

THE PAVING BRICK INDUSTRY IN OHIO

by Steven D. Blankenbeker, Cedar Heights Clay, Oak Hill, Ohio

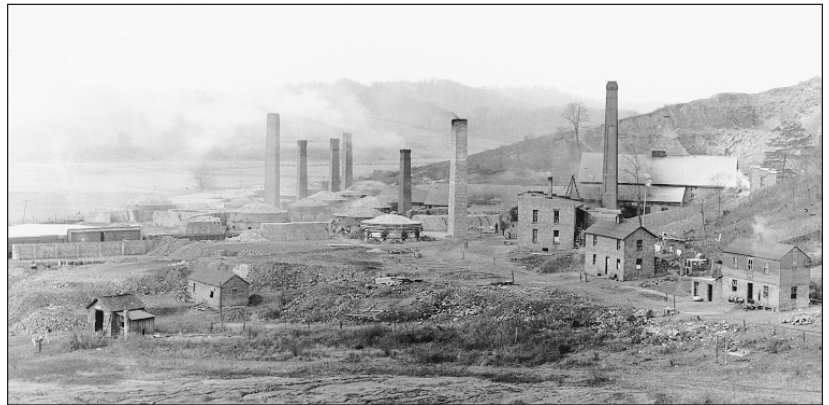
The native rocks and sediments of Ohio have provided raw materials to industry since the earliest pioneers entered the state. Today, many of these same materials, such as coal, clay, limestone, salt, and sand, continue to contribute to the economy. But one industry that used the rich mineral resources of Ohio has nearly faded from the landscape. If not for the durability of the products, the paving brick industry of Ohio would be easily forgotten. Today, however, we can still see lasting reminders of this industry in the streets, alleys, and sidewalks of nearly every town and village in our state.

The paving brick industry flourished in Ohio from the 1880's until the 1930's—50 years and hundreds of millions of paving bricks. Miles and miles of roads in Ohio and the Midwest were paved with these heavy bricks (also called blocks or pavers). So well suited for this purpose were these bricks that many streets in use today are nearly the same as they were when the bricks were laid nearly 100 years ago.

A paving brick is larger than a conventional building brick—traditionally 9 inches x 4 inches x 4 inches and weighing about 10 pounds. The larger size helped keep the block from being dislodged by a vehicle or weather. Typical traffic of the late 1800's was horse-drawn carriages and pedestrians, so the earliest bricks obviously were made without automobiles in mind. Paving bricks also had to be resistant to weathering. A porous brick would absorb moisture and fail in freezing weather. A porous brick also would be structurally weak and more likely to wear away in high-traffic areas. To create a brick having low porosity and high strength presented the paving brick manufacturer with a difficult task.

PRODUCTION OF PAVING BRICK

Brick production in the late 1800's normally involved molding bricks in wooden molds. Local shales, fireclays (plastic and flint clays that are resistant to heat), or surface clays were the raw material, and firing was done in beehive kilns fueled with coal. The quality of these products was sufficient for buildings, but the consistency of the firing was less critical than for pavers. Firebricks (highly heat-resistant bricks used to line furnaces), as well as some ornamental bricks, were being made by presses at this time, but molding was still the most common production method. Extrusion was just becoming a viable means of manufacturing and generally required more water than molding did. For pavers, the challenge was to form a large brick, dry it without cracking, and fire it to a low absorption. The mass in the kiln was much greater for pavers, and the temperature required was much



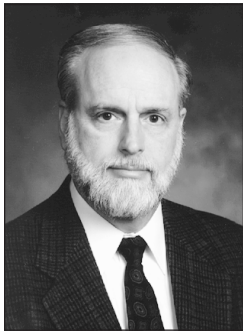
A view of the brick works of the Carrollton Granite Brick Company in Carrollton (Carroll County), circa 1900. Note the beehive kilns.

higher (to achieve low porosity) than for building bricks. Certainly, there were many failures in firings; losses of up to 50 percent were not uncommon in the early years of paver manufacturing. Some firing cycles lasted nearly a month. A brick that was well fired so that the grains were fused and the pores were closed was termed “vitrified.”

Paving brick had to be compacted to a higher density than a pressed firebrick. Paving bricks commonly were extruded to roughly the finished size and then “re-pressed” to square up the brick and further increase the density. Re-pressing allowed the manufacturer to “brand” the brick—impress the company's name on it. Because nearly all re-pressed pavers were branded, today we can still identify the manufacturer. Re-pressing also allowed the brickmaker to produce either lugs (small knobs at the corners of the face) or raised lettering on the brick. When the bricks were laid, these raised areas kept the bricks spaced apart just enough to allow pitch or sand to be introduced between them to help secure the roadbed. Grooves commonly were



BUCK EYE paving brick, circa 1895, made by the Roseville Brick and Terra Cotta Company at Roseville, on the Perry-Muskingum County line. Photo by Michael D. Williams.



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Ohio Geology

A quarterly publication of the

Ohio Department of Natural Resources
Division of Geological Survey
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Columbus, Ohio 43224-1362

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World Wide Web: [http://
www.dnr.state.oh.us/odnr/geo_survey/](http://www.dnr.state.oh.us/odnr/geo_survey/)

Ohio Geology is a free publication. To
become a subscriber please contact the
Division of Geological Survey at the
above address, phone numbers, or e-mail.

