyday lives.* Did you know that the metallic sheen in the finish of many new cars is actually finely ground muscovite (a type of mica)? Did you know that sericite (another type of mica) and muscovite are used in making wallboard joint filler and retardants in fire extinguishers? Did you know that the frosting on your birthday cake has gypsum in it? As you travel our highways, do you stop to think that there would be no highway were it not for limestone quarries and sand and gravel operations? When you fill up your water glass, do you consider that you might have no water at all without the iron and industrial diamonds in the bit that was used to drill your water well? The U.S. Bureau of Mines tells us that 35 different minerals are required to make a TV set. All of those minerals had to be extracted from the earth.

Mining of nonfuel minerals alone contributes over $30 billion to our national economy each year. The value of nonfuel minerals produced in Ohio hit a record high of more than $780 million in 1989! The value of coal mined in Ohio in 1989 was over $970 million (30.3 million tons). The mining of carbonate rocks and sand and gravel continues to be an extremely important element of Ohio's economy, especially during the rapid growth of our cities and suburbs. Successful mining of coal in Ohio will surely depend on mining of limestone and dolomite for use as sorbents, especially in light of proposed federal acid rain legislation. Many of our nation's construction firms depend on Ohio's sandstone industry to produce high-quality building stone. The wallboard we use in our homes would be much more expensive were it not for the gypsum mine in Ohio. Our clay and shale industry supplies the raw ingredients for the manufacture of many items such as ceramics, cement, bricks, and tiles. Our state's salt industry is a major contributor to the millions of tons of salt used nationally for human and animal consumption, ice control, and water conditioning.

In the January 1990 issue of *Minerals Today,* published by the U.S. Bureau of Mines, Director T S Ary has responded to a number of questions about the condition of the mining industry in the United States. Readers of *Ohio Geology* who are concerned about our nation's and state's mineral resources should read Ary's comments. He believes that the outlook for the next several years is good. Ary stresses that new mining and processing technologies will make the mining industry safer and more productive. Automation and robotics will reduce hazards. Ary reminds us that in the last 20 years, government environmental agencies have laid down tough regulations for the mining industry. He says that industry has not only heeded the regulations, but has gone beyond the requirements with new mining practices that are more environmentally sensitive. Ary points out that the United States faces a serious problem because of reliance on imported strategic and critical minerals (minerals critical to the industrial base or the national security). The U.S. Bureau of Mines is researching potential substitutes for these important minerals, but our growing dependence on foreign imports could place us in precarious situations.

As *informed citizens,* we need to become fully aware of our need for a healthy mining industry and further development of domestic strategic and critical mineral deposits. As we celebrate the 20th anniversary of Earth Day here in Ohio, we need to give full credit to the mining community for the role they play in providing an acceptable quality of life balanced with a serious concern for protecting the environment. In order to be *informed citizens,* our friends in the media need to provide fair, accurate, and complete coverage of the status of mining and mineral resources in Ohio and the nation. We need to work together and spread the word that mining is absolutely necessary to the quality of life we enjoy.

The Ohio Geological Survey is continuing its 150-year-old commitment to serving the mineral industries by providing maps and reports that show the location, quality, and quantity of industrial minerals and fossil fuels. We are opening up new frontiers, especially in the newly discovered Precambrian rift-basin complex of southwestern Ohio, where strategic and critical minerals may be present. We are also playing a significant role in educating the public about the need for mining (and recycling) our mineral resources. Our annual Mineral Industries Teachers Workshop will continue, and may expand into two workshops to include more of the state's mineral resources. I ask our readers to join in the effort to raise public awareness of the critical importance of geology and mineral resources to our daily lives. *Make every day Earth Day!*

OHIO GEOLOGY

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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.

OIL AND GAS PIPELINES MAP AVAILABLE

A revised *Oil and gas pipelines in Ohio* map is now available from the Division of Geological Survey. This color map, at a scale of 1:500,000 (1 inch equals about 8 miles), shows the location and extent of subsurface natural gas and liquid petroleum storage areas. The map includes a list of oil-pipeline and gas-pipeline companies and their mailing addresses.

