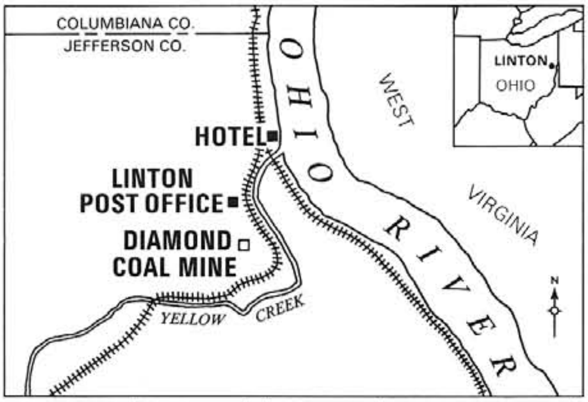
SPRING 1984

Ohio Geology Newsletter

Division of Geological Survey

"CREATURES FROM THE BLACK LAGOON"— COAL-SWAMP VERTEBRATES FROM LINTON, OHIO

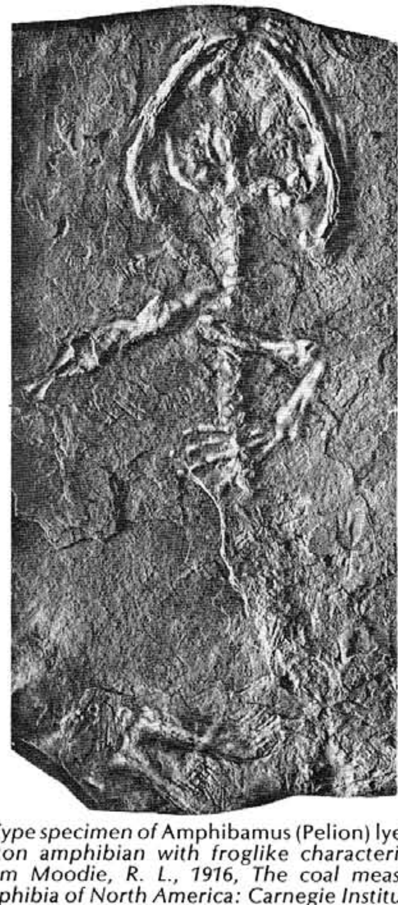
Other than a modest-sized group of paleontologists—geologists who study fossils—few people are familiar with one of the most important fossil localities of Pennsylvanian age in North America and indeed the world. However, anyone who has looked through a textbook on historical geology or visited a museum that features reconstructions of life of the past has undoubtedly, and probably unknowingly, encountered recreations of a remarkable suite of fossils from a small and long-abandoned coal mine along the Ohio River in Jefferson County, Ohio. This site, known as Linton, has produced several thousand specimens of fishes, amphibians, and reptiles during a period of 125 years of collecting. This geographically obscure but paleontologically famous fossil locality has been one of the principal contributors to our knowledge of "life in the swamp" during the Pennsylvanian Period, about 300 million years ago. At that time the coal-bearing rocks of eastern Ohio accumulated in a series of coastal swamps and deltas, where life flourished in a moist, tropical environment. But it is from only a very few sites, such as Linton, that large and diverse assemblages of fossils have been recovered, enabling paleontologists to reconstruct a portrait of life during this period of earth history.



Location of Linton and the Diamond Mine as composited from maps published in the 1870's.

The Linton site is on the north bank of Yellow Creek just south of Wellsville and within sight of the Ohio River and busy Ohio Route 7. Thousands of people pass within a stone's throw of Linton on a daily basis, but no signs mark the spot and probably few if any of these individuals either realize the significance of the fossil-bearing rocks, or have knowledge of the famous people who have visited here and of the historic events that occurred at this location.

Today, as one stands on the dark pile of gob that marks the location of the portal of the underground mine, it is difficult to imagine that in 1774, at the mouth of Yellow Creek, a significant episode in the history of Ohio began. It was in the spring of that year that the family of Logan, the great Mingo chief, was lured from their campsite on Yellow Creek across the Ohio River and then murdered by Jacob Greathouse and his party. This incident is reputed to have initiated Lord Dunmore's War. Chief Logan took scalps from 30 settlers that summer in retaliation, and the murder of his family was the basis for much of his eloquent and impassioned speech delivered at Logan Elm in Pickaway County.



