SUMMER 1983

Ohio Geology Newsletter

Division of Geological Survey

OHIO METEORITES

One of the Survey's many functions as a public-service agency is to identify various rock, mineral, and fossil specimens submitted by individuals. One category of geological curiosity that appears to have a fairly wide public appeal is that of meteorites—about a dozen or so specimens of presumed meteorites cross our desks each year. Unfortunately, none of these "odd"-looking rocks have turned out to be genuine meteorites; commonly they are furnace slag, hematite nodules, concretions, or case-hardened sandstone.

Distribution of meteorite falls and finds in Ohio.

The Ohio record of meteorites is a sparse one; only seven specimens are known from the state. In addition to these seven are numerous meteorites from Hopewell Indian burials. Most of the Hopewell specimens are meteoritic iron that has been worked and fashioned into various ceremonial and decorative items. It is probable that these Hopewell meteorites were not collected in Ohio but were obtained by trade from some other part of the country.

In these days of routine space-shuttle flights, planetary probes, and sophisticated satellites, objects such as meteorites may be judged by some to no longer hold any great scientific interest. This, however, is not the case. Meteorites are older (between 4 and 5 billion years old, as determined by radiometric dating) than rocks exposed at the surface of the Earth or the Moon and therefore are the only readily available remnants of the primordial solar system. In addition, many meteorites are thought to be similar in composition to those materials located in the Earth's core. Recently, Antarctica has yielded meteorites that are thought to have been derived from the Moon and from Mars.

What are Meteorites?

Meteorites can be defined as rock fragments of extraterrestrial origin that have impacted on the surface of the Earth after a rigorous hypervelocity passage through the atmosphere. A meteoroid is a body of rock, from a fraction of an inch to 330 feet in diameter, that is freely floating through space in orbit around the Sun. Asteroids differ from meteoroids only in size, ranging from 330 feet to 600 miles in diameter. The luminescent phenomenon, commonly called a "shooting star," that accompanies a meteoroid's atmospheric passage is termed a meteor.

Many meteorites are thought to have once been parts of asteroids. A large group of asteroids forms a belt between Mars and Jupiter, about 90 million miles from Earth. This group of asteroids follows a path of low eccentricity; however, another group of asteroids follows highly ellipical paths that cross the orbits of Mars, Earth, and Venus.

Conservative estimates suggest that a meteoroid with a mass of 0.35 ounce passes into the Earth's atmosphere once every 5 minutes. A meteoroid with a mass of 220 pounds strikes the atmosphere every 3 to 4 days. A meteorite with a mass of about 1,100 tons strikes the Earth every 20 to 30 years. These meteorites are capable of creating craters the size of a small football stadium. Although large numbers of small- to medium-sized meteorites strike the Earth each year, it is estimated that only two meteorites will fall per square mile every million years. Such frequency makes them comparatively rare.

Although several billion meteoroids (most of these are sand-sized particles) may annually plunge through the Earth's atmosphere, only a few hundred withstand vaporization from frictional heat to land as meteorites on the Earth's surface. The majority of these meteorites plunge into the depths of the oceans that cover nearly three-fourths of the Earth's surface.

Relatively large meteoroids that enter the Earth's atmosphere may generate huge, extremely bright,

continued on next page

Chief's corner

by Horace R. Collins

This issue marks the second anniversary of *Ohio Geology*. It has been an interesting two years to say the least. When the Geological Survey made the commitment to publish a quarterly newsletter, we knew there would be many difficulties to overcome; keeping *Ohio Geology* on schedule at the printers, keeping authors and editors on schedule, and paying the bills in a tight money environment were some of the more worrisome considerations. These all proved to be real hurdles, along with several others, such as maintaining a consistent paper stock, a problem which we had not anticipated.

Ohio Geology, however, has managed to come out more or less on schedule for the past two years and we are encouraged to keep going. Most encouraging of all has been the favorable response from the readers of *Ohio Geology*. It has been especially gratifying to see several hundred copies of several issues ordered for classroom and private use. *Ohio Geology* is designed to serve and inform the general public on geologic and mineral-resource matters in Ohio. Based on comments received and demand for the newsletter, we feel that goal has been attained. If we can continue to meet this goal, the mechanical problems of producing *Ohio Geology* will not deter us. As always, we are eager to hear your comments on the content and format, as well as suggestions for topics.

