GEOLOGICAL SURVEY OF OHIO

WILBER STOUT, State Geologist

Fourth Series

Information Circular No. 1

MINERAL RESOURCES OF OHIO

by

WILBER STOUT

COLUMBUS
1938

THE F. J. HEER PRINTING CO.
Columbus, Ohio
1938

MINERAL RESOURCES OF OHIO

The mineral resources of Ohio consist for the most part of the common kinds, but because they are very useful and plentiful they are a source of much wealth to the State. The most important of these are coal, clay, shale, limestone, dolomite, sandstone, conglomerate, iron ore, stones for abrasive use, marl, peat, gypsum, salt and flint. Further, from the deep-seated rocks we get petroleum, natural gas, and salt brines from depths of from 300 to 6,000 feet or more.

These mineral resources are conveniently distributed over the State, occur under favorable conditions for recovery, have good marketing facilities over the great trunk railroads, and have available fuel for power and smelting operations.

Ohio holds sixth rank in the United States in the value of its mineral production. It is surpassed by Pennsylvania, largely through coal and cement, by Oklahoma, Texas, and California through petroleum, and by West Virginia through coal and natural gas. The three adjoining states—Pennsylvania, West Virginia, and Ohio—constitute an area whose mineral resources are not exceeded elsewhere in the world. This wealth of material has led to great industrial development. Annually Ohio's mineral production is valued from $100,000,000 in periods of depression to more than $200,000,000 in years of special activity.

COAL

Coal may be listed first among Ohio's important resources because this fuel may be interpreted as power and power as industry. The Moravians who made the first settlement in Ohio in 1772 at Schoenbrunn knew of the presence of coal in the Tuscarawas Valley and attached some importance to it. Before 1800 its occurrence in a number of localities was recorded by soldiers, travelers, and surveyors. The first definite use of coal in Ohio as a fuel appears to have been in 1808 for the evaporation of brine at the Jackson "Salt Licks". Records show that in 1810 the Sharon coal was worked in a ravine at Tallmadge and the Pittsburgh coal was mined by drifting at Steubenville. Mineral fuel was mined and offered for sale in 1814 at Zanesville. Coal shipments on the Ohio River began by flatboats in 1819 and by a regular towboat in 1835. After this coal mining developed rapidly, the fuel being used mainly for heating and steaming purposes. A great impetus to the use of this fuel came in

1845 with the placing in blast of Mary furnace at Lowellville, burdened entirely with coal as the smelting medium. Coal furnaces, in all over 70, were then built in rapid succession in Youngstown, Massillon, Jackson, Ironton, the Hocking Valley, Steubenville, and Niles. The opening of the Lake trade about 1860 also increased mining in a large way. At present coal mining is very active and is one of the State's important industries.

The coal-bearing rocks of Ohio have a maximum thickness of approximately 1,575 feet and extend over an area of 12,340 square miles. The counties with important coal fields are Belmont, Jefferson, Harrison, Athens, Guernsey, Tuscarawas, Perry, Muskingum, Stark, Meigs, Columbiana, Hocking, Jackson, Carroll, Coshocton, Noble, Morgan, Vinton, and Lawrence. The total production for the State is normally about 30,000,000 tons, although the mean consumption is around 70,000,000 tons, the extra coal coming from West Virginia, eastern Kentucky, and western Pennsylvania.

The number of distinct coal beds that have been named in Ohio is 53. Of these 17 are mined in a large way; 18 are worked locally for domestic fuel; and 18 are too thin or bone to be useful in an economic way. The total amount of available fuel is at least 50,000,000,000 tons. Ohio coals are adapted for general heating, steam generation, burning of ceramic ware, artificial gas, and other common purposes.

Cannel coal also occurs in Ohio. This is a variety of bituminous coal, with massive structure, compact texture, dull luster, and conchoidal fracture. It is high in volatile matter, derived from the special enrichment of seed spores, resins, and gums. Cannel coal is found in small fields at a number of localities and is mined mainly near Canfield in Mahoning County, Millersburg in Holmes, Warsaw in Coshocton, and Flint Ridge in Licking. These cannel coals were first employed with charcoal for iron smelting in some of the old charcoal furnaces. In the early fifties they were distilled for kerosene for lighting homes. Near Warsaw, cannel coal was retorted for a few years for the tar products, benzine and anthracine, for bases for the dye industry. Such fuel is now used for cheerful grate fires for the home.