Type specimen of Amphibamus (Pelion) lyelli, *a Linton amphibian with froglike characteristics (from Moodie, R. L., 1916, The coal measures Amphibia of North America: Carnegie Institution of Washington Publication No. 238).*

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ODNR
OHIO DEPARTMENT OF NATURAL RESOURCES

Richard F. Celeste, Governor • Lt. Gov. Myrl H. Shoemaker, Director

Chief's corner

by Horace R. Collins

The thought occurred to me recently that a geologic map is, in a way, similar to beauty. It is often said that beauty is in the eye of the beholder. Similarly, it could be said that the value of a particular type of geologic map is in the eye of the user. Most geologists will declare unequivocally that a geologic map is a thing of beauty; however, not all people would hold such feelings, and, in fact, not even all geologists would immediately recognize the value of a specific type of map. For instance, the further one is removed from glacial geology and from professional work which might involve glacial sediments, the less likely an individual geologist may value a glacial map.

To the geologist looking for sand and gravel aquifers in glaciated terrane, glacial maps along with companion maps showing the thickness of the ice-deposited sediments (drift-thickness map) and the topography of the bedrock surface beneath such deposits (top-of-rock map) are of great value. The same maps are extremely valuable to oil and gas well drillers and to drilling-industry regulators for determining how much casing must be set to get safely through freshwater zones in the drift. A geologist or stone producer searching for a quarry site will have his field of search greatly narrowed by having maps showing the thickness of sediments overlying a potential deposit. Every operator knows what thickness of overburden can be removed to reach the resource before mining becomes technically and financially prohibitive.

Maps accompanied by data on engineering characteristics of the various glacial units are eagerly sought after by many individuals. Construction engineers and engineering geologists are concerned about and must design structures with the load-bearing characteristics of the individual glacial units in mind. Some sites have a susceptibility to suffer greater damage from landslides and earthquakes than do other sites. Such differences in geologic-hazard conditions can often be identified by a careful examination of the appropriate geologic maps. Solid-waste-disposal sites require specific geologic conditions related to the ability of the sediments to safely retain the wastes and not permit interaction between the wastes and either surface or ground waters.

The examples could go on. In Ohio the maps mentioned above would have little specific value to the coal geologist searching for deep deposits of low-sulfur coal. This does not mean, however, that the maps have less value than others or that the Geological Survey should not be actively pursuing the mapping of the glacial deposits of the state. What it means is that as beauty is in the eye of the beholder, so also the value of geologic maps are in the eye of the user.

LIMESTONE INSTITUTE MEETING

The mid-year meeting of the National Limestone Institute will be held in Columbus on July 22, 23, 24. For further information, contact Robert A. Wilkinson, Managing Director, Ohio Aggregates Association, Suite 200, 20 S. Front St., Columbus, Ohio 43215.

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.

continued from page 1

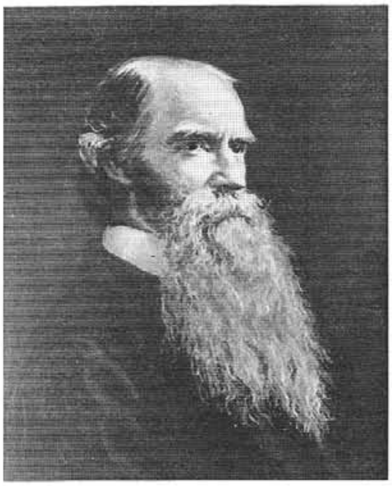
Only three-quarters of a century later the mouth of Yellow Creek had changed from an untamed frontier to a bustling part of the industrial revolution. Coal had been mined in this valley for local use for a number of years, but it was not until 1855 that several entrepreneurs from Connecticut, operating under the name of the Ohio Diamond Coal Company, opened a drift mine on the north bank of Yellow Creek in a 9-foot bed of coal known locally as the "Big Vein," now regarded to be the Upper Freeport (No. 7) coal. The Ohio Diamond Coal Company went bankrupt within 2 years and the Diamond Mine, as it was thereafter known, reverted to the original property owner, Samuel Nessly, at a sheriff's sale. The mine changed ownership several times during its active life.

In the 1870's, during the height of mining activity at the Diamond Mine, production reached more than 250 tons per day and about 20 miners were employed. Most or all of the production was utilized by the railroad. By 1892 the coal at the Diamond Mine was nearly exhausted and the mine closed. In 1917, the River Ridge Coal Company of Cleveland reopened the mine and began removing the pillars of coal that supported the roof (see *Historical Vignettes,* p. 7). With the roof caved in, the mine was finally closed in 1921.