OHIO GEOLOGY

A newsletter published quarterly by the Ohio Department of Natural Resources, Division of Geological Survey, Fountain Square, Columbus, Ohio 43224.

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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.

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luminous trails across the sky known as fireballs or bolides. Commonly these bolides are of sufficient brightness to be visible for hundreds of miles; some are bright enough to be visible during the day. Sounds that have been compared to thunder, distant cannon fire, the staccato of machine-gun fire, or the whistling of wind through telephone wires are commonly associated with the atmospheric passage of bolides. Many meteorites have been recovered when the trajectory of a fireball has been accurately judged by observers.

The impact of a large meteorite or a comet nucleus (composed of ice and dust) with the Earth could have catastrophic consequences if such a mass struck in a populated area. Such impacts can be expected occasionally and indeed have been recorded in this century. In 1908 an object thought to be a comet nucleus with an estimated mass of 11,000 to 110,000 tons impacted in the remote Tunguska region of Siberia. Trees were flattened within a 25-mile radius of the impact site.

The visible surface of the Moon exhibits more than 30,000 impact craters ranging in diameter from 1,600 feet to 180 miles. At least 60 such impact craters have been documented on Earth, the most famous of which is perhaps Barringer (Meteor) Crater near Winslow, Arizona, an impact structure with a diameter of 0.75 mile formed about 15,000 years ago. The Serpent Mound cryptoexplosion structure in Adams and Highland Counties, Ohio, has been suggested to be a meteorite-impact structure (astrobleme); however, recent studies indicate that this disturbance is related to release of gases from underlying basement rocks. Meteorite-impact craters on Earth are, however, short-lived phenomena owing to the dynamic forces of weathering and erosion that quickly obliterate surface irregularities. In addition, because meteorites fall with equal and random frequency over the Earth's surface, nearly three-fourths of them land in the oceans. Moreover, many meteorites, particularly smaller ones, are consumed by frictional heating in the relatively dense atmosphere surrounding the Earth.

Classification and Characteristics of Meteorites

There is a variety of meteorites and a complete subdivision of them is complex; however, there are three primary categories that are based upon mineralogic composition.

Stony meteorites (aerolites)—composed of iron-magnesium-silicate minerals and lesser amounts of metallic iron and nickel; the most abundant (92 percent) group of meteorites but the most difficult to recognize because of their superficial resemblance to some rocks of terrestrial origin.

Iron meteorites (siderites)—metallic meteorites made up of alloys of iron and nickel with small amounts of silicate minerals; although only about 6 percent of meteorite falls are iron meteorites, they compose 95 percent of meteorite finds because of their comparatively easy recognition.

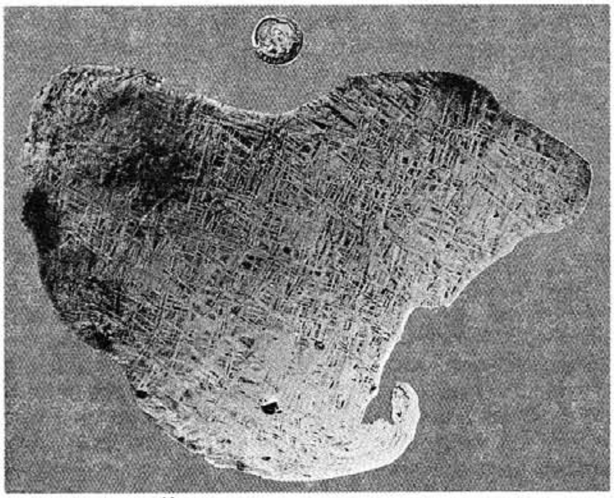
Stony-iron meteorites (siderolites)—composed of approximately equal amounts of iron-nickel and silicate minerals; the least common (2 percent) variety of meteorites.

Most meteorites exhibit characteristics that readily distinguish them from most rocks of terrestrial origin; however, conclusive assignment of a specimen may require expert opinion and various laboratory tests.

The surface of a meteorite consists of a thin black fusion crust acquired during its passage through the atmosphere. Commonly, meteorites picked up on the ground exhibit a rusty-brown color rather than a black fusion crust because of oxidation (rusting) of the iron. The interior of a meteorite, as revealed by breaking off a corner, is light in color and speckled with silver-colored iron.