Editor: Michael C. Hansen
Layout/Design: Lisa Van Doren

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From The State Geologist...

Thomas M. Berg

STRIKING A BALANCE BETWEEN WISE USE AND PROTECTION OF OUR NATURAL RESOURCES

The lead article in this issue of *Ohio Geology* features the very interesting history of the paving brick industry in our state. Steve Blankenbeker's narrative also reminds us of the crucial role the mineral industries play in our daily lives. Ohio's mineral industries are working hard to provide the products that our citizens have come to expect. Many have heard the slogan, *If it's not grown, it's mined*. How true that is! We would not have bricks to build our homes, schools, hospitals, and other structures if we were unable to mine the clay and shale needed to make the bricks.

Every Ohioan needs to know that we cannot sustain our present standard of living without all the important products Ohio mines produce. It's also important for every Ohioan to recognize that today's miner is deeply concerned about environmental security and is dedicated to reclaiming the land. The Ohio Department of Natural Resources' mission is: *To ensure a balance between the wise use and protection of our natural resources for the benefit of all*. In order for the Department to pursue this mission, it must have an accurate knowledge of the location, quantity, and quality of Ohio's mineral, fuel, and water resources. An accurate geologic framework is needed to develop a clear awareness of what can be used and what must be protected. To that end, the Ohio Geological Survey continues to build that framework through its geologic-mapping programs, subsurface investigations, and mineral, fossil-fuel, and geologic-hazard assessments.

The Division of Geological Survey continues to produce the unbiased, impartial, and integrated geologic information needed by all who are concerned about mineral production and environmental protection. Mining companies can count on obtaining the specifics about the location, quantity, and quality of Ohio's mineral resources as the Survey moves ahead with its investigations. At the same time, the Division is working hard to develop the capability of making that same information available to counties, townships, planning agencies, and environmental-protection organizations so that intelligent land-use decisions can be made efficiently and effectively.

List of educational resources updated

An updated *List of educational resources* has been issued by the Survey. This free publication lists nontechnical and technical publications and programs of the Survey that are of interest to teachers, students, and hobbyists, as well as educational materials and programs of other divisions of the Ohio Department of Natural Resources. The list includes an extensive compilation of sources of additional Earth science and educational information such as publications, CD-ROM's, videos, science programs, and World Wide Web sites. Please request a copy of the *List of educational resources* from the Geologic Records Center of the Survey (see contact information below).

1998 Report on Ohio mineral industries

The *1998 Report on Ohio mineral industries* contains production and employment information and operator directories for minerals produced in Ohio, as well as information on oil and gas wells drilled in the state. The report includes a *Mineral industries map of Ohio* (black and white, scale approximately 1:750,000, or 1 inch equals about 12 miles). The price of the report is \$10.00 plus \$0.58 Ohio sales tax and \$2.50 shipping and handling and can be ordered from the Ohio Division of Geological Survey, Geologic Records Center, 4383 Fountain Square Dr., B-2, Columbus, OH 43224-1362; telephone: 614-265-6576; fax: 614-447-1918; e-mail: geo.survey@dnr.state.oh.us. Visa and MasterCard are accepted.

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added to the back of the bricks for the same purpose. It was much easier to put lugs on a brick than raised lettering, so manufacturers apparently abandoned raised letters shortly after the turn of the century. Thus, a paver that has raised letters is generally an older type. Many companies produced extruded pavers and by-passed the pressing operation. These common pavers generally bear no brand, unless a manufacturer rolled the brand on the edge or end of the brick. There is no way to know the manufacturer of most unpressed bricks.

There were a few specialty types of pavers. A "hill" block has a beveled edge on one face that gave a horse a secure foothold on slopes. "Rail" blocks were used wherever a road traversed railroad tracks, allowing brick to be laid right up to the rails. "Depot" or sidewalk blocks were a thinner, vitrified paver that would still resist weathering. Some oversized blocks—5 inches in height—were produced. It is hard to imagine mass producing these exceptionally large bricks. Most of the larger pavers made in Ohio were made in the northern part of the state.

RAW MATERIALS

Raw materials were abundant in eastern Ohio, but paving brick manufacturers had specific requirements. A clay that required very high temperatures to become watertight was undesirable. Only relatively low-maturing fireclays could be used. Because most fireclays have a high degree of plasticity or "stickiness," fireclay required a higher percentage of water to make it workable, and extra water was undesirable because it slowed drying and increased shrinkage. Therefore, only low-plasticity or "short" fireclays could be used alone to make pavers. Shales are low-maturing materials, but they typically lack sufficient workability to form well. The best paving bricks were those made from a good forming shale or those made from a combination of shale and fireclay. A material having a wide firing range was also an asset.

The type of materials used to make a paver can be determined in part by the block's color. Fireclay pavers are generally buff or yellow, and shale pavers are dark red, brown, or purplish. If you break most shale pavers, buff specks of fireclay commonly are visible, indicating that clay was added to help the forming. Additions of fireclay were typically about 15 percent.