The name "Linton," which is now immortalized in the annals of paleontology, comes from the name of a post office and a small surrounding community that was established in proximity to the Diamond Mine soon after it opened. However, with the demise of the mine in the late 1800's, this little community began to fade, and in 1901 the post office was closed and moved to Vulcan in Columbiana County. The Linton Hotel, later known as Waterford Downs, was destroyed by fire in the 1970's and with it passed the last remaining vestige of this community except for a few foundation stones among the brush.

LINTON FOSSILS

John Strong Newberry, later to become second State Geologist of Ohio (1869-1882), is credited with the discovery of the fossils at Linton, or at least with bringing them to the attention of the scientific community. The circumstances of his discovery of this remarkable deposit are unknown, but perhaps a miner or other local citizen noticed the abundant and unusual fossils in the cannel coal at the base of the Upper



John Strong Newberry, second State Geologist of Ohio (1869-1882), the discoverer and principal collector and investigator of the fossil vertebrates from Linton.

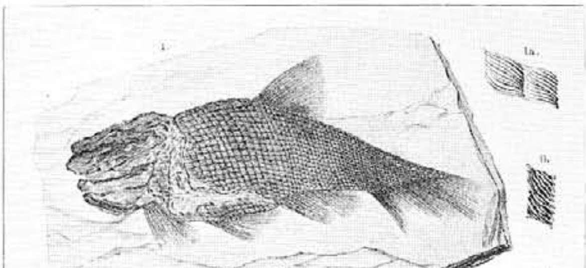
Freeport seam and called them to the attention of Dr. Newberry. Nevertheless, Newberry was aware of these fossils as early as 1856, a year after the mine opened, when he first published a note on fossil fishes from Linton.

Newberry apparently personally collected many of his spectacular specimens; a local newspaper account in 1856 called attention to the fact that "Dr. Newberry, Government geologist" had been observed searching for fossil remains within the Diamond Mine. It is conceivable also that Newberry obtained additional specimens from miners and local collectors. Newberry visited Linton periodically throughout his career and his large collection was housed at Columbia School of Mines (Columbia University) in New York and later transferred to the American Museum of Natural History. Newberry apparently also supplied numerous specimens to paleontologists at museums throughout Europe.

Newberry's substantial collection was the basis for extensive reports and illustrations in the Survey's 1873 report, Volume 1, Part 2, Palaeontology and the 1875 report, Volume 2, Part 2, Palaeontology. The former report described the fishes of Linton and the latter report contained descriptions of the amphibians by Edward Drinker Cope, the famous and prolific Philadelphia paleontologist. It was in these reports that the full magnificence of Linton fossils was revealed to both the scientific community and the citizens of Ohio. Even after more than a century, these reports are still sought after by those interested in fossils.

The many reports on the fossils of Linton drew numerous collectors to the Diamond Mine in the late 1800's, during the active years of coal extraction. Many of these individuals were well-known paleontologists or professional collectors, but important collections were also assembled by local amateurs, including Samuel Huston, a local surveyor who in later years became State Commissioner of Highways for Ohio. These collections eventually found their way into numerous museums throughout the United States and Europe. Ironically, none of the material stayed in Ohio. In part, this circumstance may be due to the fact that during the late 1800's Ohio had no well-established, permanent museum facilities in which to house the specimens. Even today only a small number of Linton specimens are in Ohio: Orton Museum at the Ohio State University has a small collection of Newberry's specimens, and the Cleveland Museum of Natural History has a representative collection of Linton fossils obtained by field parties in the 1950's.

Although interest in Linton fossils never waned completely in the years following the closing of the Diamond Mine in 1892, as evidenced by the publication of occasional scientific papers on them, the actual site of the mine faded into obscurity. It was not until the 1950's that Donald Baird of Princeton University, today the leading authority on Linton and its fossils, rediscovered the site. In subsequent years Baird has amassed a large collection of Linton specimens and solved many problems connected with interpretations of these fossils. Richard Lund also assembled a significant Linton collection, which is now housed at the Carnegie Museum in Pittsburgh. Robert Hook, a graduate student at the University of Kentucky, is currently studying the Linton site in detail, and David Hamilla and Gregory McComas of Youngstown State University (see article on fossils from Columbiana County, elsewhere in this issue) have assembled a significant collection of Linton specimens.