Meteorites are commonly irregular in shape with dull, rounded edges except where the specimen is broken. The surface is sometimes covered with shallow, comparatively large pits (regmaglypts) that resemble thumbprints in clay.

Two characteristics which readily distinguish meteorites from most terrestrial rocks are specific gravity and magnetic properties. Meteorites, especially iron meteorites, are extremely heavy when compared to terrestrial rocks of equal size. Iron meteorites are strongly attracted to a magnet, whereas stony and stony-iron meteorites are weakly attracted.



Widmanstätten pattern on a polished surface of an iron meteorite from South Africa. Photo courtesy of Orton Museum, Ohio State University.

A distinctive feature of many iron meteorites is a unique triangular crystal structure unknown in terrestrial rocks. This arrangement of iron crystals, known as the Widmanstätten structure, is visible on a polished surface of a meteorite that has been etched with nitric acid. It is thought that this crystal arrangement forms only under conditions of intense heat, pressure, and slow cooling such as is found in the interior of a planetary body.

Meteorites from Ohio

Although Ohio is a densely populated and intensively farmed state, the record of meteorites is relatively sparse. A total of seven meteorites that fell in Ohio have been recovered. Two of these are termed "falls" because their atmospheric passage and landing were witnessed. The remaining five are termed "finds" because they were discoveries that landed unwitnessed at an unknown date. In addition, numerous meteorites and objects fashioned from meteoritic iron have been recovered from Ohio burial mounds of the Hopewell Indian culture. The source of these meteorites is uncertain, but it is possible that they were brought to Ohio as trade objects from Brenham, Kansas, a distance of 840 miles.

Five meteorites have been discovered as finds in Clark, Hamilton, Montgomery, Preble, and Wayne Counties. Information pertaining to these finds is summarized in the accompanying table. Most of these specimens were collected in the last century as surface finds. Two other Ohio meteorites were collected after they were witnessed to fall to Earth. The Pricetown meteorite fell on February 13, 1893, near Pricetown in Highland County. It is a stony meteorite with a weight of 1.98 pounds and is in the collections of the American Museum of Natural History in New York City. Little information concerning the circumstances of its recovery has been published.

The most famous Ohio meteorite is known as the New Concord meteorite, named for the community on the Muskingum-Guernsey County border in eastern Ohio. This meteorite fell just after noon on May 1, 1860, and startled residents over a large area with a loud noise, similar to thunder, that lasted for about half a minute. Many observers witnessed a large fireball that was clearly visible even in the bright midday sky. This stony meteorite fragmented in the atmosphere and at least 30 pieces were scattered over an area of about 3 x 10 miles stretching eastward from New Concord in Muskingum County across Westland Township in Guernsey County. One of these fragments reportedly struck and killed a calf. The total weight of the recovered fragments of the New Concord meteorite is 500 pounds. The largest specimen weighs 103 pounds and is displayed in the Department of Geology at Marietta College. This specimen was obtained by E. B. Andrews, Professor of Geology at Marietta College and geologist with the Second Geological Survey of Ohio (1869-1884). Andrews was one of the first scientists on the site of the New Concord fall and wrote an initial account of this meteorite. It is probable that the recovered specimens represent only a portion of those that fell and that many others lie undiscovered in the New Concord area.

METEORITE FINDS AND FALLS IN OHIO

Meteorite name	County	Date of recovery	Weight (pounds)	Classification
Cincinnati	Hamilton	1870	0.44	stony-iron
Dayton	Montgomery	1892-1893	57.9	iron
Enon	Clark	1883	1.7	stony-iron
New Concord (fall)	Muskingum-Guernsey	May 1, 1860	499.4	stony
New Westville	Preble	1941	10.6	iron
Pricetown (fall)	Highland	Feb. 13, 1893	1.98	stony
Wooster	Wayne	1858	49.5	iron

A fragment of the New Concord meteorite, which fell in Muskingum and Guernsey Counties in 1860. Note the thumbprintlike depressions (regmaglypts) and black fusion crust on the surface. Photo courtesy of Orton Museum, Ohio State University.