The oil and gas pipelines map will be of interest to oil and gas producers, government agencies, and planners. Folded copies of the map are $6.54, including tax and mailing, and flat copies are $7.54, including tax and mailing in a tube.

NEW CLOSING TIME FOR PUBLICATIONS CENTER

The Publications Center for the Department of Natural Resources and the Survey now closes at 4:30 p.m. The Center still opens at 8:00 a.m. All over-the-counter sales, including orders for oil and gas maps from the Subsurface Stratigraphy and Petroleum Geology Section, must be completed by 4:30 p.m. Business hours for the rest of the Survey and the Department remain 8:00 a.m. to 5:00 p.m. Monday through Friday.

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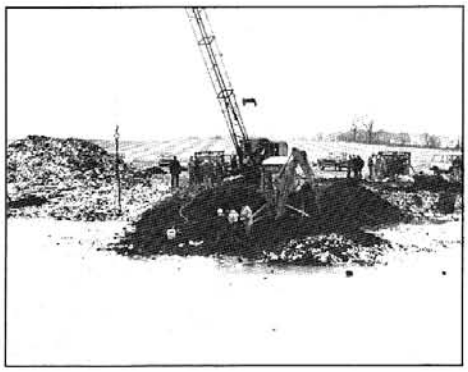
important specimens for perpetuity. No matter how sincere the intentions of an individual, it is difficult for most people to provide the care and proper housing for large and delicate fossil specimens. The annals of paleontology are filled with horror stories of privately held specimens being lost, or simply thrown in the trash after the death of their collector and caretaker.



View of the Burning Tree mastodon site, near Heath, Licking County. The mastodon was collected in peat just in front of the dragline.

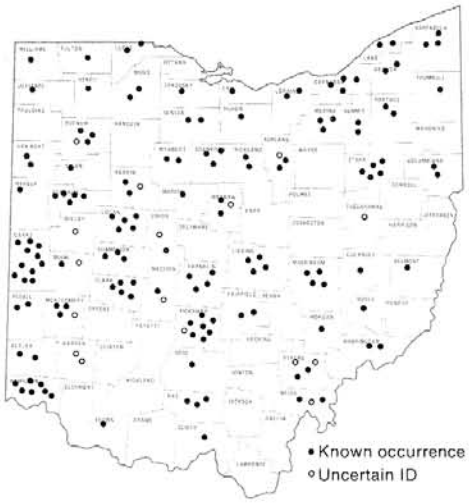
A strong effort to keep the specimen in Licking County has been mounted by the Licking County Archeology and Landmarks Society under the direction of Paul Hooge. The skull of the mastodon was displayed at Indian Mound Mall in Newark on December 21-23 and attracted crowds of curious people. Large numbers of "Save the mastodon" T-shirts and sweatshirts were sold at the mall, and cash donations exceeded all expectations. A total of about $13,000 was raised. Hooge intends to use the money to preserve the specimen and to conduct educational programs and scientific investigations. A suitable facility in which to display the specimen must still be found.

Skeletal elements of the Burning Tree mastodon soon after their removal from peat.

The strong desire to retain the mastodon for display in Licking County is an outgrowth, perhaps, of the 1926 discovery of a mastodon skeleton near Johnstown (see accompanying article). There still appears to be a surprisingly strong resentment locally that the Johnstown mastodon ended up as a featured exhibit in Kirtland Hall at the Cleveland Museum of Natural History. However, news reports from 1926 do not seem to indicate that there was much local effort to keep the skeleton in Johnstown.

MASTODONS IN OHIO

The American mastodon, *Mammut americanum,* and its distant relatives, the wooly mammoth (*Mammuthus primigenus*) and Columbian mammoth (*M. columbi*), are the most characteristic animals of the Pleistocene Ice Age. These creatures are members of the Order Proboscidea. Mammoths are closely related to the modern Asian elephant, whereas the mastodon has no surviving relatives. Although both animals are generally similar in appearance, the mammoth is characterized by a humped cranium, a sloping back, and comparatively slender limbs. The mastodon, on the other hand, was built like a tank—heavy, stout limbs, broad shoulders, and a low cranium. Both animals averaged about 10 feet high at the shoulder. Mastodons probably weighed on the order of 4 to 5 tons.