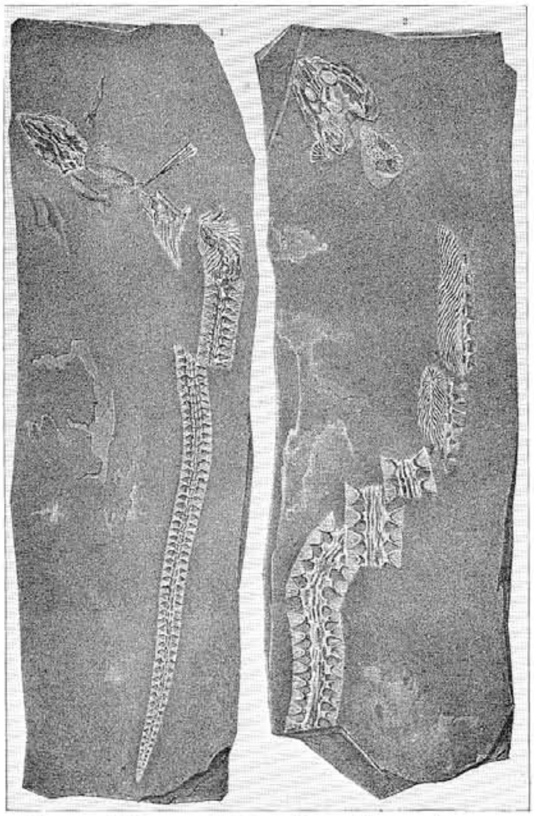


Small bony fish, known as paleoniscoids, from Linton. Details of scales and bones are also depicted. The illustration in the lower right corner (No. 5) was interpreted by J. S. Newberry to be the tail of a crustacean. Recent studies indicate, however, that this specimen is a pelvic fin and clasper element of a male xenacanth shark (from J. S. Newberry, 1873).

That significant collections are still being made from Linton may be surprising in view of the fact that the mine has been closed for nearly a century, but this good fortune is due both to the method of mining and processing of the coal and to the occurrence of the fossils. The specimens are preserved in a cannel coal (composed principally of plant spores) 4 to 10 inches thick that forms a layer or bed at the base of the Upper Freeport coal seam. This cannel, which after weathering splits into thin, sheetlike layers, thus revealing the fossils, was in part removed from the mine with the coal and split off as waste just outside the mine entrance. During more than 35 years of active mining, a huge pile of fossil-bearing cannel and other waste rock accumulated on the mine dump. Even after more than a century of exposure to the elements the cannel remains remarkably fresh and can be easily split with a thin-bladed knife to reveal the remains of a fish, an amphibian, or rarely, a reptile.

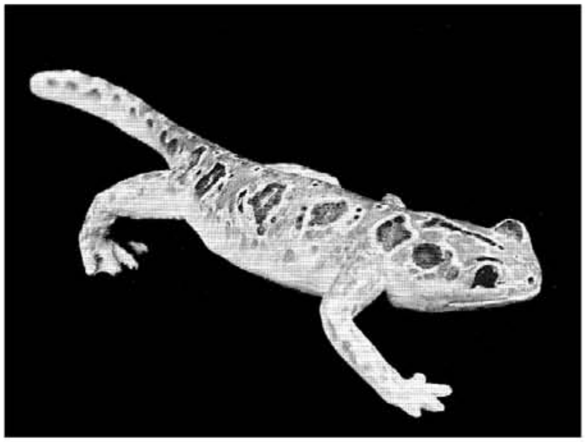
First-time collectors at Linton are commonly disappointed by the appearance of their first fossil, if indeed they can find one right away. The specimens are mostly small and the original bone or other skeletal material has been replaced by pyrite that has weathered and destroyed the original internal structure. What remains on the slab of cannel, however, is a remarkably detailed impression of the skeleton. Donald Baird developed a technique of etching the specimen in acid to remove the remaining bone and pyrite and then coating the slab with liquid latex rubber. After the latex has hardened it is peeled off the specimen to reveal a nearly perfect cast of the skeleton.

The Linton fossils consist of at least two species of fresh-water sharks, nine species of bony fishes, 26 species of amphibians, and three species of reptiles. Some of the animals are known from only a few specimens, whereas others are known from hundreds of specimens. *Rhabdoderma elegans,* a coelacanth fish, is the most abundant fossil at Linton and is known from perhaps 3,000 specimens.



Two eel-like amphibians from Linton that were described by E. D. Cope. Both were originally regarded as species of Ptyonius, *but the specimen on the left is now known as* Sauropleura *(from J. S. Newberry, 1875).*

Included among the amphibians are eel-like forms such as *Sauropleura* and *Ptyonius* that were apparently adapted for an entirely aquatic existence. Another amphibian, described originally as *Raniceps lyelli,* later named *Pelion lyelli,* and now known as *Amphibamus lyelli,* bears remarkable similarities to modern frogs, and indeed some authorities place this species on the evolutionary line of the frogs.