The somewhat paltry total of meteorite finds in Ohio is in part a reflection of the comparative rarity of these extraterrestrial objects, but it is probable that specimens reside in attics and curio boxes, their owners unaware of the importance of an odd-looking rock. It is probable also that many specimens lie undiscovered in farm fields across the state.

Because meteorite distribution is statistically random over the Earth's surface, Ohio should possess a similar number of meteorites as any other area of comparable size. Although a large portion of Ohio is under cultivation and therefore unobscured by vegetation for a portion of the year, two factors mitigate against the recovery of meteorites. First, the humid climate promotes oxidation, and many meteorites would be reduced to crumbled piles of rust in a matter of years after exposure. Second, the most intensive farming is in areas of the state that have been glaciated and consequently possess a large number of rocks (erratics) that litter the surface. Meteorites would tend to not be readily noticed among thousands of other rocks in a plowed field.

Are meteorites randomly distributed across Ohio or are there areas where meteorites might be concentrated? Obviously, areas of known falls such as the New Concord area offer the potential for producing additional specimens, but recent description of the method of concentration of meteorites by Antarctic glacial ice suggests a possible pattern for Ohio.

In little more than a decade of collecting, more than 5,000 meteorites have been obtained from the ice surface in Antarctica. This figure takes on added significance when compared with the figure of about 2,000 non-Antarctic specimens in existing museum collections gathered over a period of nearly two centuries. The Antarctic meteorites, which appear to represent numerous falls over a large area of glacial ice, are concentrated in narrow zones when the moving ice encounters a topographic barrier that impedes the flow of the glacier and forces the ice to well upward. Erosion of the ice by surface winds (at a rate of about 2 inches per year) concentrates the meteorites.

A striking aspect of the glacial map of Ohio is that the large Wisconsinan ice mass that covered western Ohio late in the Pleistocene Epoch was divided into two lobes, known as the Miami and Scioto lobes. The Wisconsinan glacier was split into two lobes by the Bellefontaine outlier, a topographic high composed of Devonian rocks. This outlier forms Campbell Hill, the highest elevation in Ohio (1,550 feet). Not coincidentally, boulder belts—areas of concentrated glacial erratics—surround and "stream" southward on either side of this topographic barrier.

Could the Bellefontaine outlier have served as an effective mechanism for concentrating meteorites that fell on the vast expanse of glacial ice during the late Pleistocene? This question is currently unanswered. No meteorites have been reported from the Bellefontaine area, although no one has probably searched for them either. Additional problems in testing this speculation are that many meteorites may have been destroyed by weathering in the 16,000 years or so since retreat of ice from the Bellefontaine area, surviving meteorites would be "diluted" by the large numbers of terrestrial erratics in the boulder belts, and the heavy cover of vegetation would hide them from sight.

IF YOU THINK YOU HAVE FOUND A METEORITE

The Survey, as well as many university geology departments and museums, will gladly identify suspected meteorites and, if they are genuine, arrange for scientific study of the specimens. If the specimen cannot be brought in or is too large for mailing, a small walnut-sized piece should be detached and submitted for examination. New varieties of meteorites, and consequently new information about the birth and history of our solar system, turn up from time to time. Any new meteorite from Ohio is important and individuals have a unique opportunity to make a contribution to science by making specimens available for study.

FURTHER READING

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—Michael C. Hansen

THE GEOLOGY OF MOHICAN STATE PARK

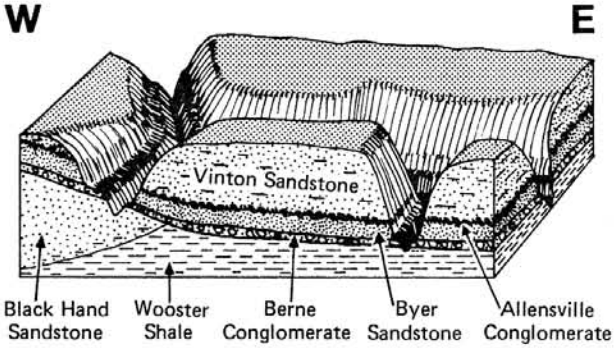
The geology of Mohican State Park bears the imprint of three vastly different ages in Ohio: the Mississippian Period (roughly 330-355 million years ago), when Ohio lay under tropical seas; the Pleistocene Epoch (roughly 10,000 to 2 million years ago), when much of Ohio was ice bound and frozen; and the present, when a temperate climate and ongoing erosion work on the exposed bedrock of eastern Ohio. The evidence of each age is there to be seen by the visitor, who with the aid of geology can sort out the past and present foundations of the beauty of Mohican State Park.