Shale generally was mined in open pits using shovels, although some may have been mined underground. Some surface shale deposits exceeded

100 feet in thickness and required very little earth moving to get to the material. In some cases, mining only involved blasting the shale from an exposed outcrop. This practice was common in the Portsmouth district, where Upper Mississippian shales of the Cuyahoga Formation are well exposed along the Ohio River. Cleveland-area brickyards used mostly Devonian-age shales of the Chagrin Member of the Ohio Shale, easily obtained from exposures along the Cuyahoga River valley. Fireclay typically was mined underground. The majority of brick plants relied on coal for fuel. In many places the clay and coal were available in the same mine, as most fireclays are underclays directly below the coal.

The shales and fireclays of eastern Ohio gave the brickmaker quite a selection from which to choose his raw materials. The alluvial drift materials of western Ohio are too fine grained and have too short a firing range to produce a large brick. Therefore, nearly all paving bricks in Ohio were produced east or south of Columbus. So readily available were good materials for brickmaking in the eastern half of the state that other factors, such as fuel supply, market, and shipping facilities, probably were as important when deciding on a site. Many brickyards were located adjacent to established rail lines or near rivers or canals for barge shipping. Many paving brick factories were actually converted firebrick or sewer-pipe plants, or were plants that made many types of clay products.

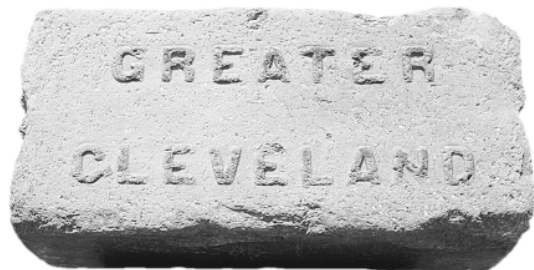
PAVING BRICKS IN OHIO

The first bricks used for road surfacing in Ohio were made in Newell, West Virginia, by Captain John Porter. His bricks, made from the Lower Kittanning fireclay, were used to pave a portion of Third Street in Steubenville (Jefferson County) in 1884. The quality of these first bricks was such that, in 1910, Steubenville city officials stated that the bricks had not cost them \$1.00 in repairs since they had been laid 26 years earlier.

The first paving bricks manufactured in Ohio were made at Malvern, in Carroll County, in the summer of 1885, by John Kratz and Ross Rue. These first bricks, made from the Middle Kittanning fireclay, were only 2½ inches x 4 inches x 8½ inches. This small enterprise in 1888 became the Canton & Malvern Fire Clay Paving Brick Company.

About this same time, the Hocking Clay Manufacturing Company of Logan, in Hocking County, began making Hayden Block—a large brick resembling a concrete block and weighing 16 pounds. In 1885, this company supplied enough of their block to pave 3,704 square yards of Lexington Avenue in Columbus. It took 22 blocks to pave 1 square yard. By 1893, they had supplied block to pave 345,347 square yards of pavement on 38 streets in the capital city. These very large blocks were salt glazed, a process in which salt is introduced into the kiln during firing, resulting in a glaze forming on the surface. These 100+-year-old blocks can still be seen in the streets of German Village, south of downtown Columbus. The Hocking Clay Manufacturing Company later moved to Haydenville (Hocking County).

These early successes led many other firms to begin manufacturing paving block in Ohio. By 1893, 44 separate firms were producing bricks for paving, and 357 kilns were being used exclusively for pavers. The annual production of paving brick in Ohio in 1893 was 292 million blocks. To put this in perspective, it required approximately one-half



A very large, raised-letter paver from Cleveland, circa 1905 (manufacturer unknown). This brick, which measures 3½ inches x 5 inches x 10 inches and weighs 15 pounds, is the largest paver made in Ohio. Photo by Michael D. Williams.

million blocks to pave 1 mile of road 25 feet wide. Thus, there were enough pavers produced annually to pave nearly 600 miles of road.

Some areas in eastern Ohio had materials that were exceptionally well suited for making paving bricks. Around Malvern, in northwestern Carroll County, where the first Ohio pavers were made, the Middle Kittanning coal and fireclay were situated at perfect tippel height throughout the Sandy Creek valley. Materials could be drift mined in the adjacent hills and delivered by rail right to the plants. Numerous plants, including ones in Minerva and Waynesburg, were built in the area to use the Middle Kittanning fireclay.

A paver from Malvern, called "Blue Granite Block," was awarded a medal for its quality in a paving brick competition at the 1893 World's Columbian Exposition in Chicago. ("Granite" was a common term for pavers, inferring that the product was "granitelike" or very hard.) The block was made jointly by the Malvern Clay Company and the Canton & Malvern Fire Clay Paving Brick Company. After receiving the medal, these two firms began placing a likeness of the medal, including a depiction of Christopher Columbus, on their bricks. These wonderfully decorative and historic bricks can still be seen today around Malvern. Another, similar brick, which has a Liberty head profile on it, was made at Carrollton (Carroll County) by the Carrollton Granite Brick Company at about the same time.

