Ohio Geology
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# FROM PULPSTONES TO BATS

*by*
*Douglas L. Crowell*

On a hill west of Empire, Ohio, overlooking the Ohio River stand many stacks of pulpstones. Some of these stones are rough cut, and some are finished and look no different than they did nearly 65 years ago, as if they are still waiting to be shipped. These silent sentinels are remnants of an unusual mining operation at the Smallwood sandstone mine in sec. 34, Knox Township, Jefferson County. The Smallwood mine was operated by the Smallwood Pulp Stone Company and now is a potential habitat for a community of bats. The Smallwood Pulp Stone Company had plants at Empire, Ohio, and Opekiska (Monongalia County), West Virginia, and was the largest producer of pulpstones in the United States in 1932.

Pulpstones were cut from sandstone strata and manually shaped into cylinders 4 to 5 feet in diameter and 2 to 4 feet wide (thick). They are much larger (thicker) versions of grindstones and were used for grinding wood into fine fiber for making pulp and paper. When paper began to be manufactured from wood pulp in the mid-1800's, there was a demand for stone suited to grinding wood to a pulp. The discovery of the method of mechanically grinding wood to produce pulp is credited to Charles Fennerity of Halifax, Nova Scotia, in 1844. The first pulp mill using a grinding wheel was built in 1846 by H. Voelter.

Most pulpstones were imported from Newcastle-upon-Tyne, England, until Ohio began supplying these stones in the late 1800's. Grindstones have diameters similar to pulpstones but are typically only 8 to 12 inches wide. Grindstones originally were used for sharpening tools. During the late 1800's, Ohio's grindstones were popular in finish grinding of metals prior to polishing or painting. Ohio has supplied about 90 percent of the 4.5 million tons of grindstones consumed in the United States. Although pulpstones were produced in Ohio during the late 1800's, production data were not reported until 1903. From 1903 to 1916, Ohio supplied between 82 and 90 percent, by value, of the grindstones and pulpstones produced in the United States.

The object in grinding pulp is to free the fiber in the wood from its cementing bond of lignin. In 1904, 913,000 tons of pulp were ground for use in the production of newsprint paper alone. By 1930, 4,750,000 tons were ground by pulpstone. The standard pulpstones used in the early 1900's to grind 24-inch-wide wood were 54 inches in diameter and had a 24-inch-wide face. Such a stone would weigh about 2.5 tons and required a power supply of 350 to 450 horsepower per stone to drive. By the 1920's, the size of pulpstones had increased. To grind 48-inch-wide wood, these stones were 67 inches in diameter and had a 54-inch face. These stones weighed about 7.7 tons and required a power supply of 1400 horsepower per stone to operate. (Note: pulpstone tonnage was calculated, using the formula for the volume of a cylinder, $\pi r^2 h$, on the basis of 140 pounds per cubic foot of sandstone.)

Grindstones were produced in Washington County, Ohio, as early as 1819. The first government report on pulpstone production in the United States was issued in 1898, the same year the Latto quarry at Tippecanoe, Harrison County, Ohio, was re-opened by the Halderman Stone Company of Cleveland, Ohio, to produce bridge stone, building stone, grindstones, and pulpstones. The Latto quarry, developed in the Buffalo sandstone (Pennsylvanian) in sec. 21, Washington Township, Harrison County, was opened about 1889 by the Tippecanoe Stone Company and was operated by several companies until it was abandoned in 1907. In addition to these quarries and the Smallwood mine at Empire, other quarries in Ohio that produced pulpstones include:

*Wendell A. Reese of Empire, Ohio, on top of finished pulpstones produced at the Smallwood mine at Empire, 1996.*

1. The Empire Pulp Stone Company of Steubenville, which mined the Lower Freeport sandstone (Pennsylvanian) in sec. 35, Saline Township, Jefferson County. The sandstone in this quarry is uniformly coarse grained, contains little mica, and is cemented in part by iron oxide. This quarry was abandoned about 1923.
2. The Smallwood-Low Stone Company of Lisbon, which mined the Lower Freeport sandstone in sec. 14, Center Township, Columbiana County. About 1,500 pulpstones were produced and shipped annually from this quarry, including exports to Canada and Japan.
3. The General Stone Company of Amherst (Lorain County), which mined the Buffalo sandstone near Steubenville in sec. 25, Island Creek Township, Jefferson County. This quarry produced two sizes of pulpstone: some were 62 inches in diameter and had a 54-inch-wide face, and some were 54 inches in diameter and had a 27-inch-wide face. Some of these pulpstones were shipped to Canada. This quarry employed 30 to 40 men.
4. The International Pulp Stone Company of Elyria (Lorain County), which mined the Lower Freeport sandstone at California Hollow near East