Reconstruction of Amphibamus (Pelion) lyelli.

But perhaps the most famous fossil from Linton, known originally as *Eosauravus copei* and now known as *Tuditanus punctulatus,* was at one time thought to be the oldest known reptile. Subsequent study has disclosed that this species is actually an amphibian. Reptiles are known, however, from fragmentary remains at Linton.

THE LINTON DEPOSIT

What makes the Linton fossil deposit so famous is that it was one of the earliest reported records of abundant life in the coal swamps and it was, and may still be, a unique deposit. Linton is rivaled by only a few other deposits of Pennsylvanian age, but none of these has produced exactly the same suite of fossils.

The question as to whether there are other "Lintons" in Ohio or adjacent areas is presently unanswered. Certainly the animals found at Linton must have lived at numerous locations in the coal swamps that persisted in eastern Ohio for nearly 30 million years. Specimens of fishes, amphibians, and reptiles occasionally are found in the coal-bearing rocks of the state, but not in concentrations anything similar to that at Linton. Was there some unique factor that concentrated and preserved these remarkable fossils at Linton?

J. S. Newberry and his successor, Edward Orton, Sr. (3rd State Geologist of Ohio, 1882-1899), both of whom visited the Diamond Mine when it was active, made important observations on the local geology and speculated on the environment of deposition of the Linton deposit. Orton observed that the fossil-bearing cannel beneath the coal at the Diamond Mine was present only in a depression, known at the mine as the "swamp," that coincided with the thickest coal. He indicated that this elongate "depression" placed the Upper Freeport coal nearly 40 feet lower in elevation than would be expected. Orton further observed that "The coal has been found in the north entry to climb a hill as steep as is to be seen in any mine of the State, and to gain all the elevation required to make it normal, within 150 yards of the lowest portion of the mine."

Newberry, on the basis of his observations of the geologic conditions and the fossils at Linton, speculated that the cannel at the base of the coal accumulated in a pond or lagoon in a deeper area within the swamp. Subsequent investigators have improved little on the generalized ideas of Newberry.

Robert Hook, under the guidance of his advisor, John C. Ferm, recently embarked on the task of solving the enigma of why the Linton deposit appears to be unique. With the aid of a grant from the National Science Foundation, Ferm and Hook have begun to study in detail the geology of the rocks at Linton and in surrounding areas.

Hook, whose interest in Linton began as an undergraduate student at Wittenberg University in Springfield, is only in mid-stage with his field work, but he has made some important observations that may explain why "Linton-type" deposits are not more common; more importantly, these observations may help to predict specifically where to look for other "Lintons." In the course of examining exposures of rock in the vicinity of Linton, Hook has observed that the expected sequence of rocks cannot be recognized and that the coals—which are generally reliable marker beds in Pennsylvanian rocks—have little lateral persistence. The abnormal thickness and lower elevation of the Upper Freeport coal at Linton suggests that it may merge with the underlying Lower Freeport coal bed. In addition, not far from the Diamond Mine, another coal bed has been displaced from its original horizontal position to an angle of about 60 degrees. Conditions such as these are not common in the coal-bearing rocks of Ohio and explain why geologists have experienced both consternation and confusion in this area for more than a century. More importantly, they may be a clue to why the Linton deposit is here and nowhere else.

Robert Hook, of the University of Kentucky, collecting fossils on the Linton mine dump.

Hook also has noted that a fault mapped by Jack Gray, Head of the Survey's Subsurface Geology Section, in conjunction with the Eastern Gas Shales Project, passes close to the site of accumulation of fossils at Linton. Did this fossiliferous cannel and locally thick coal accumulate on the down-thrown side of a small fault block? Such a relationship between thick, local coals and faults has been noted in other areas of the country, although none of these deposits have been reported to have an accumulation of fossils such as at Linton.

There are few answers and a growing number of questions concerning the deposition of this remarkable suite of fossils at Linton. After nearly a century and a quarter of investigation most of the pieces of the puzzle have been obtained. Perhaps the puzzle will now begin to take form as a coherent picture.

Linton remains as one of the premier fossil sites in North America. This forlorn little mine dump poised above Yellow Creek and the Ohio River produced some of the most exciting and scientifically important fossils of the nineteenth century and continues to provide paleontologists with important information on life of the past. Remains of animals new to science continue to be found. Although there would be little argument from most quarters on the value of reclaiming abandoned mine lands, in the case of Linton it would be a loss of both a scientific and an historic landmark.

Acknowledgment: Our appreciation goes to Robert Hook for providing information on the progress of his study and with numerous bits of historical information about Linton.