PETROLEUM

Ohio has derived a large income from petroleum. This substance was recorded in this State in 1814 through the drilling of a well for salt brine at Olive just east of Caldwell in Noble County. However, the first production of petroleum in the State on a commercial basis was in the William Rayley well drilled in 1860 at Macksburg in Washington County.

Since this discovery more than 150,000 wells have been drilled in Ohio. Of these about 70 per cent have produced either petroleum or natural gas in paying quantities. The depth of drilling ranges from 100 feet to 7,890 feet. In western Ohio granite has been reached in wells near Gibsonburg, Findlay, Tiffin, and Delaware. Production occurs at many horizons and in sandstones, conglomerates, dolomites, and limestones. Some of the important sands are Trenton of northwestern Ohio, Clinton and Oriskany in the east central part, and Berea, Big Injun, Keener, Maxton, Macksburg, and Cow Run in the southeastern part. The value of the petroleum now produced in Ohio is roughly about $6,000,000 annually.

NATURAL GAS

Hildreth in the report of 1838 records the discovery of natural gas in drilling for brines at Olive in Noble County in 1814, on Leading Creek in Meigs County in 1822, and on the Hockhocking River in Athens County in 1824. No use, however, was made of this gas. The intense drilling for petroleum after 1860 naturally led to the discovery of natural gas in many wells, but it was then considered a detriment instead of an asset. In 1874 gas from a small pool near the mouth of California Hollow near East Liverpool was piped to dwellings and to a pottery. In a large way the commercial use of natural gas began in this State in 1884 with the discovery of great flows in wells near Findlay in the Trenton dolomite. This gave an impetus to drilling throughout large areas and soon led to a large increase in production. The most important was the discovery of the great Clinton field at Lancaster in 1887. The sands of most importance are, in ascending order, Trenton, Clinton, Oriskany, Ohio shale, Berea, Keener, and Maxton. Natural gas is a mineral resource worth to the State approximately $8,000,000 annually.

CLAYS AND CLAY PRODUCTS

The turning of ware on the potter's wheel, one of the oldest industries known to man, was brought into the Ohio settlements through the demand for various utensils for the household. It began in a small way in many places in the State, usually in country shops worked seasonally with farming or in progressive villages with special advantages for raw materials or for trade. The first factory of any kind in Cincinnati appears to have been an earthenware pottery operated by William McFarland in 1799. This industry soon flourished also in Zanesville, Steubenville, Hillsboro, Akron, East Liverpool, Salem, and other centers. The increase in settlements and the advance in civilization created demands for other lines of wares, hence to meet these needs, yellow ware was introduced

in 1840, fire brick in 1841, door and furniture knobs in 1844, sewer pipe in 1851, white ware in 1860, electrical porcelain in 1872, floor and wall tile in 1874, sanitary ware in 1888, etc.

The rise of Ohio to an eminent position in the production of ceramic wares may be attributed to an abundance of clays and shales over extensive areas, to their excellent working properties, to their fitness for a wide variety of useful wares, to the plentiful supply of fuel for manufacture and burning, to intelligent labor skilled in all phases of the work, to efficient means for transportation—railroad, boat, and truck—and to the commanding position of the State for the general markets of the country. Ohio takes first rank in the United States in the value of its clay products. The annual valuation is about $35,000,000 and in peak times it has reached close to $100,000,000.

The range of ceramic products is wide, only the general classes being mentioned here. The products include stoneware, earthenware, Rockingham, white ware, cooking ware, electrical porcelain, drain tile, common brick, back-up block, building brick, salt-glazed brick, paving block, sewer pipe, fireproofing, fire brick, conduits, glass pots, chemical stoneware, floor and wall tile, roofing tile, quarry tile, terra cotta, and novelties.

LIMESTONES AND DOLOMITES

The consolidated rocks throughout the western half of Ohio are limestones, dolomites, and calcareous shales. However, thinner, more local, and less valuable deposits are present throughout the coal fields in the eastern and southeastern parts.

A limestone may be defined as a rock composed largely of calcium carbonate, a dolomite as one composed of about 56 parts calcium carbonate and 44 parts magnesium carbonate. In the main, both groups were laid down in parts of the sea where the water was warm, fairly shallow, and moderately clear. These rocks are of wide application, directly or indirectly having more than 200 distinct uses. The limestones are employed for Portland cement, steel and blast furnace flux, water softening, agricultural lime, hydrated lime, glass making, chemical industries, ceramic glazes, paint pigment, soap and glycerine, and allied uses. Dolomites are widely employed for mortars, plasters, railroad ballast, road metal, concrete aggregate, flux stone, dolomite refractories, carbon dioxide for dry ice, ingredients of glass and glass wool, many chemical purposes, and building stone. To Ohio the limestones and dolomites are an asset of more than $15,000,000 annually. The supply is practically unlimited and the quality good.