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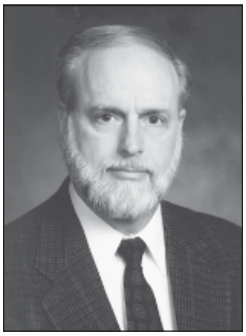

*Thomas M. Berg, Division Chief and State Geologist*

# *From The State Geologist...*

Thomas M. Berg

## USE OHIO ROCK!

We frequently hear slogans like "Buy American" or "Buy Ohio" encouraging people to utilize domestic resources rather than relying on imports. I support that concept and would like to offer another slogan: **"Use Ohio Rock!"** Doug Crowell's fascinating article on pulpstone in this issue of *Ohio Geology* gives some idea of the diversity of uses of Ohio stone. Our state is richly endowed with a wide variety of building stones that can be used in all kinds of construction. Much of Ohio's natural stone has an intrinsic beauty that cannot be duplicated synthetically. Even though artificial stone is becoming fairly common and exceptional in quality, I think there is nothing like the "real thing." Many of the abundant limestones and dolomites in western Ohio are extremely durable and aesthetically pleasing, and will last for centuries. The numerous sandstones in eastern Ohio can be used for basic construction, decorative trim, and flagging. Even the shales and clays which are so common in our state can be fabricated to all kinds of brick and tile.

The Division of Geological Survey will soon be completing a totally new bedrock geologic map of Ohio. Our geologists can use their mapping to identify all kinds of rock types that may suit the special needs of architects, engineers, and builders. The maps and related databases also can be used to develop quarry and reclamation plans and predict the amount of overburden that may need to be moved. Ohioans should give thoughtful consideration to using indigenous rock in future construction or reconstruction. Contact the Geological Survey, and we will help you find the stone resources and producers that fit your needs. If you require a particular rock type that does not occur at the surface in Ohio, we can put you in touch with other geological surveys whose states have the kind of rock you want.

Let's support our stone producers. **Use Ohio Rock!**

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## 1995 REPORT ON OHIO MINERAL INDUSTRIES

The *1995 Report on Ohio mineral industries* features statistics and directories of operators for each mineral commodity produced in Ohio (excluding oil and gas) plus an article on historic pulpstone mining. An abbreviated version of this article is the feature article in this issue of *Ohio Geology*.

In 1995, coal was produced by 63 companies at 151 mines in 23 counties. Production totalled 25,538,935 tons (10.7 percent decrease from 1994); 12,457,262 tons were produced at 143 surface mines, and 13,081,673 tons were produced from 8 underground mines. This was the first year since 1948 that tonnage from underground production exceeded tonnage from surface production. The total value of coal sold was $673,619,983; average price per ton was $26.49. The five leading counties for 1995 coal production were Belmont, Meigs, Vinton, Monroe, and Harrison. Ohio is the 15th-largest coal-producing state in the nation.[1] Wyoming, West Virginia, Kentucky, Pennsylvania, and Texas rank first through fifth, respectively. The top five coal-consuming states, in descending order of consumption, are Texas, Indiana, Ohio, Pennsylvania, and Illinois.

Limestone and dolomite were sold or produced by 81 companies at 121 operations in 52 counties in 1995. Sales totalled 67,567,697 tons (7.0 percent increase from 1994). The total value of limestone and dolomite sold was $282,857,437; average price per ton was $4.19. The five leading counties for 1995 limestone and dolomite production were Erie, Ottawa, Franklin, Delaware, and Wyandot. Ohio ranks first nationally in the production of lime, followed by Missouri, Alabama, Pennsylvania, and Kentucky. Ohio also ranks seventh in the production of crushed stone, which includes crushed sandstone; Texas, Pennsylvania, Missouri, Florida, and Georgia rank first through fifth, respectively.

In 1995, sand and gravel were sold or produced by 245 companies at 304 operations in 63 counties plus Lake Erie. Sales totalled 50,640,409 tons (1.8 percent decrease from 1994). The total value of sand and gravel sold was $195,313,568; average price per ton was $3.86. The five leading counties for 1995 sand and gravel production were Butler, Franklin, Portage, Hamilton, and Stark. Ohio ranks fourth nationally in the production of construction sand and gravel. California, Texas, and Michigan are first, second, and third, respectively, and Washington ranks fifth.