The covered bridge in the middle of the park is a good point of departure for the visitor who wants to reconstruct the Mississippian-age landscapes. A small parking lot south of the covered bridge is the trailhead for the Lyons Falls trail and the Chestnut Ridge trail.

Black Hand Sandstone at Lyons Falls.

The Lyons Falls trail winds through some of the best exposures of Black Hand Sandstone in the park. Heading towards the dam, one sees low cliffs of the coarse, pebbly sandstone that gradually rise higher and higher above the river. If everything above the Black Hand Sandstone were stripped away, it would reveal the wedge shape of this deposit. In the park the wedge is thickest by the dam and pinches out at about the covered bridge.

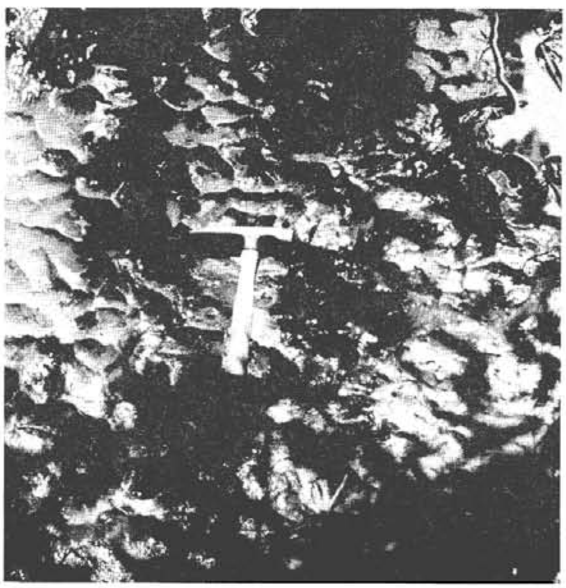
BEDROCK GEOLOGY IN MOHICAN STATE PARK



Geologists have interpreted the Black Hand deposit in the park as part of a barrier bar that was located offshore from the great Black Hand delta. The delta stretched across eastern Ohio from south to north and probably derived its sediments from highlands located east of Ohio. The barrier bar stood like a rampart before the delta and protected the waters behind the bar. These warm quiet waters were full of marine life, and the organic-rich muds that settled behind the bar became the fossiliferous Wooster Shale, exposed in the walls of the Clear Fork gorge downstream from the covered bridge.

The wedge shape of the Black Hand is also revealed in the exposures at the three waterfalls in this area. The cliffs at Little Lyons Falls and Lyons Falls display flat-lying beds of sandstone, but the cliffs at Tipping Rock Falls clearly dip to the east down the back of the old barrier bar.

The sediments in the barrier bar settled following deposition and the bar began to sink beneath the waves. The waves reworked the coarse pebbly sands on the tip of the barrier bar and spread them across the back-barrier muds to



Ripple marks in the Wooster Shale.

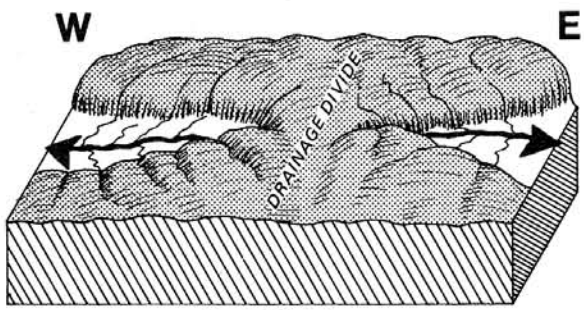
create a deposit which became the Berne Conglomerate. The Berne forms a ledge above the less-resistant Wooster Shale downstream from the covered bridge.

Over the Berne Conglomerate the sea began to deposit fine-textured sands that frequently retained ripple marks from currents and storms. An outstanding exposure of ripple marks can be seen in the streambed along the Chestnut Ridge trail less than a half mile from the parking lot. These ripple marks are in the Byer Sandstone.