FURTHER READING

Newberry, J. S., 1873, Ohio Geological Survey, Volume 1, Part 2, Palaeontology, 399 p.

________1875, Ohio Geological Survey, Volume 2, Part 2, Palaeontology, 435 p.

Murphy, J. L., 1980, The Ohio Diamond Mine—paleontological treasure trove: Ohio Historical Society Echoes, v. 19, no. 2, p. 4-5.

—Michael C. Hansen

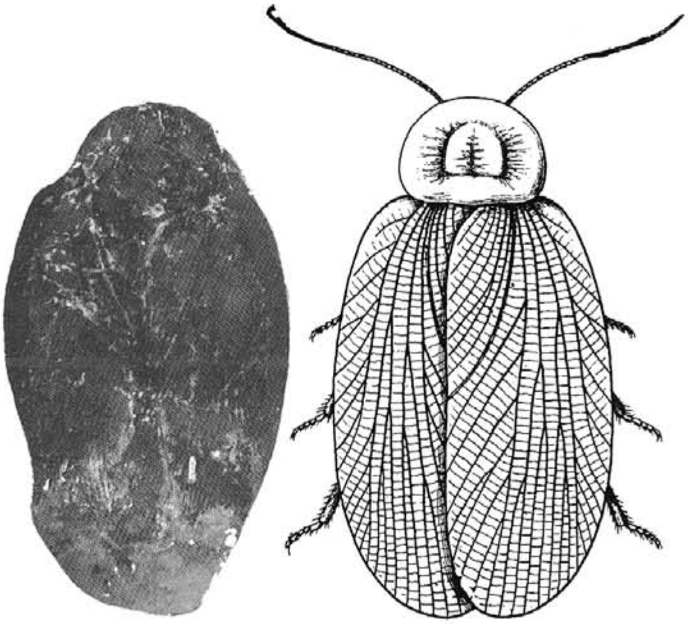
SPECTACULAR FOSSILS FROM PENNSYLVANIAN ROCKS IN COLUMBIANA COUNTY

Abundant and well-preserved fossils are common in many parts of Ohio and from all geologic systems exposed in the state. Indeed, Ohio is nationally known to collectors of fossils, and many individuals specifically come to the state in order to sample the bonanza. The numerous inquiries received by the Division of Geological Survey in regard to fossil-collecting sites bear witness to this popularity. Most of these sought-after fossils are common varieties of invertebrate animals that populated the warm, shallow seas that covered the state during most of the Paleozoic Era. Countless millions of brachiopods, clams, snails, cephalopods, trilobites, and corals are entombed in the limestones and shales that crop out across the state.

Highwall exposure at strip mine in Columbiana County. The light-colored shale near the base of the exposure is the insect-bearing horizon and the thick, dark shale above it is the marine Brush Creek shale and limestone. The mined coal (Mahoning?) is at the base of the exposure but is hidden from view by fallen rock along this dangerous and unstable highwall. Fossil specimens were collected from spoil piles to the left of the highwall.

From time to time, rare fossils turn up and generate excitement both among collectors and professional paleontologists. Such was the case recently when Gregory A. McComas and David S. Hamilla, avid fossil collectors and geology graduates of Youngstown State University, discovered an unusual deposit of fossils of Pennsylvanian age in an inactive coal strip mine in Madison Township, Columbiana County, about 3½ miles southeast of West Point. A gray shale, interbedded with layers of ironstone, above the mined coal (tentatively identified as the Mahoning coal) has produced numerous well-preserved remains of insects, including a nearly complete cockroach about 4 inches in length, and several spiders, one of which is nearly complete. In addition, remains of millipedes ("thousand leggers"), a tooth-bearing jaw of a freshwater xenacanth shark, teeth and scales of lungfish, and beautifully preserved impressions of ferns and other vegetation have been collected from this site. Among the plant remains are branches of an early conifer known as *Walchia*. This occurrence of *Walchia* is thought to be the earliest in the eastern United States.

Spider from shale above the Mahoning? coal in Columbiana County. Length of the specimen is about 1 centimeter. Photo courtesy Orton Museum, the Ohio State University.



Cockroach about 10 centimeters in length from shale above the Mahoning? coal in Columbiana County. Right, reconstruction of a Pennsylvanian cockroach similar to those from Columbiana County. (Photo courtesy of Orton Museum, the Ohio State University).