Sandstone and conglomerate were sold or produced by 19 companies at 30 operations in 17 counties in 1995. Sales totalled 1,783,308 tons (2.0 percent decrease from 1994). The total value of sandstone and conglomerate sold was $32,253,601; average price per ton was $17.86 for crushed stone and

[1]National standings were provided by the U.S. Geological Survey and U.S. Department of Energy, Energy Information Administration.

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Liverpool in sec. 24, Liverpool Township, Columbiana County. The California Hollow quarry opened in the early 1900's and employed between 40 and 50 workers. It was abandoned in the 1930's. This company also operated a pulpstone quarry near Hammondsville, Jefferson County.

Although Ohio was a national leader in the production of grindstones and pulpstones, it is the way the sandstone was mined at the Smallwood mine that is unusual.

## SANDSTONE MINING

Pulpstones and grindstones in Ohio generally were produced at quarries by surface mining methods. However, the pulpstones of the Smallwood Pulp Stone Company at Empire were produced by both surface and underground mining methods. The Smallwood Pulp Stone Company began surface mining sandstone at Empire about 1914, possibly as early as 1906. By 1917 the U.S. Geological Survey reported that the Smallwood Pulp Stone Company had active quarries at both Empire, Ohio, and Opekiska, West Virginia. The sandstone produced at the Empire mine is the Upper Freeport sandstone. This Pennsylvanian-age sandstone is about 70 feet thick and was deposited by rivers that meandered back and forth across the area. The sandstone lies about midway in the steep-sided hills west of Empire.

Once the overburden at the Smallwood mine was removed, a coal-fired, compressed-air channeling machine cut the sandstone into blocks 20 feet square and 10 to 12 feet thick. The channeling machine could cut a groove about 3 inches wide and 10 to 12 feet deep into the sandstone, using chisel-like teeth. Channeling machines were developed in the 1880's and replaced hand cutting of the grooves. The use of a channeling machine was common among northern Ohio sandstone quarry operators. Sandstone quarry operators in southern Ohio used machines called ditchers to cut circle-shaped grooves in sandstone. This machine, also developed in the 1880's, used a channeler or drill that revolved around a fixed, vertical post.

After the outline of the sandstone block was cut, holes were drilled at the base of the block. Explosive charges sufficient to crack the sandstone were placed in the holes and detonated. The sandstone blocks were split to desired sizes by additional drilling and blasting. The removal of sandstone created a highwall. As mining continued the highwall advanced farther into the hillside until an overburden thickness of about 60 feet was reached. At this point, the removal of overburden material was too costly and difficult, and normally the mining operation would be abandoned. However, the Smallwood Pulp Stone Company continued their operation at Empire by tunneling into the Upper Freeport sandstone and mining it underground.

Around 1920, three drift openings were made into the sandstone by Smallwood employees Charles and James Vance. These drift openings measure about 30 feet wide and 25 feet tall and extend into the hill approximately 150 feet before joining an entryway that runs parallel to the crop of the sandstone. The sandstone apparently was mined by room-and-pillar style of mining; room height was nearly equal to the full thickness of the sandstone. Steel I-beams were used to span the entryways to provide roof support in addition to the sandstone pillars. According to an inventory form on file at the Ohio Historic Preservation Office of the Ohio Historical Society, some of the I-beams were removed from the mine during World War II and sold as scrap iron.

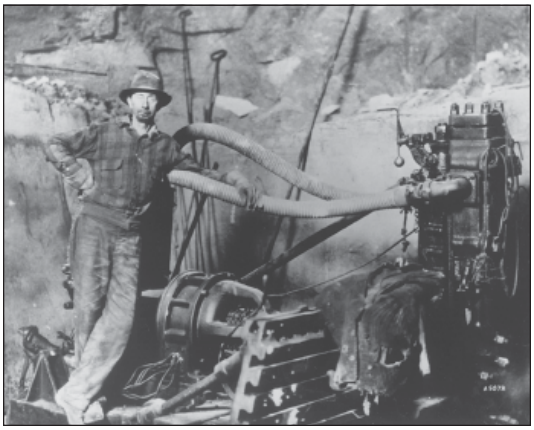
*Stacks of pulpstones and grindstones at the Latto quarry at Tippecanoe, Harrison County, 1996.*

The Upper Freeport sandstone at the Smallwood mine was mined underground by the same channeling machines that were used to mine the sandstone at the surface. Sandstone blocks produced underground were split to size and then brought to the surface by mine car for finish work.