Occurrence of mastodon remains in Ohio. Each symbol represents the occurrence of one or more skeletal elements (presumably a single individual) within a particular county. The placement of the symbol in the county is not intended to indicate a specific location. Data are from Forsyth (1963) and unpublished records in the files of the Division of Geological Survey.

Perhaps the most distinctive characteristic differentiating mastodons and mammoths is the design of their teeth. Mastodons had teeth with a series of cones on the surface that were used to masticate twigs, branches, and aquatic vegetation. There were two or three teeth in each jaw of a mastodon. Mammoths, on the other hand, had only one tooth in each jaw; these teeth had a flat grinding surface characterized by a series of enamel plates. Mammoth teeth were well adapted for a diet of siliceous, abrasive grasses. Tooth characteristics and diet explain the greater abundance of mastodons in Ohio and adjacent areas because of the prevalence of open spruce forests versus grassland prairies.

Although each new discovery of remains of a mastodon creates considerable local interest and is commonly regarded as a unique event, skeletal remains of these elephantlike animals are, as noted above, the most commonly reported fossils from Pleistocene sediments in Ohio. Although there is no modern, comprehensive compilation of mastodon remains found in the state, a conservative estimate would be that more than 150 individuals have been reported in the last century and a half. Most of these records consist of isolated bones or teeth found along a stream or during an excavation, but more than a dozen complete or nearly complete specimens have been discovered since European settlers began digging and draining Ohio. Many of these skeletons, especially those discovered in the early and middle part of the last century, were either not collected or not properly preserved so they do not survive in existing collections.

It is a surprising fact that mastodon skeletal remains greatly outnumber not only those of other large Pleistocene mammals (the megafauna) collected in the state but also the remains of small mammals such as mice and other rodents. It is common ecological knowledge that herbivores outnumber carnivores in any population, and small herbivores or omnivores outnumber large herbivores. Was something awry in the Pleistocene so that mastodons outnumbered mice? The solution to this apparent puzzle is simply a matter of recognition. Dragline and backhoe operators are far more likely to notice a mastodon skull or femur than comparable skeletal parts of a mouse! Adding to the misery, from the paleontologist's perspective, is the fact that almost all discoveries of mastodon remains are at construction sites where work must proceed immediately. Extraction of the mastodon (or other member of the megafauna) therefore must be a quickly executed salvage operation with little opportunity for careful, layer-by-layer excavation and sifting of sediment for small animal remains.

One of the few sites in Ohio to have careful systematic excavation was the

Carter site in Darke County, in western Ohio. Work by the Dayton Museum of Natural History at this site in the early 1970's produced remains of not only megafauna such as two mastodons, a ground sloth, a giant beaver, and a stagmoose but also field mice, meadow voles, ground squirrels, martins, minks, long-tailed weasels, and various birds, turtles, and fish.

It is probable that there are hundreds of complete or partial mastodon and other megafaunal skeletons entombed throughout the glaciated portion of the state in bogs that were former glacial lakes. Each time a dragline or a backhoe bites into the sediments at one of these sites there is the potential for another discovery that will add to our understanding of Ohio's past history and create excitement among the local residents.

Perhaps the greatest mystery surrounding mastodons, mammoths, and other megafauna is their disappearance about 10,000 years ago. The reasons for this extinction are elusive, although there has been no dearth of speculation by scientists on the probable cause or causes. Such speculation is particularly enticing because this extinction took place so recently (geologically speaking) and can be accurately dated by radiocarbon techniques. Remains of the animals, the sediments in which they were entombed, and floral remains are so comparatively fresh and abundant that it would seem to be a simple process to examine the evidence and quickly discover the reason for the demise of the megafauna.

Of all of the Pleistocene extinction theories that have been proposed, two have gained favor in recent years. Perhaps the most provocative idea has been advanced by Paul S. Martin of the University of Arizona. Martin has suggested that Paleo-Indian hunters crossed the Bering Strait about 12,000 years ago and spread across the North American continent in a wave or front. As they migrated southward, these efficient hunters reduced the populations of large animals to such a degree that the herds could not recover.