An oversize paving brick of the Robinson Clay Products Company commemorating the medal-winning 1893 World's Columbian Exposition in Chicago. The medal image is of Christopher Columbus. Note the combination of raised and impressed letters. This brick was made after 1900. Robinson took over the Malvern Clay Company. Photo by Michael D. Williams.



The Canton area in Stark County is adjacent to major outcrops of Clarion shale, which was a good material for pavers. The Pro Football Hall of Fame occupies the site of the old Williams brickyard, and the nearby stadium was built in the shale pit. Canton would eventually become known as the "paving brick capital of the world"; no fewer than nine plants manufactured pavers in the area. The modern-day Belden Brick Company, which has a number of plants in Tuscarawas County, started out making paving block near Canton as the Canton Brick Company. However, it was the dominance of the Metropolitan Paving Brick Company that was critical to the growth of Canton brickmaking. The company was formed in 1902 by the merger of the Imperial Shale Paving Brick Company and the Royal Brick Company. They soon bought other plants in the area, including some near Cleveland, and eventually had control over most of the paver production in northeastern Ohio. Metropolitan Block can still be seen in streets all over the country. Peak production was in 1923, when Metropolitan shipped 92 million pavers.

Zanesville, which has been famous for its ceramic products since the mid-1800's, had several brick companies, including the Harris, Townsend, and Jones brick works. In addition to the high-quality fireclays that supplied the pottery and tile

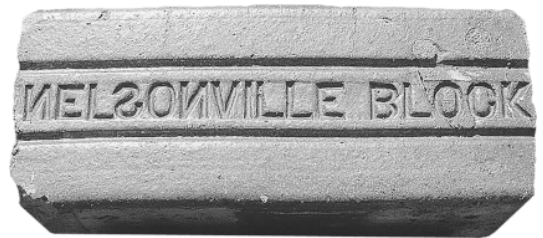


Metropolitan Block, a common paving brick. Note the diamond-shaped lugs. Photo by Michael D. Williams.

industries, there were several shale seams available for brickmaking, including the Clarion and Middle Kittanning. Most of the brickyards were located just east of town.

The Portsmouth district, stretching along the Ohio River in Scioto County from Sciotoville to Portsmouth, was famous for its firebrick production beginning in the 1860's. Several established brickyards switched to making pavers, and other plants were constructed specifically to produce paving block. Easily obtainable local shales and the availability of the river for shipping made this an ideal place to produce pavers. The Portsmouth district supplied brick to many towns all along the Ohio and Mississippi Rivers.

Nelsonville pavers, produced in the Hocking River valley in northwestern Athens County, are known for their salt-glazed surfaces. This glazing helped to make the pavers watertight and gave the blocks a very distinctive and attractive surface. Most of these bricks were made from the Lower Kittanning fireclay. Some of the old kilns and stacks of the Nelsonville Brick Company are preserved at Brick Kiln Park, on the west side of Nelsonville. Nelsonville also is famous for its decorative sidewalk pavers, which include stars, circles, and flowers, all having the characteristic glazed surface.



A salt-glazed Nelsonville block. Note the backward letters. Photo by Michael D. Williams.

Other towns along the Hocking River valley that had brickyards were Logan, Glouster, Athens, and Trimble. The village of Trimble boasts that its "Trimble Block" was used to pave the Indianapolis Speedway. A few towns in Indiana make the same claim though, and the Speedway maintains that Hoosier bricks alone were used. The Speedway commonly is referred to as "the brickyard," recalling the early days when the entire track was paved with brick. Today, only the start/finish line is brick. When the track was first surfaced in 1909, paving brick was still regarded by many people as an unproved surfacing material. The success of the paved surface at the Indianapolis Speedway certainly helped the industry in general, regardless of who manufactured the bricks. Bricks from Alliance, in Stark County, were marked "Speedway Block," no doubt using the connection to the fa-

mous brick-surfaced race track to help promote their product.

A unique brick-producing town in Ohio is Middleport, on the Ohio River in Meigs County. Most of the roads and sidewalks here are still surfaced with locally produced brick. These pavers were made at two plant sites, both of which started operations about 1890. The Riverside Brick Company plant was on the riverbank. The Middleport Granite Brick Company sat back just off the river. Eventually these two firms merged to become the Middleport Brick Company. These plants were unique because of their selection of raw materials—both used alluvial floodplain silt, found throughout the Ohio River valley. This silt was fine enough that it required little if any preparation prior to being formed into a brick. The lack of preparation is indicated by the presence of alluvial pebbles in many bricks. These pavers are among the darkest, glassiest bricks to be found. Some have an iridescent surface. The glossy appearance is due to the high silica content of the silt, which upon firing melts with alkaline minerals to form a type of glass.

Another town on the Ohio River that produced unusual bricks is Marietta, in Washington County. Here the Pennsylvanian-age red shales of the Conemaugh Group were used by several companies, including Cislser, Sterling, and Acme, to produce some of the most brilliant red bricks found anywhere. A brick rarely maintains such a true red color when it is fired at temperatures approaching vitrification.

Even the State of Ohio once made paving block. The State used prison labor to make bricks marked "O B A" (Ohio Board of Administration) at prison brickyards at Roseville, on the Perry-Muskingum County line, and at Junction City, in Perry County.