## PULPSTONE PREPARATION

The first stage in finishing a pulpstone was to cut off the corners of the sandstone blocks, a process called "scabbling," using compressed-air tools to produce a stone with a cylindrical shape. Next, a square or round eyehole 4 to 5 inches in diameter was cut through the center of the stone. The eyehole allowed the stone to be placed on a shaft of a lathe. As the stone was turned on the lathe, iron rods resembling crowbars were held against the stone to machine a smooth, rounded edge.

The finished pulpstones at the Smallwood mine were taken down the steep hillside by an elaborate, gravity-type tramway. A steel cable passed around a drum at the top of the incline, a loaded car attached to one end and an empty car to the other.



*Quarryman next to a channeling machine used inside the Smallwood mine.* Circa *1920's. Photo courtesy of Wendell B. Reese.*

***Pulpstones were cut from sandstone strata and manually shaped into cylinders 4 to 5 feet in diameter and 2 to 4 feet wide (thick).***

*Part of the yard crew around a lathe at the Smallwood mine at Empire. As the stone revolved in the lathe, steel bars were held against the stone to give it a smooth, circular surface.* Circa *1920's. Photo courtesy of Wendell B. Reese.*

The empty car ascending the hill served as a counterbalance to the loaded car descending the hill. The finished pulpstones were hoisted onto railroad cars and transported to pulp mills in Michigan, Wisconsin, and Canada.

As the sandstone blocks were mined they were soft and contained small amounts of water, commonly called "quarry sap." The water generally drained out of the sandstone within a week or two after having been cut, but the stone remained somewhat soft. With continued exposure to air the stone hardened or seasoned, just as concrete hardens with time. This seasoning process took about a year before the stones were put into service. Freezing is harmful to fresh-cut pulpstones, therefore pulpstone operators generally worked from late spring until early fall. In describing winter shipment of pulpstones, a 1988 report by the Ohio Historical Society stated, "they [pulpstones] were packed in horse manure to keep [them] from freezing."

The Upper Freeport sandstone was mined underground at the Smallwood mine until 1932. No production was reported for this mine after 1931 and no pulpstones were produced in Ohio after 1931. The Smallwood mine remained idle from 1932 until it was abandoned in 1937. During the 1930's the pulpstone industry in Ohio and nationally was replaced by the use of artificial abrasives. Artificial pulpstones could withstand the higher stresses created by modern pulp mills better than natural pulpstones.

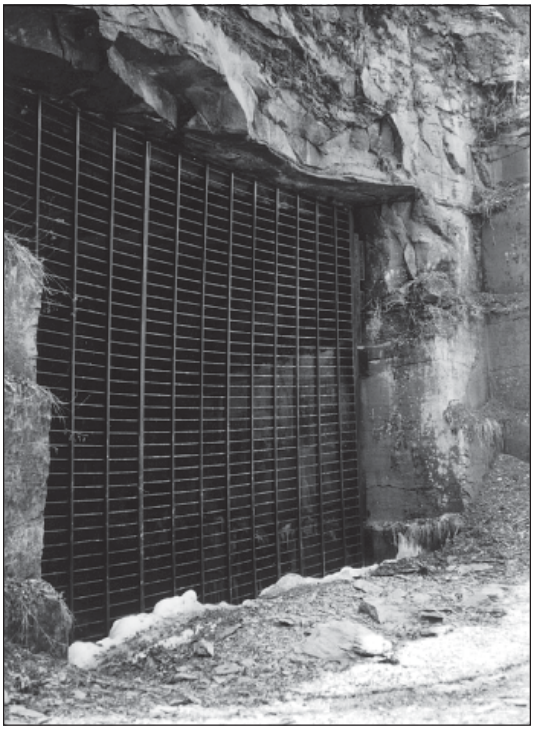
The Smallwood mine provided employment to about 40 men, many of whom spoke little or no English, according to Empire resident Shirley Bartles. The average annual wages earned by Ohio's sandstone quarrymen during the period from 1914 to 1931 ranged from $593.40 in 1914 to $1,335.51 in 1927. The average annual wages of sandstone quarrymen compare well with wages paid to workers producing other mineral commodities. The average annual wages in 1930 were: $973 to coal miners, $1,090 to clay miners, $1,182 to sandstone quarrymen, $1,347 to gypsum miners, and $1,400 to limestone quarrymen. Robert Mattern recalled that as a boy of 14 years old, during 1916, he worked as a general laborer in the quarry at California Hollow and earned $1.50 per day. Although mining sandstone provided a modest income, it allowed some to live in relative comfort. On his quarryman's salary Charlie Vance was able to purchase shoes and clothing for less fortunate children at Empire in addition to providing for his own four children, as his granddaughter Shirley Bartles recalled.