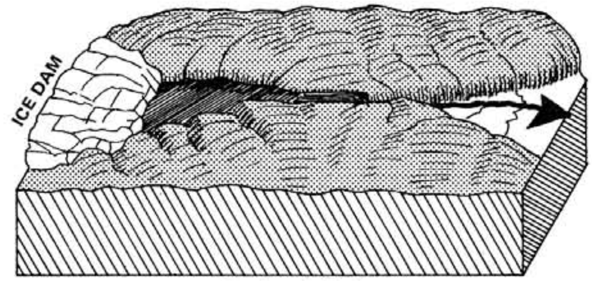
A thin blanket of Allensville Conglomerate separates the Byer Sandstone from the Vinton Sandstone, which very closely resembles the Byer. Although the genesis of the Allensville is unclear, the sediments probably came from the same source area as the Berne and Black Hand. The Allensville represents a temporary but widespread change from the conditions that laid down the Byer and Vinton. The Byer and Vinton Sandstones are the cliff-formers at the overlook on the eastern end of the park.

The Mississippian seas receded from Ohio and were succeeded by the formation of coal and other rocks during the Pennsylvanian Period. Although Pennsylvanian-age rocks are not prominent in the park, coal was mined only 3 miles south of the Clear Fork gorge.

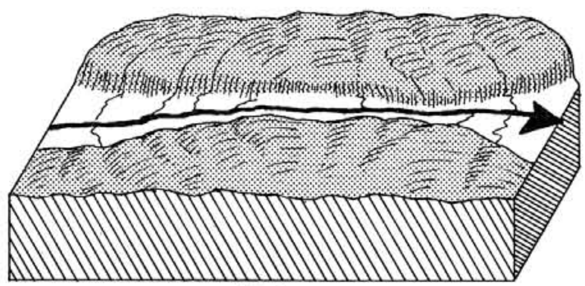
CREATION OF CLEAR FORK GORGE



Preglacial drainage



During glaciation



Modern gorge

The next impressive geologic development in the park region came during the Pleistocene Epoch. Where the Clear Fork gorge runs today, two streams used to flow in opposite directions from a drainage divide that ran between the present locations of the Ranger Station and the Youth Camp. At some time during the Ice Age the west-flowing stream was dammed by a wall of ice that probably stood near the present location of the Pleasant Hill dam.

The water in the west-flowing stream collected in the dammed valley until it backed up over the drainage divide. The escaping water cut down into the divide until the two valleys had joined to form the Clear Fork gorge. After the ice dam melted away, the waters in the region continued to flow eastward through the narrow Clear Fork gorge.

The clue for the geologists reconstructing this history was the hourglass shape of the gorge. Most stream valleys widen downstream, but Clear Fork gorge narrows and then widens again. The visitor can see the site of the old drainage divide from the picnic shelter just west of the Ranger Station. The gorge is at its narrowest here. It is interesting to note that glaciers rimmed the park on three sides during the Pleistocene but never flowed in the gorge.

The processes shaping the park did not stop when the glaciers melted away. The Clear Fork of the Mohican River continues to cut down into the base of its gorge and carry away the sediments weathered from its walls. Along the Hemlock Gorge trail between the Class B campground near the covered bridge and the Class A campground at the west end of the park, the hiker will find treeless areas and mounds of rubble at the bases of the steepest slopes in the gorge. The river is undercutting its outer banks on each bend, and the land tends to slump wherever the bedrock is weak. This kind of erosion might eventually remove the hourglass shape of the gorge and obscure the evidence of the previous landscapes.

Years of research by many geologists made possible the interpretation of the geologic history of the park. Evidence from all over Ohio and neighboring states helped create a coherent picture of the landscapes of the geologic past. Like a jigsaw puzzle, the tiny pieces of information only make sense within the whole picture and the whole picture must be slowly reconstructed with the tiny clues. In studying the rocks and landforms of the park, the visitor can experience some of the excitement and discovery of seeing the history of the area revealed.