The brands on paving bricks commonly include the manufacturer of the brick or the city in which it was made, or both. The brand on some extruded pavers include the year in which the bricks were produced. Several brick designs were patented. One design, patented by Mr. Hallwood, was very popular in the early days of paving brick manufacturing because it included parallel grooves around the entire brick to help bond the brick to sand or pitch. "HALLWOOD" blocks were produced by many companies. Companies using the Grant brick machine, invented by one of the owners of the Riverside Brick Company of Middleport, included the word "GRANT" on their bricks.

Many bricks bear confusing information, such as those branded "Wheeling" that were made in

Bellaire (Belmont County), Ohio, or ones marked "Youngstown" that were made in Bessemer, Pennsylvania. "Portsmouth Granite" blocks were made in Firebrick, Kentucky. Some bricks have backward letters; these may or may not have been intentional. The letters "s" and "n" seem to have caused the most problems and occur backward with surprising frequency.

By the Depression years of the 1930's, road building had changed dramatically. Automobiles were common, and the need for more and better roads was increasing. Alternative surfacing materials such as cement and asphalt were overtaking brick. Roads could be laid faster and cheaper with other materials, and the demand for paving brick was gone. Most plants that survived converted to some other form of clay working. The Whitacre-Greer Company at Alliance (Stark County) is the only Ohio firm still producing pressed vitrified pavers.

Because many of the old bricks have survived the years and remain today in excellent shape, it is easy to collect hundreds of them, including many with distinctive designs and lettering. Old brickyard sites, city garages, creeks, and ditches are all good places to find pavers. In addition to the ones already mentioned, the following cities and towns are believed to have had a yard producing pressed pavers at some time: Ashtabula and Conneaut (Ashtabula County); Wellsville (Columbiana County); Coshocton (Coshocton County); Collinwood and Willow (Cleveland suburbs, Cuyahoga County); Empire and Toronto (Jefferson County); Wickliffe (Lake County); Coal Grove and Ironton (Lawrence County); Lorain (Lorain County); Garfield (Mahoning County); Woodsfield (Monroe County); East Fultonham and Ellis (Muskingum County); Ava (Noble County); Corning and New Straitsville (Perry County); South Webster (Scioto County); Massillon, Minerva, North Industry, Waco, and Waynesburg (Stark County); Akron (Summit County); Newcomerstown (Tuscarawas County); Hamden (Vinton County); and Wooster (Wayne County).

Nearly 1,000 different types of branded paving brick have been identified from Ohio; nearly 100 different types of branded pavers are attributed to just the Portsmouth-area brickyards. The Ohio Ceramic Center at Roseville has large displays of various paving blocks from throughout the state, including many of the ones mentioned in this article.

Editor's note: this article is condensed from an article of the same name in the *1998 Report on Ohio mineral industries* (see p. 2).

The best paving bricks were those made from a good forming shale or those made from a combination of shale and fire-clay.

Ohio's Mineral Industries & the Environment— North And South teachers workshops

Forty-six educators from Ohio explored issues of Ohio's mineral resources, mining, reclamation, and environmental protection during the 13th annual Ohio's Mineral Industries & the Environment—North and South workshops sponsored by the Ohio Department of Natural Resources, Division of Geological Survey and the University of Akron, Department of Geology. The northern Ohio workshop was conducted July 12-16 and was based at the University of Akron. The southern Ohio workshop was conducted July 26-30. Classroom sessions were held at the Ohio Aggregates & Industrial Minerals Association's offices in Gahanna.

The field trips were based at the ODNR Fountain Square complex in Columbus.

The 1999 workshops had 18 more participants than any previous year, due largely to the financial assistance given the workshops by a large number of sponsors. Grants totaling nearly \$13,000 were contributed by the Ohio Aggregates & Industrial Minerals Association and 13 of its member companies: American Sand & Gravel, Inc., Belden Brick Co., Hanson Aggregates Midwest, Kimble Clay & Limestone Co., Olen Corp., Oster Sand & Gravel, Inc., C.F. Poeppelman, Inc., Quality Ready Mix, Inc., S & S Aggregate, Inc., Schloss Materials Co.,





Workshop participants observe a mining operation at a shale pit of the Belden Brick Co. in Tuscarawas County.

Shelly Materials, Inc., Ward Materials, Inc., and Wyandot Dolomite, Inc. Additional financial assistance was provided by the Ohio Mining and Reclamation Association (now known as the Ohio Coal Association), Women in Mining, Northern Ohio Geological Society, Eastern Section of the American Association of Petroleum Geologists, Ohio Geological Society, Piqua Catholic Schools, and Sylvania City Schools. Sponsor donations paid for the field trips, a three-quarters reduction in participants' tuition fees, and a dinner/reception for participants. The American Coal Foundation, American Electric Power, American Geological Institute, Mineral Information Institute, National Mining Association, National Stone Association, and U.S. Geological Survey supplied educational materials.

First offered in 1987, these week-long summer workshops provide teachers with an in-depth look at Ohio geology, the importance of Ohio's fuel and nonfuel mineral industries, and how environmental protection is compatible with mining. Many Ohioans are unaware that coal, oil/gas, limestone/dolomite, sand/gravel, sandstone/conglomerate, clay/shale, gypsum, salt, and peat are produced in Ohio. Also, many do not know how these mineral resources are used daily, or how important these mineral resources are to the economy of Ohio.