## BATS

When the Smallwood mine was abandoned the drift openings were not sealed. When any mine is abandoned the roof integrity of the openings and entryways is not maintained and these areas are not safe to enter. As a result, abandoned mine openings such as those at the Smallwood mine become attractive nuisances. Today, abandoned mines are closed for safety reasons by federal and state governments and mining companies. Permanent sealing, however, puts at risk bats that use or may use abandoned underground mines to hibernate, to raise their young, or as a migratory rest stop between summer and winter roosts. Because of the colonial nature of bats, roosting habitats need to be large and secure enough and have a proper environment to accommodate small groups of fewer than a hundred bats up to large colonies of several hundred thousand bats. Populations of over 100,000 bats are known to live in some mines of the northeastern United States and may be discovered wherever bats live near mines cool enough for hibernation.

Bats hibernate in caves or mines that have a winter temperature of 38° to 43°F, 65 to 95 percent humidity, and safety from human disturbance. More than half of North America's bat species use abandoned mines as a refuge because their roosts in old-growth trees, old barns, and other outdoor buildings are being lost. In a 1995 article, Bob Webster reported some basic bat facts: bats are not blind. They won't get stuck in your hair. And, contrary to popular belief, they seldom transmit diseases such as rabies to humans and animals. Bats do, however, eat a lot of insects and help pollinate a variety of plants. Just one colony of 150 "big brown bats" can catch enough cucumber beetles each summer to protect local farmers from 18 million of the beetle's rootworm larva, which cost U.S. growers $1 billion annually.

*Three drift openings of the Smallwood mine at Empire. The opening at right measures 25 feet tall and 30 feet wide.* Circa *1988. Photo courtesy of the Ohio Division of Mines and Reclamation.*



*Bat gate covering a drift opening to the Smallwood mine, 1996. This gate allows bats to use the mine as a hibernation site and prohibits human entry to the mine.*

When the Ohio Department of Natural Resources, Division of Mines and Reclamation considered sealing the Smallwood drift openings in 1988, an assessment was made of the site as a potential bat habitat. Although no bats were documented, the Smallwood mine site was determined to be an ideal habitat for the endangered Indiana brown bat as well as other native species. In 1991, a bat gate was erected over each drift opening to permit bat entry and prohibit human entry to the mine. Similar assessments have resulted in 20 bat gates having been erected between 1986 and 1994 at 12 different abandoned-underground-mine sites in Ohio, including the Smallwood mine. Additional abandoned-underground-mine sites are being considered by the Ohio Division of Mines and Reclamation as potential habitats for bats.


## ACKNOWLEDGMENTS

The following individuals provided valuable information or assistance for this article: Shirley Bartles, Helen Van Dyke, Mary Robinson, Wendell B. and Wendell A. "Wink" Reese, Sandy Day, Susan Burkett , Mr. and Mrs. Parker Burkett, Andrew Milarcik, Michael Puskarich, Robert and Carl Mattern, Steven Gordon, David Simmons, Max Luehrs, James Gue, Hal Miller, Mark Smith, Jeffrey Reichwein, and David Swanson .

Editor's note: This article is adapted from an article in the *1995 Report on Ohio mineral industries.*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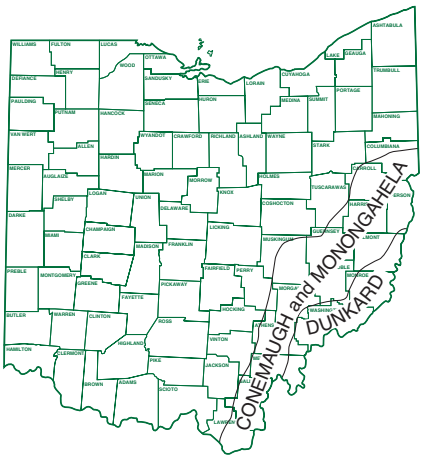
# "THOSE "D----D REDBEDS"

*It's those d----d redbeds*. A redcoat, General James Braddock, may well have been the first to utter these words. As the first road builder across the Appalachian Plateau, his wagons may have slipped, slid, and become mired in the plastic mud of wet redbeds that are so conspicuous in the Plateau.