The spiders, millipedes, cockroaches, and other insects have not been studied in detail by specialists, but the preservation of these specimens is so good that they perhaps will provide insight into the structures and life habits of these ancient organisms. Such is the preservation of these fossils that at first glance the spider (see accompanying photo) appears to be a modern one that was squashed on the rock. Indeed, Greg McComas, upon prying apart an open joint in a block of shale and seeing the spider on the exposed surface, had exactly that initial reaction.

The fossil harvest at this locality does not end with the arthropod-bearing shale and ironstone because above this horizon is a marine shale and nodular limestone (Brush Creek shale and limestone) that contain many varieties of brachiopods, snails, clams, corals, and—most spectacular—a thin bed (about 4 inches thick) that is a veritable pavement of coiled cephalopod shells, most of which are specimens of a single nautiloid species, *Metacoceras mcchesneyi*. A slab of shale about a yard square yielded nearly 60 cephalopods 3 inches in diameter. Such an occurrence is most unusual in Pennsylvanian marine rocks in Ohio.

Why is this extraordinary concentration of both marine and nonmarine fossils at this particular locality? Such a question cannot be answered with certainty until detailed studies of this rock sequence and surrounding rocks are carried out. We can, however, make some general observations on the environment in which these rocks accumulated and in which these plants and animals lived during the Pennsylvanian Period, nearly 300 million years ago.

During Pennsylvanian time, Ohio was in equatorial latitudes and the climate was warm and humid. A shallow, restricted sea stretched northeastward across the state into neighboring Pennsylvania (the state from which this group of rocks got its name). Into this shallow sea, deltas were built by streams flowing northward, carrying their load of sediment from the rising Appalachian Mountains. The surfaces of the deltas were covered by shallow freshwater lakes and luxuriant vegetation, which settled into swamps and eventually was transformed into the rock known as coal. Sand and mud associated with subenvironments of the deltas eventually became sandstone and shale. Offshore, in the shallow marine waters, sediments that would become limestone and shale accumulated.

Most deltas, however, are not stable structures that remain in one place for a considerable period of time. The streams that form them switch courses and begin building new delta lobes at new locations. The old delta lobe, now deprived of its life-giving sediment, begins to settle and sink, allowing the sea to slowly encroach over the surface and drown the coal-forming vegetation. This simplified picture is an explanation for the origin of some of the Pennsylvanian rocks of Ohio and adjacent areas and explains the rapid lateral and vertical changes in the rock types found in this sequence.

In view of this scenario or model, the fossil-bearing rocks in the strip mine in Columbiana County can be interpreted to have begun with a swamp in which vegetation accumulated in sufficient quantities to produce a coal of mineable thickness. The end of coal deposition was marked by the accumulation of gray shale and ironstone in a shallow freshwater lake or perhaps a brackish bay. In these waters freshwater sharks and lungfishes lived. Shoreline vegetation fell into the quiet waters and was entombed in the fine-grained sediments along with insects, spiders, and millipedes that became displaced from their terrestrial foothold. Eventually the lake or bay was flooded by water from the sea and a dark-gray limy shale (Brush Creek) began to accumulate and bury animals such as brachiopods, corals, cephalopods, and marine sharks.

There our bit of earth history ends for this particular locality. Still unanswered is the reason for the tremendous accumulation of cephalopod shells in a thin horizon. Does this represent a mass mortality of these free-swimming relatives of the octopus? Perhaps these shells, which float after the death of the animal, were blown long distances at the surface of the sea and concentrated in the upper, quiet reaches of a bay, where they then sank to the bottom mud. This and other questions may be answered by detailed study of these rocks.

Dave Hamilla and Greg McComas have gathered an extraordinary amount of information and spectacular fossils from this unusual site, which is most fortunate, because in a few months it may be forever closed to study by the mandatory process of reclamation of mined lands. The continual dilemma of the geologist is brought into sharp focus by sites such as this one where reclamation, in restoring a modern landscape, draws the curtain on a view of an ancient landscape of primitive pine trees and ferns crawling with spiders and cockroaches.

—Michael C. Hansen

BILL BUSCHMAN RETIRES

Bill Buschman, with his desk uncluttered at last, retires after 19 years with the Survey.

After 19 years of service to the Survey, William J. Buschman, Jr. retired on March 31, 1984. Bill served as head of the Subsurface Geology Section for several years before taking charge of Survey fiscal and purchasing matters and a variety of administrative duties. He obtained a degree in geology from the Ohio State University in 1948, after serving in the U.S. Air Force, where he flew 26 combat missions in the Asiatic-Pacific theater. Bill then spent 16 years as a petroleum geologist in Venezuela and Colombia before joining the survey in 1965.