A second idea, which has been advanced by a number of reseachers in various forms, is that climatic changes at the end of the Pleistocene disrupted plant communities to such an extent that many narrowly adapted, large herbivores were without preferred food plants. Predators, such as sabertooth cats, short-faced bears, and dire wolves, would have been directly and immediately affected by the disappearance of their preferred prey.

FURTHER READING

Forsyth, J. L., 1963, Ice Age census: Ohio Conservation Bulletin, September, p. 16-19, 31-32.

Silverberg, R., 1970, Mammoths, mastodons, and man: New York, McGraw-Hill, 223 p.

THE JOHNSTOWN MASTODON

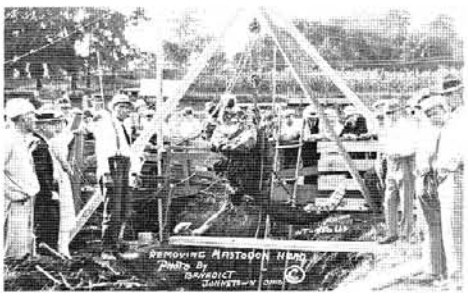
Pop culture observer Andy Warhol is reported to have said that everyone is famous for 15 minutes. Many small communities in Ohio have had such infamy at some point in their history and thereafter proclaim the event through local stories and commonly through a sign posted at the city limits. The small Licking County community of Johnstown had its 15 minutes in 1926. On Thursday, August 12, Jim Bailey, a tenant farmer on the Friend Butt farm, began to dig in order to bury two hogs that had drowned the previous night in a watering trough. Bailey's shovel struck something hard, which at first was little deterrent to the task at hand. He moved a short distance to softer ground and put the hogs in their final resting place. But curiosity, the stuff of which great discoveries are made, compelled Bailey to investigate the object that offered resistance to his shovel. A few spade strokes and the brushing away of dirt revealed the tusk and soon the skull of a huge creature that, for want of a more accurate appellation, was locally referred to as a "do-daddle."

Skull of Johnstown mastodon, found near Johnstown, Licking County, in 1926. Note the lower jaws twisted beneath the skull. Photo by C. A. Benedict. Photo postcard courtesy of Timothy Corriveau.

Bailey's daughter, Edith Edwards of Cardington, recently added some facts to the circumstances surrounding the discovery in an article in the *Johnstown Independent*. Mrs. Edwards, who was eight years old at the time of the discovery, said that she was the second person to see the Johnstown mastodon and that she and her father immediately realized the identity of the animal. Jim Bailey also realized that the mastodon would create considerable interest because he observed to his daughter that "I've a good notion to just cover it up and forget it. You know all hell's going to break loose when this gets out."

Word spread through Johnstown, and soon throughout the state and country, that a magnificent creature of the past had been discovered. By the time Friend Butt arrived at the site after returning from a visit with his sister, H. R. Goodwin from the Ohio State Museum was in charge of the digging and Bailey and others were charging 10 cents to view the proceedings. Friend Butt raised the price to a quarter. C. A. Benedict of Johnstown purchased, for $50, exclusive rights to photograph the mastodon. Photo postcards, popular at the time, were sold at the site.

By the following Sunday (August 22), 10 days after the initial discovery, 10,400 people from eight states had journeyed to Johnstown to see the creature that now had been identified as a mastodon. At least some of the curious were disappointed, however, as they had been led to believe that it was a live mastodon, a survivor from the Ice Age that had somehow managed to avoid previous detection in the placid countryside of Johnstown, Ohio.



Removal of the skull of the Johnstown mastodon in 1926. Photo by C. A. Benedict. Photo postcard courtesy of Timothy Corriveau.

In those pre-television days of travelling circuses, carnivals, and sideshows, the mastodon discovery had obvious entertainment value. Max Hirschberg, a businessman from Newark, Ohio, soon purchased the mastodon from Friend Butt for $3,000 and erected a tent, electric lights, a ticket booth, and refreshment stands at the site. Digging continued for two months, obviously drawn out in order to milk every last quarter from those who

would pay to see such a thing. Hirschberg claimed the animal was 18 feet tall and led the onlookers to believe that remains of a giant lizard, perhaps a dinosaur, also were emerging piece by piece from the ground. Mortal combat between mastodon and lizard had led to the demise of both at this very site, according to Hirschberg. Dr. J. Ernest Carman, then chairman of the Department of Geology and Mineralogy at The Ohio State University, remarked, in unpublished notes preserved at Orton Library, that Hirschberg was "... loud talking, of the type that might be directing movie actors."