Red rock is well known and renowned in the American West through the images portrayed in films set in the midst of towering red cliffs and dramatic still photographs of scenes in Arizona, Utah, and neighboring states. But red-colored sedimentary rocks—known to geologists as redbeds—are found not just in our West, where they measure hundreds to thousands of feet in thickness, but throughout the world, including eastern Ohio and adjacent parts of the Appalachian Plateau. However, instead of majestic sandstone cliffs, the redbeds of the Appalachian Plateau are soft shales that weather rapidly and slip, slide, and flow to form gentle contours that are quickly grassed over. They are, in fact, barely, if at all, noticed by the casual observer, and outcrops are difficult to find, even by an experienced geologist who is looking for them.

Ohio's redbeds and those throughout the Appalachian Plateau are sedimentary rocks that consist primarily of clay-sized particles but contain some silt and sand. They are commonly calcareous and may be associated with limestone. Redbeds may lack any order or structure such as smooth layering or bedding planes and may appear as a




*Distribution of landslide-prone redbeds in Ohio.*

*Redbeds interbedded with light-colored nonmarine limestone of the Monongahela Group (Pennsylvanian) along I-77, near Macksburg, Washington County.*

simple, poorly bedded mass of rock. The thickness of individual Ohio redbeds ranges from a few to tens of feet, and they are commonly sandwiched between drab-looking shale and sandstone. As the term "redbed" suggests, they are typically brick red but vary in color, and have been described by Ohio geologists as pink to red, chocolate red, reddish brown, maroon to purple, and purplish red. They may also be variegated or mottled gray and red, and locally may even be partly green. They are particularly common in Ohio in the upper half of Pennsylvanian-age rocks (Conemaugh Group and Monongahela Group) and in the Dunkard Group of Early Permian age.

The red coloring is the result of oxidation of iron-bearing minerals to iron oxide—rust. Concentrations of as little as 4 percent iron minerals (iron oxide) can effectively stain the rock red. Historically, two major hypotheses have been developed to explain the red color of these beds. One theory holds that the red staining was acquired in a tropical or semitropical environment and the red materials were then transported to an area of deposition. The opposing hypothesis contends that the red color of the sediments was obtained after deposition, through weathering, and that many redbeds represent ancient soils, known as paleosols. Recent studies suggest that Appalachian Plateau redbeds represent delta-plain sediments that have been subject to seasonal wetting/drying cycles.

Redbeds are a significant economic detriment throughout the Appalachian Plateau because of their propensity for forming landslides, although they may be useful in the future as landfill bedliners. These soft rocks composed mostly of clay deteriorate quickly when wet, becoming a sticky, gooey, plastic mud that can mire anything from beasts to vehicles of all kinds. Many years ago, while doing field work for the Survey, I found a man mired hip deep in a redbed spoil pile in a strip mine. The man's companion, surveying the stuck victim, was holding an impotent-looking spade and appeared ready to start rescue operations. The victim, to repeat a worn cliché, "was not amused" with the epithet "old stick-in-the-mud." An offer for assistance was dismissed as unnecessary, and apparently so, for an hour later when I passed the site again both were gone. I might add that this is the only instance I have witnessed where a "beast" has become entrapped in a redbed quagmire.

But landsliding, not entrapment, has been the bane of those building roads or structures resting on redbeds. Even in undisturbed areas, these beds readily slip, slide, and flow downhill. In fact, the translation for the Native American name Monongahela means "river of the caving bank." However, any cut exposing redbeds enhances conditions favorable to landsliding, as many builders have learned. Regionally, the Appalachian Plateau is second only to California in losses from landslides. So, as long as we inhabit the Appalachian Plateau, we will continue to hear the re-echoing of the statement, "it's those d----d redbeds."

*—Richard M. DeLong*

Editor's note: Richard M. DeLong retired from the Survey in 1988 after 34 years of trudging across the redbeds of eastern Ohio.