SANDSTONES AND CONGLOMERATES

The pioneer settlers, mainly through necessity for a durable material, first turned the sandstones in the eastern half of the State to profitable account in building homes, mills, factories, dams, bridges, canal locks, furnaces, cupolas, public buildings, etc., as a progressive step in the development of the State. Such materials were widely distributed over the area, had outcrop exposures favorable for quarrying, were readily fashioned by the mason into desired forms, and in general were pleasing to the eye or gave appeal to the sense of durability. The sandstones of Ohio have a wide range in color, texture, and composition. The color range varies from nearly white through gray, buff, yellow, brown, and pink to dark shades. Some are banded in an attractive way and most retain pleasing and permanent shades. When sandstones become distinctly pebbly they are known as conglomerates. In these the pebbles are quartz, mainly vein quartz, and vary in size from wheat grains to hen's eggs. Prominent sandstones are the Berea, Buena Vista, Massillon, Clarion, Cow Run, Waynesburg, and Marietta; and conspicuous conglomerates are Allensville, Black Hand, and Sharon.

The sandstones and conglomerates of Ohio have been very useful in many other roles than for building purposes. Some of the most important of these may be mentioned. The iron industry in this State began on a sandstone lining. Such material continued as the standard lining for the charcoal furnaces from the building of Hopewell furnace on Yellow Creek in 1804 to the blowing out of Jefferson near Oak Hill in December, 1916. These sandstone linings served the purpose very well as the material was moderately refractory, was fairly resistant to abrasion, was very effective in meeting the acidity of the slag, and was so changed by heat—the quartz grains passing to tridymite—as to become impervious to gas penetration. The hearths of the early forges and cupolas were also made of sandstone. Later ganister or the hard clay-bonded sandstones of southern Ohio found extensive use for lining Bessemer convertors and soaking pits in steel plants.

SAND AND GRAVEL

Sand and gravel, although very common materials, are of importance in this State as they occur in abundance, have wide application, and are the basis for large plants. Such deposits are largely the work, either directly or indirectly, of the great glaciers that in Pleistocene time extended over about three-fifths of the area and contributed materials carried out along the main drainage ways in the remaining portion. The best deposits, regarding sorting, sizing, etc., are the outwash beds along

streams such as the Miami, Little Miami, Scioto, Hocking, Muskingum, and Tuscarawas rivers. Further, outwash aprons along moranic fronts, and kames and eskers within the glaciated areas also provide much good material. On this account both sand and gravel are widely distributed and easily available at the surface. Such sand is employed mainly for mortars, plasters, concrete work, and filter beds; and the gravel has extensive use for railroad ballast, highway metals, walks, concrete, filter aggregate, etc.

MOLDING SANDS

Molding sands are the fine-grained, siliceous sands bonded with clay matter and iron oxides and useful in the metal industries for making molds for castings. Such deposits are well scattered over Ohio but are most abundant in the eastern half. Some are of glacial origin, others are alluvials laid down along streams, many are only residuals from the natural decay of stratified sandstones, and a few are wind blown loesses. The regions most productive are Gallia, Muskingum, Perry, Jackson, Holmes, and Tuscarawas counties. These sands are marketed for the steel, gray iron, aluminum, brass, bronze, and other alloy industries.

BRINES

Brines for the manufacture of salt have been of great importance to Ohio since the industry was initiated in 1797 by white settlers at Jackson. However, these brines here issuing from the base of the Sharon conglomerate along Salt Creek had been worked in a crude way for hundreds of years by the aborigines who evaporated the weak solutions by the heat of the sun or by boiling over wood fires. Soon after 1800 the industry gained headway in Muskingum, Columbiana, Morgan, Athens, Tuscarawas, Gallia, Meigs, and Guernsey counties.

These brines are considered to be conate or fossil sea water held in the interstices of the rock and left there through the process of deposition of the rock mass in the sea. Later such salt solutions were greatly enriched and considerably modified by operations of nature not well understood. The concentration of the brines varies from 37 grams per thousand, that of sea water, to 280 grams per thousand, that of some salines from the deep-seated rocks. In general, the deeper the brine the greater the concentration. Good commercial brines are now pumped from depths ranging from 1,000 to 3,000 feet.