As winter approached, and everyone who wanted a look at the bones had seen their fill, the crowds diminished. Hirschberg then offered the specimen to the Cleveland Museum of Natural History for $5,300. Near-poverty, which, contrary to public perception, is a tradition of long standing at most museums, prevented the Cleveland Museum from immediately acting on Hirschberg's offer. To the rescue came M. F. Bramley, president of Cleveland Trin-paving Company, who offered $10,000 to the museum to purchase, pack, ship, and mount the specimen. The only qualification was that the museum must allow Bramley to exhibit the mastodon at Luna Park, a Cleveland amusement center, for the following two summers.

Cleveland Museum officials quickly accepted the offer and by December 30, 1926, the Johnstown mastodon was legally their property. Immediately after New Year's, Peter Bungart, museum preparator better known for his magnificent preparations of Devonian fossil fish, went to Johnstown and packed and shipped the bones to the American Museum of Natural History in New York for preservation and mounting.

On March 18,1927, the Johnstown mastodon returned to Ohio, ready for its bones to be rejoined in their proper sequence. In mid-May, the skeleton was exhibited to the public at Luna Park with the anticipation that it would draw huge crowds. However, the mastodon exhibit operated at a loss from almost the very beginning, and by February 1928 the skeleton was ready to be shipped to the Cleveland Museum of Natural History for permanent exhibition.

—Michael C. Hansen

WHERE TO SEE A MASTODON IN OHIO

Cincinnati Museum of Natural History—skull of a mastodon from Indiana on display.

Cleveland Museum of Natural History—Johnstown mastodon, collected in 1926, from Licking County, Ohio. Large, nearly complete, mounted skeleton on display.

Dayton Museum of Natural History—Carter mastodon, collected in early 1970's from Darke County, Ohio. Skull of juvenile on display.

McKinley Museum of History, Science, and Industry, Canton—Deville mastodon, collected in 1970 from Canton, Stark County, Ohio. Large, nearly complete, mounted skeleton on display.

Ohio Historical Center, Columbus—Conway mastodon, collected in 1875 from Clark County, Ohio. Exceptionally large, nearly complete, mounted skeleton on display.

Teeth, tusks, and other skeletal material of mastodons are displayed in many college and university geology departments, county historical society museums, and even in some elementary and secondary schools.

FURTHER READING

Hyde, David, 1986, Mammoth undertaking: Johnstown's claim to fame: Ohio Magazine, v. 9, no. 9, p. 9-11, 57-58.

Mann, D. N., 1962, The Johnstown mastodon: The Explorer, v. 4, no. 5, p. 14-21.

GEORGE W. WHITE AWARDED MATHER MEDAL

The late Dr. George W. White, former State Geologist of Ohio (1946-1947), was posthumously awarded the Mather Medal of the Ohio Geological Survey on October 25, 1989. Dr. White's wife, Mildred, accepted the medal on his behalf in Champaign, Illinois. Philip J. Celnar, Head of the Survey's Technical Publications Section and a member of the Mather Medal Committee, presented the medal to Mrs. White.

George White was an Ohio native who spent his formative years in the state and received his formal education at Otterbein College in Westerville and The Ohio State University in Columbus. Although Dr. White spent much of his professional career at institutions outside of Ohio (1925-1941, 1947-1985), most of his research was on the glacial geology of northeastern Ohio. He returned to northeastern Ohio nearly every summer to map glacial geology on a county-by-county basis. The Survey has published the maps and reports on these counties. Almost all of them were authored by George White or one of his students or research associates. The culmination of his efforts in this regard

Philip J. Celnar presenting Mather Medal to Mildred White in her Champaign, Illinois, home, October 25, 1989.

was the publication by the Survey of Bulletin 68, *Glacial geology of northeastern Ohio.* This bulletin is a compendium of Dr. White's interpretation of the glacial deposits and their history in this part of the state and includes a map depicting the distribution of glacial deposits.