*This landslide in redbeds in the Conemaugh Group (Pennsylvanian) in 1986 destroyed the westbound lanes of I-70 near New Concord, Guernsey County. Repairs took 30 days and cost more than $600,000.*

# New oil and gas maps

The Survey now has available eight new color maps that depict the distribution of gas, oil, and storage fields in various geologic formations. These maps are at a scale of 1:500,000 and are derivatives of two recently completed projects: Gas Atlas and Tertiary Oil Recovery Information Systems (TORIS). Both projects were partially funded by the U.S. Department of Energy. The maps, which are part of the Survey's Digital Chart and Map Series (DCMS), are $8.00 each plus handling and Ohio sales tax for in-state customers. They can be ordered from the Division of Geological Survey, 4383 Fountain Square Drive, Columbus, OH 43224-1362. For additional information or to place credit-card orders please call 614-265-6576.

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| DCMS-13 | Lower and Middle Pennsylvanian sandstones undifferentiated |
| DCMS-14 | Lower and Upper Mississippian sandstones undifferentiated |
| DCMS-15 | Lower Mississippian Berea Sandstone (includes "1st Berea" and "2nd Berea") and Cussewago Sandstone |
| DCMS-16 | Upper Devonian fractured black shales and gray and black shales |
| DCMS-17 | Upper Devonian siltstones (includes "Thirty Foot" and "Gordon") and "Big Lime" (includes Middle Devonian Onondaga Limestone and Sylvania Sandstone; Lower Devonian Oriskany Sandstone; Upper Silurian Bass Islands Dolomite, Salina Group, and Lockport Dolomite |
| DCMS-18 | Lower Silurian Cataract/Medina Group ("Clinton"/"Medina" sandstone and "Packer Shell") |
| DCMS-19 | Middle Ordovician fractured shale, Trenton Limestone, and Black River Group (includes "Gull River" and Wells Creek Formation) |
| DCMS-20 | Middle Ordovician and Upper Cambrian Knox Dolomite (includes Beekmantown dolomite, Rose Run sandstone, Copper Ridge dolomite, "B-zone," and "Krysik" sandstone) |

# Ohio historical marker dedicated at McDonald quarry, Greene County

The Greene County Historical Society and the Ohio Historical Society sponsored a ceremony to dedicate an Ohio Historical Marker at the site of the McDonald Stone Quarry on the McDonald farm on Stone Road, southeast of Xenia, on July 27, 1996. This limestone quarry provided the state stone for the Washington Monument in the 1800's. In 1849, each state was asked to provide a block of native stone for inclusion in the monument honoring President Washington in Washington, D.C. A block of cut and polished limestone from this quarry was sent to Washington in 1850. The Ohio stone measures 6 feet by 3 feet by 9 inches and is in the stairwell (seventh landing) in the interior of the Washington Monument. The 555-foot monument was begun in 1848 and completed in 1885. The inscription on the Ohio stone reads: "The State of Ohio / The Memory of Washington / and / The Union of the States / Sunto Perpetus."

The quarry on Wilford McDonald's farm operated from about 1820 until 1896. The quarry probably ceased operation because seepage from a nearby spring flooded the pit. There was some small-scale removal of stone in the 1930's. The quarry site remains today as a water-filled pit.

The stone produced at the quarry is the Dayton limestone (Dayton Formation), a marine unit of Silurian age that was quarried extensively in Greene, Miami, and Montgomery Counties in the nineteenth century. The McDonald quarry had a reputation for producing one of the finest grades of dimension stone in the state. The Dayton limestone averages about 4 feet in thickness throughout its area of outcrop, but was up to 8 feet thick at the McDonald quarry. Many nineteenth-century buildings in western Ohio, particularly in the Miami Valley, used the Dayton limestone for foundations, window sills, steps, and other components. The Old Courthouse in Courthouse Square in the city of Dayton is constructed of Dayton limestone; this building is acknowledged as one of the finest examples of Greek Revival architecture in the United States. St. Peter in Chains Cathedral in Cincinnati is built mainly of Dayton limestone. The locks along the Miami and Erie Canal, on which much of the stone was shipped from Dayton to Cincinnati and Toledo, were built of Dayton limestone.

*View of water-filled quarry on the McDonald farm. The gatepost and wall in the foreground are Dayton limestone.*

ACKNOWLEDGMENT

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*continued from page 2*

$28.85 for dimension stone. The five leading counties for 1995 sandstone and conglomerate production were Geauga, Perry, Knox, Pike, and Ross. Ohio ranks 17th nationally in the production of dimension (building) stone. Georgia, Indiana, Wisconsin, Vermont, and Arizona rank first through fifth, respectively.