In two half-day classroom sessions taught by experienced professionals from academia, industry, and state regulatory agencies, the workshop participants learned about Ohio's geology, mining and utilization of Ohio's mineral resources, and the regulations that govern mineral extraction in Ohio. During three full days and two half-days of field trips, participants saw how current mining practice, while meeting our mineral resource needs, does leave land in an attractive, valuable condition. The field trips provided ample opportunities to talk with industry representatives, have a first-hand look at current mining and reclamation practice, and to sample a variety of rocks and fossils.

The 23 participants at the northern Ohio workshop observed the mining and reclamation activities at a sand and gravel mine of American Sand &

Gravel, Inc., in Stark County and a shale mine and brick plant of Belden Brick Co. in Tuscarawas County. They toured a mine of Kimble Clay & Limestone Co. in Tuscarawas County that produces coal, clay, and limestone and is also a site of a landfill. They visited the limestone-mining operation of Sandusky Crushed Stone Co. (Rogers Group, Inc.) in Erie County, where they had an opportunity to see a blast. They also toured the gypsum mine and wallboard plant of Celotex Corp. in Ottawa County, and the limestone quarry and lime plant of Martin Marietta Magnesia Specialties, Inc., in Sandusky County. When two field-trip stops cancelled at the last minute, the participants learned that sometimes flexibility is a key element to conducting a workshop. One cancelled stop was replaced by a tour, arranged the night before, of a hardwood-bark mulch plant of Weisgarber Trucking Co., Ltd., in Wayne County. The workshop participants learned that the preparation of wood by-products into mulch uses processes and equipment (crushing/grinding, conveyors, screens, large front-end loaders, and trucks) identical to that used by the mining industry. The second cancelled stop was replaced by a visit led by Glen Mulvaney of MB Operating Co., Inc., to an operating oil and gas drilling rig in Stark County. This stop was arranged an hour before the tour by one of the workshop participants. This tour and a tour led by Ken Miller of the Cow Palace, an oil and gas museum in Wayne County, taught the participants about the mechanics of drilling for oil and gas, as well as the economics and environmental concerns of oil and gas production.

The 23 teachers at the southern Ohio workshop observed sand and gravel mining at Olen Corp. in Franklin County and mining and reclamation activities at a coal, clay, and limestone mine of Waterloo Coal Co. in Vinton County, where they experienced a blast. They visited Buckeye Furnace State Memorial, a reconstructed charcoal-iron furnace, and toured a manmade wetland constructed to mitigate acid mine drainage from surface and underground abandoned mine land. They visited a shale mine and brick plant of Bowerston Shale Co. in Licking County, a limestone-mining operation of Martin Marietta Aggregates in Franklin County, and a sandstone mine and glass-sand-processing plant of Olgebay Norton Industrial Sands, Inc., in Perry County. Doug Core, a geologist and oil and gas consultant, led a tour of a working oil and gas pump in Licking County and explained the economics and environmental concerns of the oil and gas industry.

The overwhelming interest and enthusiasm expressed by the teachers each year indicate that the effort and partnerships of all those involved have been successful. Including this year's 46 teachers, 296 elementary through high school teachers have earned 2 graduate or undergraduate credit hours by participating in the workshops. An estimated 97,400 students have benefited from the practical information presented to teachers.

The next northern Ohio Mineral Industries & the Environment workshop will be June 26-30, 2000. The southern Ohio workshop will be July 10-14. Teachers interested in taking one of these workshops can be placed on a notification list by contacting Dr. Roger Bain, Department of Geology, University of Akron, Akron, OH 43235; telephone: 330-972-7659; or by e-mail: rbain@uakron.edu.

—Douglas L. Crowell

THE OHIO MINERAL INDUSTRIES IN 1998

Data compiled by the Ohio Department of Natural Resources, Division of Geological Survey for the *1998 Report on Ohio mineral industries* (see p. 2) indicate that Ohio's mineral industries remained strong in 1998. Four nonfuel mineral commodities—sand and gravel, limestone and dolomite, sandstone and conglomerate, and shale—set all-time sales records. The total value of coal, industrial minerals, and oil and gas sold in Ohio in 1998 was \$1.8 billion, a 3.5 percent decrease from 1997. The value of nonfuel minerals continued to increase steadily, recording a 72 percent increase since 1991 (see graph). Coal was produced from 129 mines, and nonfuel minerals were produced from 495 operations. A total of 52 mines produced multiple mineral commodities (for example, coal and clay). There were 445 new wells completed for oil and gas in 1998, of which 322 were productive and 123 were dry. More than 8,000 people were directly employed by the mineral industry in Ohio during 1998.

Coal was produced by 52 companies at 129 mines in 21 Ohio counties in 1998. Production decreased 9.4 percent from 1997, totaling 27.8 million tons (all tonnages reported are in short tons). Reduced production at the state's three largest underground mines accounted for almost the entire decrease. Eight underground mines produced 14.7 million tons in 1998, and 121 surface mines produced 13.1 million tons.