—Karen Van Buskirk

HIGH-CALCIUM LIMESTONE IN WESTERN OHIO

High-calcium limestone (greater than 95% $CaCO_3$) is a relatively scarce resource in Ohio. Two previous Survey reports (Stith, 1972, 1979) dealt with known (Dundee Limestone) or possible (Black River Group) occurrences of high-calcium limestone in Ohio. In 1981-1982, a coring program was conducted to further explore the existence of high-calcium stone in these two units (*Ohio Geology*, Winter 1982). One shallow core was taken in Defiance Township, Defiance County, from the Dundee Limestone (Devonian). This core had 22 feet of high-calcium stone (97.4% $CaCO_3$, 0.86% $MgCO_3$, 0.79% SiO_2, 0.11% Fe_2O_3, 0.089% S, 1.20% total insolubles) at 77 to 99 feet deep. Deep snow and soft ground prevented drilling the second planned core into the Dundee.

Three holes were drilled to the Black River Group (Ordovician) in southwestern Ohio. The first, in Franklin Township, Clermont County, was not completed because of strong natural gas pressure. The other two cores, in Pierce Township, Clermont County, and Wayne Township, Butler County, were drilled to the Knox Dolomite (Cambrian-Ordovician). The possible high-calcium zone, the Carntown unit, is in the lower part of the Black River Group. Preliminary results on the core from Butler County show the presence of thin zones, 2½ to 10 feet thick, of high-calcium stone in the Carntown unit. Although the Carntown is a high-carbonate (greater than 95% $CaCO_3$ plus $MgCO_3$) unit, the high-calcium stone is not of mineable thickness in this core. The Pierce Township core has 37.6 feet of high-calcium stone in a total of 59.3 feet of high-carbonate stone in the Carntown unit. The section from 641.3 to 678.9 feet is 95.3% $CaCO_3$, 2.59% $MgCO_3$, 1.08% SiO_2, 0.12% Fe_2O_3, 0.076% S, and 1.84% total insolubles.

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—David A. Stith
Head, Geochemistry Section

UPDATE ON MINERAL-PRODUCTION STATISTICS

Mineral-production statistics will soon be on line as programs are developed for the new computer system being installed at the Survey offices. The new system is part of a larger computer system already in place at the ODNR Fountain Square complex, and will have the capability to communicate with other State of Ohio computer systems. Computer processing of the large amount of mineral-production data we receive each quarter will make compiled quarterly statistics available to citizens, industry, and government in a much shorter time than has been possible previously, and will allow us more time to develop other services regarding Ohio mineral industries.

In the meantime, however, we are managing to stay on schedule producing the statistics by hand, but we need the help of all mineral producers to remain at maximum efficiency. We strongly encourage timely submission of reporting forms each quarter—the sooner we receive all the reports, the sooner we can compile the statistics and make the figures available. It is also important that these reports be completed accurately and thoroughly. Mineral statistics and operator directories are utilized by many people, including potential customers of Ohio mineral industries.

—Maggie Sneeringer
Regional Geology Section

QUARTERLY MINERAL PRODUCTION, JANUARY-FEBRUARY-MARCH 1983

Commodity	Tonnage sold this quarter[1] (tons)	Number of mines reporting sales[1]	Value of tonnage sold[1] (dollars)
Coal	7,633,364	239	251,375,710
Limestone[2]	3,755,524	91[3]	18,097,410
Sand and gravel[2]	2,057,812	166[3]	6,189,866
Salt[2]	493,518	6	5,565,141
Sandstone/conglomerate[2]	248,699	11	3,673,440
Clay[2]	137,983	9	667,648
Shale[2]	94,070	16[3]	349,105
Gypsum[2]	49,833	1	415,477
Peat	4,723	2	28,248

[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.

FIREBALL SEEN IN NORTHERN OHIO

As this issue of *Ohio Geology* was about to go to press, a large fireball was seen across northern Ohio at about 4:30 A.M., Eastern Daylight Time, on July 26, 1983. Initial reports of witnesses place the track of the fireball from Van Wert County, on the Indiana border, eastward to Summit County in northeastern Ohio at a heading of about N 80° E. The corridor of visibility of the fireball was at least 40 miles in width and 150 miles in length. Data are insufficient at this time to project a probable impact area, if indeed any portions of the meteoroid survived atmospheric passage.