Dr. White's contributions to Ohio geology also include several other areas of research. He was particularly noted for his research on the history of geology, and this work included much of the early research on the geology of Ohio. Among other topics in his Ohio contributions, Dr. White published on coal-bearing rocks and caves.

George W. White died in 1985 at the age of 82. It is unfortunate that the Mather Medal was established after his death, as he would have greatly appreciated being honored for his many years of labor in his native Ohio. Dr. White's contributions to the geology of Ohio are immense (see *Ohio Geology,* Summer 1985) and will long be of value.

—Michael C. Hansen

LAKE ERIE SECTION HAS MOVED

The Lake Erie Section of the Division of Geological Survey has moved to another location in Sandusky, Ohio. The new facility provides additional office and laboratory space. The telephone number remains the same: 419-626-4296. The new address is:

Division of Geological Survey
Lake Erie Section
Great Lakes Center
1634 Sycamore Line
Sandusky, OH 44870-4132

SAME PLACE, DIFFERENT ADDRESS

The Survey is in the same location it has been since 1973; however, we now have a new mailing address. This change is necessary because of new optical scanning equipment being implemented by the U.S. Postal Service. These machines will not accept the address "Fountain Square, Building B," so letters addressed in this fashion have to be sorted by hand, thus causing delays in delivery.

Please use the following address for the Survey:

Ohio Department of Natural Resources
Division of Geological Survey
4383 Fountain Square Drive
Columbus, OH 43224-1362

SURVEY COAL GRANT

The Division of Geological Survey recently completed a cooperative agreement with the U.S. Geological Survey to enter stratigraphic data for 170 cores and 500 stratigraphic sections into the National Coal Resources Data System (NCRDS). The NCRDS is a computerized system that stores the results of coal research from throughout the nation.

Presently, 22 state geological surveys are cooperating with NCRDS. Ohio, regarded as a major coal-producing state, is far behind many states in the collection, interpretation, and publication of coal data. The NCRDS offers Ohio the opportunity to participate with other states and the U.S. Geological Survey in a plan that will help make available to the nation, as well as Ohio, the considerable amount of coal information that exists in the state.

A second NCRDS grant has been approved for 1990. With this grant the Division of Geological Survey will encode stratigraphic data into NCRDS for eight 7½-minute quadrangles covering most of Belmont County. These data will be used to construct preliminary maps that will convey geologic information on the Meigs Creek, Pittsburgh, Upper Freeport, Lower Freeport, and Middle Kittanning coals in one or more quadrangles.

The Division of Geological Survey will use a newly acquired Intergraph Interpro 225 computer workstation to perform this work. This computer will be connected to the NCRDS computer center in Reston, Virginia.

—Richard W. Carlton
Mineral Resources and Geochemistry Section

JEAN LESHER NAMED 1989 SURVEY EMPLOYEE OF THE YEAR

Jean Lesher, typesetting and printing technician in the Technical Publications Section, was named the 1989 Division of Geological Survey Employee of the Year in ceremonies held at the Division'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.

Jean, who is originally from Frazeysburg in Muskingum County, came to the Survey in 1962. Throughout her tenure she has been responsible for preparing phototype, planning layout, and pasting up text and illustrations for all Survey publications. Jean has mastered a variety of typesetting equipment through the years and is responsible for the high quality of Survey publications. Her technical and highly skilled position requires dedication and attention to detail. These abilities have long been admired and respected by Survey staff. She also maintains the Division's printing records.

Jean Lesher receiving the "Employee of the Year" award from Division Chief Thomas M. Berg.

UPCOMING EVENTS

April 21-22, 1990—Wonderful World of Gems, sponsored by the Columbus Rock and Mineral Society and the Licking County Rock and Mineral Society. Veterans Memorial, 300 W. Broad St., Columbus. Contact: Robert Kell, 3848 Norbrook Dr., Columbus, OH 43220; telephone: 614-457-1838.

April 27-29, 1990—Ohio Academy of Science Annual Meeting. Wright State University, Dayton. Contact: Ohio Academy of Science, 445 King Ave., Columbus, OH 43201; telephone: 614-424-6045.