Belmont County again led the state in coal sales in 1998 (6.0 million tons). Vinton, Meigs, Monroe, and Harrison Counties each sold more than 2 million tons. Three companies sold more than 2 million tons each in 1998: Southern Ohio Coal Co., a subsidiary of American Electric Power (5.3 million tons); Ohio Valley Coal Co. (4.3 million tons); and Quarto Mining Co., a subsidiary of Consolidation Coal Co. (2.4 million tons).

The Pittsburgh (No. 8) coal was the most heavily mined seam in 1998, followed by the Clarion (No. 4A), Meigs Creek (No. 9), Middle Kittanning (No. 6), and Lower Freeport (No. 6A) coals. Because of high sulfur content, approximately 17.5 million tons of Ohio coal was washed prior to delivery to electric-generating power plants. The average price paid for Ohio coal in 1998 was \$27.97 per ton; the total value was \$765 million. Ohio coal mines and associated facilities directly employed 3,397 persons in 1998.

Limestone and dolomite were sold or produced by 74 companies at 118 operations in 49 Ohio counties in 1998. Sales totaled 79.5 million tons, a 2.6 percent increase from the record set in 1997. This increase continues an upward trend that began in 1982, when less than 28 million tons of limestone and dolomite were sold in Ohio.

The five leading counties for limestone and dolomite sales in 1998 were Ottawa (7.6 million tons), Erie (7.2 million tons), Delaware (6.2 million tons), Wyandot (5.5 million tons), and Franklin (5.0 million tons). Five companies had sales greater than 4 million tons: National Lime & Stone Co. (13.0 million tons), Martin Marietta Aggregates (9.6 million tons), Stoneco, Inc. (5.4 million tons), LaFarge Corp. (5.0 million tons), and Hanson (4.4 million tons). Six individual mines produced in excess of 3 million tons each.

The total value of limestone and dolomite sold in Ohio during 1998 was \$357 million. Average price per ton was \$4.49. Ohio limestone and dolo-

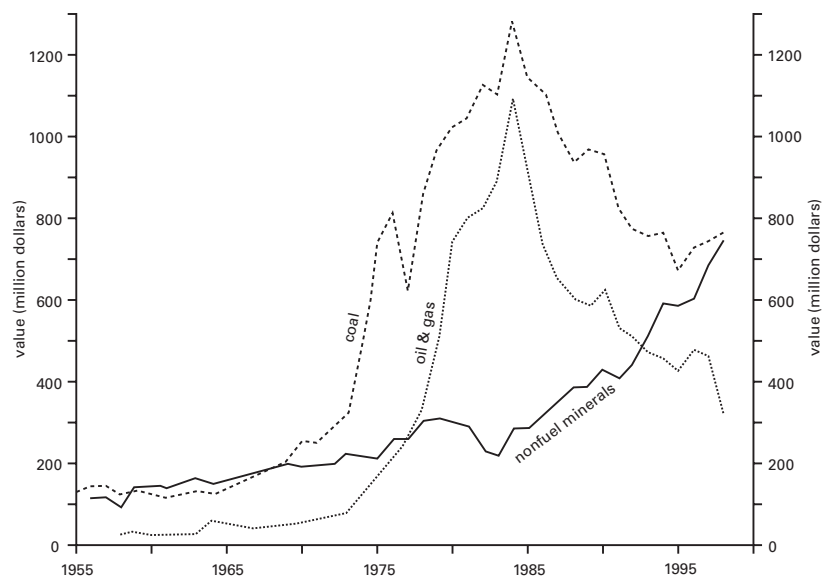
mite quarries directly employed 2,175 persons in 1998. Crushed stone for road construction was the primary use of Ohio limestone and dolomite in 1998. Lime produced from Ohio limestone and dolomite totaled 1.3 million tons in 1998 and came from five operations in Ottawa, Sandusky, and Wyandot Counties. Ohio ranks 4th nationally in both the production of lime and in the production of crushed stone (which includes sandstone).

Sand and gravel were sold or produced by 223 companies at 301 operations in 60 Ohio counties plus Lake Erie in 1998. Sales totaled 59.4 million tons, a 3.8 percent increase from 1997. Sand sales accounted for 29.68 million tons, and gravel sales accounted for 29.76 million tons. Nationally, Ohio ranks 4th in the production of construction sand and gravel and 9th in the production of industrial sand and gravel.

Five counties, located primarily in the state's metropolitan areas, had sales of more than 4 million tons each in 1998: Hamilton (6.2 million tons), Franklin (5.9 million tons), Butler (5.6 million tons), Portage (5.5 million tons), and Stark (4.5 million tons). The leading sand and gravel companies were Martin Marietta Aggregates (11.7 million tons), Shelly Materials, Inc. (4.1 million tons), Olen Corp. (4.0 million tons), and Watson Gravel, Inc. (2.1 million tons). Most Ohio sand and gravel operations are small to medium in size, although seven pits produced more than 1 million tons each, led by Olen Corp.'s Columbus Plant #3 (2.3 million tons).