Clay was sold or produced by 46 companies at 56 operations in 27 counties in 1995. Clay sales (including material for captive use) totalled 1,622,813 tons (11.6 percent decrease from 1994). The total value of clay sold was $8,888,713; average price per ton was $5.48. The five leading counties for 1995 clay production were Tuscarawas, Coshocton, Montgomery, Columbiana, and Athens. Ohio ranks fourth nationally in the production of clay and shale. California, Alabama, and Texas are first, second, and third, respectively, and North Carolina ranks fifth.

Shale was sold or produced by 25 companies at 33 operations in 20 counties in 1995. Shale sales (including material for captive use) totalled 1,768,532 tons (43.6 percent decrease from 1994. The total value of shale sold was $6,351,769; average price per ton was $3.59. The five leading counties for 1995 shale production were Hamilton, Tuscarawas, Cuyahoga, Marion, and Mahoning.

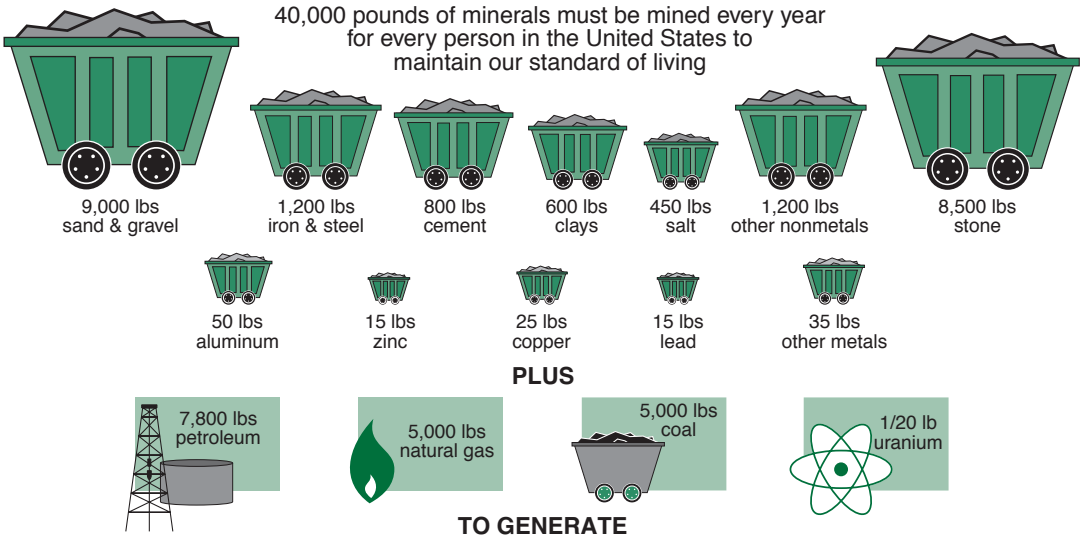
In 1995, salt was produced by 3 companies at 5 operations in 5 counties: two rock salt mines, one each in Cuyahoga and Lake Counties, and three brining operations, one each in Licking, Summit, and Wayne Counties. Salt sales totalled 4,032,637 tons (9.3 percent decrease from 1994). The total value of salt sold was $64,284,242; average price per ton was $16.18 for rock salt and $15.05 for salt in brine and evaporated salt. Ohio ranks fourth nationally in the production of salt. New York, Louisiana, and Oklahoma are first, second, and third, respectively, and Texas ranks fifth.

Gypsum was produced by 1 company at 1 operation in Ottawa County in 1995. Gypsum sales (all material was for captive use) totalled 248,719 tons (4.0 percent decrease from 1994). The total value of gypsum sold was $2,362,831; average price per ton was $9.50. Ohio ranks 12th nationally in the production of gypsum. Oklahoma, Iowa, Texas, Michigan, and Nevada rank first through fifth, respectively.

Peat production was reported by 5 companies at 5 operations in 4 counties (Champaign, Montgomery, Portage, and Williams) in 1995. Peat sales (including material for captive use) totalled 18,557 tons (163.8 percent increase from 1994). The total value of peat sold was $131,445; average price per ton was $7.08. Ohio ranks tenth nationally in the production of peat. Michigan, Florida, Maine, Illinois, and Minnesota rank first through fifth, respectively.

Copies of the *1995 Report on Ohio mineral industries* are available from the Division of Geological Survey for $7.50 plus $2.00 mailing; orders to Ohio addresses must include 5.75 percent tax ($0.43). Credit-card (Visa or MasterCard) orders can be placed by calling 614-265-6576.

*—Sherry L. Weisgarber*

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