Bill and his wife, Gwen, plan to travel, fish, and golf in addition to indulging to even a greater extent in their passion for attending Ohio State athletic events. Bill is also considering geological consulting on a part-time basis.

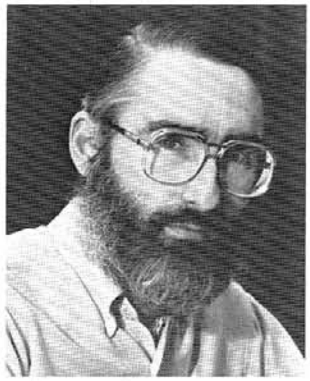
Bill's easy-going, pleasant manner and his knowledge of the intricate workings of the state's fiscal bureaucracy will be missed. We wish him well in this new phase of endeavor.

Historical vignettes

Mouth of the Diamond Mine at Linton when it was reopened. Photo by Jesse E. Hyde, December 1920.

SURVEY STAFF NOTES

Patty Johnson



Norman Knapp

Patty Johnson is an office-machine operator in the Subsurface Geology Section. Her duties include taking orders from the public for oil and gas maps and for reproducing these maps on a diazo copy machine. She also operates various other business machines and assists in the task of keeping the voluminous files of oil and gas well data in order.

Patty is originally from California but has lived most of her life in Ohio. She came to the Survey in 1980. Patty enjoys outdoor activities such as skiing, hiking, and camping and is taking evening courses towards a degree in business administration.

Norman Knapp is the Survey's chemist in the Geochemistry Section and does the majority of the analytical work in the Survey's well-equipped geochemistry laboratory. He has done a considerable amount of work with carbonate rocks and coal from Ohio and enjoys the challenges presented by precision analytical procedures.

Norm is orginially from the state of Washington, where he earned a Bachelor's degree at Whitworth College in Spokane. He came to the Survey in 1970 after completing a Ph.D. degree at Ohio University. Norm is married, has four children, and enjoys genealogy, photography, and home computers.

1983 OHIO MINERAL PRODUCTION[1]

Compiled by Margaret R. Sneeringer

Commodity	Total tonnage sold in 1983[2] (tons)	Number of mines reporting sales[2]	Value of tonnage sold[2] (dollars)
Coal	32,700,423	312	1,064,010,931
Limestone/dolomite[3]	29,447,715	120[4]	95,410,597
Sand and gravel[3]	23,133,601	252	69,258,980
Salt[3]	2,316,604	6[5]	19,705,486
Sandstone/conglomerate[3]	1,494,707	32[4]	18,615,486
Clay[3]	959,961	24	4,291,611
Shale[3]	1,305,654	20[4]	1,591,795
Gypsum[3]	224,097	1	1,871,210
Peat[3]	13,965	5	82,498

[1]The sums of previously reported quarterly totals may not necessarily equal the annual totals reported here due to the receipt of additional information or corrections to previously published figures.
[2]These figures are preliminary and subject to change.
[3]*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.
[4]Includes some mines which are producing multiple commodities.
[5]Includes solution mining.

QUARTERLY MINERAL PRODUCTION, OCTOBER-NOVEMBER-DECEMBER 1983

Compiled by Margaret R. Sneeringer

Commodity	Tonnage sold this quarter[1] (tons)	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	8,707,317	231	290,470,954
Limestone/dolomite[2]	7,596,240	106[3]	24,457,083
Sand and gravel[2]	5,871,794	183	16,834,506
Salt[2]	938,848	5[4]	8,795,345
Sandstone/conglomerate[2]	424,105	20[3]	4,728,771
Clay[2]	225,127	15	988,307
Shale[2]	827,815	15[3]	902,116
Gypsum[2]	61,475	1	513,490
Peat	1,584	1	6,720

[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.

PRICE INCREASE FOR TOPO MAPS

As of May 1, 1984, the following prices will be in effect for U.S. Geological Survey topographic maps distributed by the Ohio Survey:

7½-minute (1:24,000) topographic maps	$2.25
1° x 2° (1:250,000) topographic maps	$3.60
Relief map of Ohio (1:500,000)	$3.60
Topographic map of Ohio (1:500,000)	$3.60

These increases reflect a price increase by the U.S. Geological Survey. A free index of the topographic quadrangle maps of Ohio can be obtained from the Ohio Survey. All mail orders must include 5½ percent sales tax (in Ohio) and 10 percent for mailing costs. Small orders will be sent folded in an envelope unless an additional 50 cents is included for a mailing tube. Large orders of topographic quadrangle maps are expedited if quadrangle names are listed in alphabetical order.

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