The total value of sand and gravel sold in Ohio during 1998 was \$254 million. Average price per ton was \$4.28. Ohio sand and gravel operations directly employed 1,897 persons in 1998. Aggregate for road construction and the building industry was the primary use of Ohio sand and gravel in 1998.

Sandstone and conglomerate were sold or produced by 22 companies at 33 operations in 19 Ohio counties during 1998. Sales totaled 5.7 million tons, an all-time record for the state. The 124 percent increase in sales compared to 1997 is almost entirely attributed to the crushed sandstone



Value of coal, nonfuel minerals, and oil and gas in Ohio.

used in construction of a landfill and wetlands system at American Electric Power's Gavin coal-fired power plant in Gallia County. Gallia, Geauga, Knox, Lorain, and Perry Counties accounted for 92.7 percent of the total sandstone production. Dimension sandstone production decreased 10 percent to 42,000 tons. Ohio ranks in the top 2 sandstone dimension-stone-producing states.

The total value of sandstone and conglomerate sold in Ohio during 1998 was \$51 million. The mining of sandstone and conglomerate in Ohio directly employed 282 persons during 1998. Crushed sandstone was used primarily for glass-making and construction; the majority of the sandstone dimension stone was used for rough construction.

Clay was sold or produced by 48 companies at 59 operations in 24 Ohio counties during 1998. Sales, including material for captive use, totaled 2.2 million tons, a 45 percent increase over 1997. Tuscarawas, Perry, Lucas, Stark, Paulding, and Columbiana Counties accounted for 70.0 percent of the total sales of clay. Three Ohio clay-producing companies in Ohio sold more than 200,000 tons in 1998: Suburban South Recycling and Disposal Facility, Belden Brick Co., and Seaway Sand & Stone, Inc. Ohio ranks 5th in the nation in the production of clay and shale.

The total value of clay sold in Ohio (including captive use) in 1998 was \$8.8 million. The mining of Ohio clay directly employed 238 people in 1998. The major uses of Ohio clay in 1998 were for the manufacture of common clay products such as bricks and in the landfill industry.

Shale was sold or produced by 23

companies at 30 operations in 16 Ohio counties during 1998. Sales, including material for captive use, totaled 4.0 million tons, a 38.7 percent increase over 1997. Hamilton, Tuscarawas, Stark, Cuyahoga, and Marion Counties accounted for 94.4 percent of the total shale sales in Ohio during 1998. Rumpke Mountain Mining Co. alone accounted for 64 percent (2.5 million tons) of Ohio shale sales in 1998. Four companies had sales of more than 150,000 tons: Hydraulic Press Brick Co., Glen-Gery Corp., Waste Management of Ohio, Inc., and Belden Brick Co.

The total value of shale sold in Ohio (including captive use) during 1998 was \$8.9 million. The mining of Ohio shale directly employed 122 people in 1998. The major uses of Ohio shale in 1998 were as landfill liners and in the manufacture of common clay products such as bricks.

Salt was produced by 3 companies at 5 operations in 5 Ohio counties during 1998. Tonnage sold in 1998 included 3.1 million tons from two large underground rock-salt mines in Cuyahoga and Lake Counties and 865,000 tons from three salt solution-mining operations in Licking, Summit, and Wayne Counties for a total of 3.9 million tons, a 7.7 percent decrease from 1997. Ohio ranks in the top 5 nationally in salt production.

The total value of salt sold in Ohio in 1998 was \$64.7 million. Average price per ton was \$16.58. The Ohio salt industry directly employed 445 persons in 1998.

Gypsum was produced by one company (Celotex Corp.) at one operation in Ottawa County. Production and sales (all material was for captive use) totaled 255,000 tons, down 3.4 percent from 1997.

Celotex's Port Clinton Plant underwent significant changes during 1997-1998 to decrease operating costs. A new in-pit crusher and conveyor system, the installation of a new wallboard dryer system, and the mining of a more pure seam of gypsum have reduced labor costs by 50 percent. The total value of gypsum sold in 1998 was \$2.3 million. Average price per ton was \$9.00. Ohio ranks 15th nationally in production of gypsum.

Peat was produced by 4 companies at 4 operations in Champaign, Portage, and Williams Counties during 1998. Peat sales, including material for captive use, totaled 10,000 tons, a 41.7 percent decrease from 1997. Total value was \$109,000. Average price per ton was \$10.69. Peat in Ohio is used primarily for mulch and soil mixture.

The Ohio Division of Oil and Gas estimates 514 wells were drilled in 1998, a decrease of 265 wells from 1997. The top 5 counties in number of new wells drilled in 1998 were Washington, Wayne, Licking, Coshocton, and Athens. The total reported crude oil production in Ohio in 1998 was 6.5 million barrels, a 23.9 percent decrease from 1997. The dollar value of crude oil produced in Ohio in 1998 was \$77 million, a decrease of 49.5 percent from 1997. Natural gas production in Ohio in 1998 was 108.5 billion cubic feet, a decrease of 7.6 percent from 1997. The dollar value of gas produced in Ohio in 1998 was \$243 million, a decrease of 22.5 percent from 1997. Ohio ranks 17th nationally in the volume of natural gas produced and 18th in the volume of crude oil produced.

—Mark E. Wolfe

Ohio Geology

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