May 5-6, 1990—26th Annual Gem, Mineral, and Fossil Show, sponsored by the Cincinnati Mineral Society. Cincinnati Gardens, 2250 Seymour Ave., Cincinnati. Contact: Regina Fischer, 2437 Dorian Drive, Cincinnati, OH 45215; telephone: 513-733-3612.

CORE-LOCATION MAP AVAILABLE

The Survey now has available a core-location map that shows the location of all holes for which the Division has core. These cores include those drilled both by the Survey and by industry. This open-file map, OF 273, was compiled by Garry E. Yates, Ronald A. Riley, Patricia A. Nicklaus, and Mark T. Baranoski of the Subsurface Stratigraphy and Petroleum Geology Section. The map will be updated on a yearly basis.

The core-location map is at a scale of 1:500,000 and shows core locations, core numbers, and formations cored. It is available in both black and white and color. The black-and-white version is available by mail for $6.54 and the color version for $23.40. Prices include tax and mailing.

SURVEY RECEIVES GRANT TO STUDY ROSE RUN SANDSTONE

The Survey has been awarded a U.S. Department of Energy grant of approximately $400,000 to conduct a detailed, two-year study of the hydrocarbon potential of the Cambrian-Ordovician Rose Run sandstone in eastern Ohio. Dr. Jeffrey J. Daniels of the Department of Geology and Mineralogy at The Ohio State University will participate with geologists in the Subsurface Stratigraphy and Petroleum Geology Section of the Survey in this project by processing and interpreting seismic data and assisting in geophysical-log analyses.

The Rose Run investigation in Ohio is part of a joint research proposal with the geological surveys of Pennsylvania and West Virginia submitted to the Department of Energy under the auspices of the West Virginia University-based Appalachian Oil and Natural Gas Research Center (AONGRC). AONGRC was developed to conduct long-range research addressing the special needs of the oil and gas industry in the Appalachian Basin.

The Rose Run is a sandstone that has shown significant hydrocarbon potential in stratigraphic traps along the updip pinchout where reservoir sandstone bodies subcrop against the Knox unconformity and in localized areas that represent structural highs. Most previous drilling of this unit in Ohio has been in Coshocton, Holmes, and Tuscarawas Counties, where the Rose Run is at depths between 6,000 and 7,500 feet.

The primary objective of this investigation is to develop a better understanding of the reservoir heterogeneity to enable oil and gas operators to predict optimum drilling locations for offset wells in development areas and exploratory tests. Detailed log analyses, maps, and cross sections will be generated using advanced geological and geophysical computer-analysis techniques. In addition, permeability, porosity, and petrographic analyses will be performed on Rose Run cores obtained from the Survey's core repository and industry. All aspects of this study will be synthesized and integrated to contribute to the understanding of the reservoir characteristics of the Rose Run sandstone.

—Ronald A. Riley
Subsurface Stratigraphy and
Petroleum Geology Section

SOME MEDITATIONS ON EARTHQUAKES

Editor's note: Public interest in earthquakes throughout the United States, including Ohio, escalated sharply and almost immediately after the Loma Prieta earthquake in October 1989. Dr. Allen's reflections on seismic risk on the west coast have, we think, applicability to Ohio.

The most surprising result of the October 16, 1989, Loma Prieta earthquake south of San Francisco was the low number of fatalities and the exemplary conduct of the public. If the horrible concrete sandwich on the I-880 freeway in Oakland is excluded, casualties may have been less than 50 souls, which is unusual for a quake with a Richter magnitude of nearly 7 located near a densely populated area.

The principle enunciated in 1969 by the remarkably perceptive Dick Jahns (see Further reading at end of this article) still holds: "A big quake has to occur before the public will act to beef up building codes and formulate plans for disaster management." Of the 16 most significant earthquakes in the history of the United States, 5 have occurred in California. After each earthquake new building codes were passed, the public became better informed on how to act, and public agencies learned better how to prevent panic and looting. Oregon, like most states, has only recently begun to take similar action because we have never had a big earthquake in historic times.