Brines yield directly and indirectly products that find wide application to human needs. These include medicines, dyes, insecticides, flavors, industrial chemicals, metals and alloys, acids and alkalies, and various

others. A few of the most prominent compounds may be mentioned: bromoform, potassium bromide, chloroform, epsom salt, phenol, methyl salicylate, salol, coumarin, aniline oil, carbon disulphide, mining salts, sulphur chloride, magnesium, Dow metal, ciba dyes, indigo, lime sulphur, para dichlor-benzene, and many others.

ROCK SALT

In Ohio the salt brines are augmented by great deposits of rock salt. In the northeastern part of the State beds of rock salt occur far down in the consolidated rocks in an area over 7,000 square miles. On account of the dip of the rocks, such deposits lie at depths of approximately 1,850 feet at Cleveland, 2,200 feet at Painesville, 2,600 feet at Rittman, 4,500 feet near Alliance, 4,700 feet at Freeport, and 6,400 feet at Bellaire. The salt beds belong in the Salina formation, one of the upper divisions of the Silurian system. The salt is always more or less bedded with dolomite and shale and ordinarily makes up less than half the mass. Single layers of salt often become massive, expanding to 50, 80, or even 100 feet.

The origin of such rock salt deposits is of much interest. The beds appear to be derived simply from the concentration of sea water to a density favorable for the crystallization and the deposition of the salt grains. As depth is one of the controlling factors of utilization, the deposits now worked lie toward the western margin of the field where the formation is from 1,600 to 3,000 feet in depth. The method of attack is to penetrate the salt strata by the standard tools of the oil driller in a number of rather closely-spaced holes. Fresh water is then pumped into the wells and allowed to stand for some time, after which the brine, near saturation, is lifted by pumps and forced to the works. Through repetition of this procedure channels and cavities are dissolved in the salt layers and eventually a subterranean circulation is established from one well to another some distance away. The brines obtained in this way are highly charged with salt and are thus economical for evaporation.

During the early periods of the salt industry such brines were attractive simply for the common salt useful for general domestic purposes and for meat packing. Now other leading products marketed are soda ash, sal soda, caustic soda, bicarbonate of soda, special sodas, special alkalies, sodium sulphate, calcium chloride, bromine, chlorine, and hydrochloric acid.

GYPSUM

Gypsum or the mineral calcium sulphate was formed where a part of the sea was so detached that evaporation produced precipitation of the

sulphate salt. The area where gypsum is found in this State is not large. The commercial deposits are confined to that portion of Ottawa County lying between Lake Erie and Sandusky Bay. The rock is mined by stripping and by drifting and is then graded, crushed, and calcined for the plaster-of-Paris of commerce. The product is used extensively for fireproofing, wall board, pottery molds, stucco, white coat of plaster, statuary, crayons, retarder for Portland cement, fertilizer base, and for many other purposes.

IRON ORES

The iron ores of Ohio have small economic value at present but in the pioneer days they were important factors in the development of the settlements and adjacent country and later they aided greatly in establishing trade throughout the Ohio and Mississippi valleys. In this State iron making began in old Hopewell furnace on Yellow Creek near Poland in Mahoning County. This small stack was built by Daniel Heaton in 1804, was operated by water power, and ran on native ores, local limestone, and charcoal from the near-by forests. Statistics show that 222 separate and distinct stacks have been built in Ohio, largely in the eastern half. Of these 85 were charcoal furnaces run on native ores, 60 were coal furnaces operated on native ore with some Lake ore, and 77 were modern stacks using coke for fuel and Lake ores for the ferruginous part of the burden. The main furnace centers were Hanging Rock in southern Ohio, the Hocking Valley in the central part, the Youngstown district near the eastern line, the Ohio River group in southeastern Ohio, and the Cleveland district on Lake Erie.

CONCLUSIONS

Thus Ohio is rich in the common rocks and minerals. Our present civilization requires greater quantities of natural materials, a far wider range of products, and a more careful adjustment as to quality. This State is fortunate in that it has both the quantity and the quality of the common minerals and has facilities for their manufacture and marketing. The rocks and minerals now form the basis for thousands of mining operations and for huge and varied industries involving millions of dollars of capital. The high development of the State is due in large measure to the abundance of the mineral resources and to their intelligent employment for many purposes.

Blank page

DONALD L. NORLING