Witnesses reported the fireball had a diameter of about $1/10$ that of the full moon and a tail with a length of about two diameters of the full moon. Duration of the fireball was reported to be from less than one second to about three seconds. Colors of the fireball were described to range from bluish white to greenish to reddish orange. One observer reported several sparks from the tail. Some witnesses noted that the fireball was of sufficient brightness to cause objects such as trees and houses to cast shadows. One observer in Sandusky (Erie County) described a zigzag flight path of the object. No sounds were reported to accompany the fireball.

The Survey is attempting to collect additional information on this event in conjunction with the Scientific Event Alert Network at the Smithsonian Institution. Questionnaires are available from the Survey for any witnesses of this fireball.

MAP PRICE INCREASES

It has been necessary to increase the price of some maps distributed by the Survey because of increased printing costs and price increases by the U.S. Geological Survey. The following prices are effective as of September 1, 1983.

7½-minute topographic maps	$2.00
1:250,000 topographic maps	$3.25
Topographic map of Ohio (1:500,000)	$3.25
Relief map of Ohio (1:500,000)	$3.25
Page-size maps (geologic, glacial, oil and gas fields, oil and gas pipelines, physiographic sections)	$0.10

All mail orders for Survey publications must include 10 percent of the purchase price for mailing and handling plus 5½ percent sales tax for Ohio residents.

Historical vignettes

Glacial grooves in the Columbus Limestone in the North Quarry on Kelleys Island in western Lake Erie. Most of the spectacular grooves were destroyed during the quarrying operation. Photo taken in 1891. Courtesy of Orton Museum, Ohio State University.

SURVEY STAFF NOTES

Joel Vormelker

Bob Stewart

Joel Vormelker is a geologist in the Regional Geology Section and his principal responsibilities are the preparation of top-of-rock and drift-thickness maps for various counties in the state. Joel is a native of Cleveland and earned B.S. and M.S. degrees at Allegheny College and the University of Florida, respectively, before coming to the Survey in 1968. Since that time Joel has visited most areas of the state while collecting water-well data used in preparation of various Survey maps.

Joel enjoys boating, canoeing, and fishing during the summer months. In addition, Joel is an avid photographer and bird watcher.

Robert Stewart is a cartographer in the Technical Publications Section and has been with the Survey since 1978. Bob has done the cartographic work on a number of Survey publications, including extensive involvement with Lake Erie shore-erosion reports. He particularly enjoys the variety of work involved with the preparation of geologic maps and reports.

Bob is a Vietnam veteran and received a Purple Heart. He has three children and enjoys fishing, boating, and gun collecting as hobbies. Bob is the originator and leader of the Survey's efforts in a Christmastime "Adopt-a-Family" program sponsored by a local newspaper.

WINNERS OF THE 1983 OHIO GEOLOGY SLIDE CONTEST

1st place slide.

1st PLACE—George A. Bell, Zanesville, Ohio
2nd PLACE—Robert A. Panlener, North Canton, Ohio
3rd PLACE—Steve Dow, Medway, Ohio
4th PLACE—Larry Foster, Mansfield, Ohio
5th PLACE—Christina A. Takach, Columbus, Ohio

HONORABLE MENTION—Trudy L. Beal, Stow, Ohio; E. S. Evans, Columbus, Ohio; Allen S. Kraps, McConnelsville, Ohio; Paul F. Neely, Jr., Lancaster, Ohio; Jeffery J. Story, Claysville, Ohio.

The 1983 Ohio Geology Slide Contest received more than double the number of entries received in last year's event, making the job of the judges a difficult one, particularly because so many slides were of exceptionally high quality. Award plaques and certificates were given to the winners in ceremonies to be held on Saturday, August 13 (Conservation Day), at the 1983 Ohio State Fair. Prints of the top five slides will be on display throughout the fair in Teater Park and during the following year in the Survey lobby. The awards for this year's contest are sponsored by the Ohio Mining and Reclamation Association.

Judges for this year's contest were: David B. Buchanan, Geologist, ODNR, Division of Reclamation; Guy L. Denny, Assistant Chief, ODNR, Division of Natural Areas and Preserves; and Warren E. Motts, Commercial Photographer, President of the American Society of Photographers.

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Columbus, Ohio 43224

GEOLOGY SERVES OHIO

(Total copies printed: 2,900
Unit cost: $1.0597
Publication date: 9/83
(includes paper costs)