Brian Atwater of the U.S. Geological Survey and Curt Peterson, now at Portland State University, have been in the forefront of recent research on estuarine sediments in the Northwest. This research indicates that in the last 5,000 years the Northwest has suffered at least eight subsidence- and tsunsami-producing earthquakes. Four of the most recent ones have been dated at 350, 1,220, 1,640, and 1,760 years ago. These were Alaskan-type subduction earthquakes with estimated Richter magnitudes of about 8, which is 30 times more powerful than the California earthquake of October 16, 1989. With one interpolation and one exception, these intervals have a periodicity of 420 to 435 years, which might suggest that another earthquake is due 85 years from now.

The evidence for these dates comes from carbon-14 analyses of peat taken from cores of estuarine sediments around several bays along the coasts of Oregon and Washington. These deposits show widely correlatable, alternating layers of mud/sand (tidal flats) and peat (tidal marsh). These sediments are interpreted as implying changes from low intertidal flats to supratidal marsh/freshwater wetland, accompanied by buildup of organic muck (now peat). An earthquake causes subsidence, and an accompanying tsunami washes sands inland, covering the peat with sediment and completing the cycle. Corroborative evidence includes diatoms in the freshwater facies and foraminifera in the brackish/salt water parts of the layers.

Anthropologists studying the kitchen middens along the coast have found evidence of site abandonment or abrupt changes in Indian diet occurring close to these same dates. Remnants of submerged forests found in many places along the coast were drowned slightly less than 400 years ago.

Dating of large landslides also has added suggestive evidence; the slide that buried the Ozette Indian village on the Olympic peninsula occurred about 400 years ago. The Cascade landslide north of Bonneville, which gave rise to the legend of the "Bridge of the Gods," occurred about 730 years ago and may have been triggered by an earthquake.

Returning to the 1989 Loma Prieta earthquake, I am sorry to see that the "experts" quoted in the newspapers say that this quake is NOT the "big one." Well, maybe that is so, but maybe it's good propaganda to tell the public not to relax their efforts to bring older buildings up to par, and not to build on filled ground. And of course, maybe there will be another, bigger one. I chuckle when I think of how Perry Byerly, my seismology professor at Berkeley, told his class in 1933 that "Within 10 years we ought to be able to predict earthquakes." Seismologists are still saying the same thing after 57 years!

—John Eliot Allen
Portland State University
Portland, Oregon

FURTHER READING

Jahns, R. H., 1969, Seventeen years of response by the City of Los Angeles to geologic hazards, *in* Olson, R. A., and Wallace, M. M., eds., Geologic hazards and public problems, conference proceedings: Santa Rosa, California, Office of Emergency Preparedness, p. 283-295.

Yeats, R. S., 1989, Current assessment of earthquake hazard in Oregon: Oregon Geology, v. 51, no. 4, p. 90-91.

NEW MAP SERIES AVAILABLE

In an effort to make geologic information more rapidly available to the public, industry, and government, the Survey has begun a new series of open-file geologic maps. Contacts between geologic units and other geologic information are inked on mylar copies of U.S. Geological Survey 7½-minute quadrangle maps. Paper copies are then reproduced on a blueline copier.

The first map in this series depicts the bedrock geology of the East Palestine quadrangle in Columbiana County and was authored by Survey geologists Ernie Slucher and Glenn Larsen. This map, designated BG-C1G5, represents part of the county bedrock-geology mapping efforts in Columbiana County.

Additional maps of northeastern and southwestern Ohio quadrangles are nearing completion and should be available soon. Future issues of *Ohio Geology* will list the quadrangles as they become available.

Copies of the geologic map of the East Palestine quadrangle may be ordered from the Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362. Please order by quadrangle name and map number. Price is $5.48, which includes tax and handling.

QUARTERLY MINERAL SALES, JULY—AUGUST—SEPTEMBER 1989

compiled by Sherry W. Lopez

Commodity	Tonnage sold this quarter[1]	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	7,552,125	192	$240,460,033
Limestone/dolomite[2]	13,571,707	96[3]	48,746,873
Sand and gravel[2]	14,160,774	210[3]	48,189,510
Salt	915,802	5[4]	8,165,068
Sandstone/conglomerate[2]	475,384	24[3]	8,799,650
Clay[2]	367,390	22[3]	949,607
Shale[2]	513,386	20[3]	618,384
Gypsum[2]	60,899	1	578,541
Peat	11,969	3	54,751

[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.

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