The Lime Industry of Indiana

BULLETIN 42-J

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FRONTISPIECE

Artist Robert E. Judah's concept of a log-heap lime kiln as described by his father, David A. Judah. A good-quality lime was produced from the kiln for raising much-needed agricultural products shortly after World War I. The kiln was 1 mile northwest of Stinesville in Monroe County.


R. JUDAH
INDIANA GEOLOGICAL SURVEY
1972

The Lime Industry of Indiana

By CURTIS H. AULT, LAWRENCE F. ROONEY, *and* MARGARET V. PALMER

DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY BULLETIN 42-J

PRINTED BY AUTHORITY OF THE STATE OF INDIANA
BLOOMINGTON, INDIANA: 1974

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By CURTIS H. AULT, LAWRENCE F. ROONEY, *and* MARGARET V. PALMER

Introduction

Although Indiana has abundant limestone resources available for producing lime, these resources have not been used for commercial production since 1953. Some insight into this seeming paradox can be gained through an analysis of the history, the present status, the probable future, and the economics of lime production in Indiana.

Indiana's lime industry has not been well documented, and no comprehensive study of lime production in Indiana has been written since 1938. W. S. Blatchley, Indiana state geologist from 1895 to 1910, wrote about the lime industry of Indiana in his annual report for 1903. He briefly outlined the general nature of lime, its uses, Indiana's mineral resources, and the methods of burning lime. He described the past and present production of lime in Indiana and the plants active at the time: their location, resources, costs, and production.

In the "Handbook of Indiana Geology" (1922), W. N. Logan presented a similar outline of lime production in Indiana. He described the nature and uses of lime and listed the lime-producing centers in Indiana and the chemical analyses of the stone being used. He also gave a brief history of lime production in selected areas. In 1938 G. F. Fix outlined the possibilities of producing lime in Indiana and estimated that Indiana could produce far more lime than it was producing from its abundant resources. In a report on high-calcium limestone and high-magnesium dolomite, L. F. Rooney (1970) presented an evaluation of rocks in Indiana suitable for producing lime.

What Is Lime?

Lime (or quicklime) is calcium oxide (CaO) and is produced by calcining (heating limestone to drive off CO_2) according to the following reaction:

$$CaCO_3 + \text{heat} \rightleftharpoons CaO + CO_2.$$

Dolomitic lime is calcium and magnesium oxide ($CaO \cdot MgO$) and is produced by calcining dolomite:

$$CaCO_3 \cdot MgCO_3 + \text{heat} \rightleftharpoons CaO \cdot MgO + 2CO_2.$$

Theoretically, 56 pounds of lime is obtained by burning 100 pounds of pure limestone.

The temperature required to dissociate limestone is greater than that required to dissociate dolomite, and both are affected by impurities and the partial pressure of carbon dioxide. At 1 atmosphere pressure of CO_2, high-calcium limestone dissociates at about 900°C and high-magnesium dolomite dissociates through a considerable range of temperature but averages about 725°C (Boynton, 1966, p. 134). Lime is white when it is pure CaO or $CaO \cdot MgO$, but impurities give it a blue or yellow tint.

Lime is classified according to its chemical composition; that is, whether it contains a large percentage of calcium or magnesium. According to Boynton and Gutshick (1960, p. 498) typical analyses of commercial high-calcium limes range from 93 to 98 percent CaO and from 0.3 to 2.5 percent MgO. Typical analyses of commercial dolomitic or high-magnesium lime range from 37.6 to 40.8 percent MgO. Although, as mentioned, limestone and dolomite are reduced to about half their original weight during calcining, all the most common impurities, silica and alumina, remain and their effective percentage almost doubles. Part of the impurities will react with the lime during calcining, and thus the percentage of remaining chemically active lime will be further decreased. For many uses lime does not need to be exceptionally pure, but because lime is a low-cost bulk commodity it must be produced in large quantities and be able to meet most specifications. Therefore, to be used for lime production, limestone and dolomite must be fairly pure and contain no more than a small amount (say 2 percent) of either silica or alumina.

Uses of Lime

The many ways in which lime is used (fig. 1) reflect the utility of lime in industry. During the history of the lime industry in Indiana

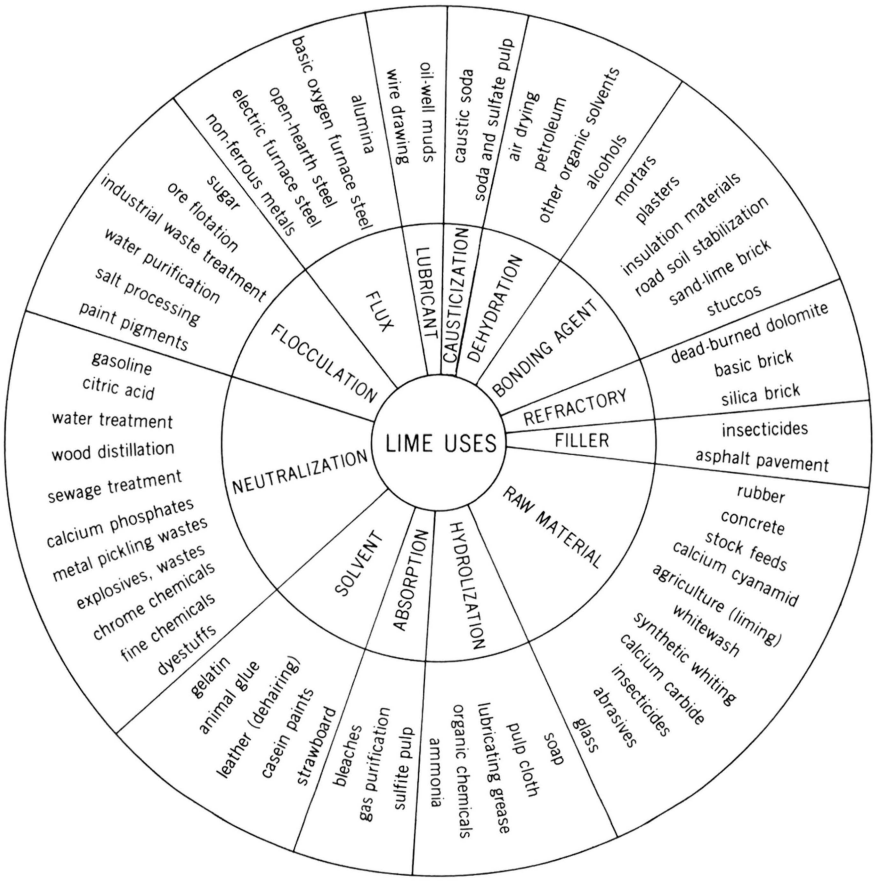

Figure 1. Uses of lime. Modified from Key, 1965, fig. 4.

and the United States, the major uses of lime have shifted as technological advances have eliminated some of its former uses and created new ones (figs. 2 and 3). Bowles and Banks (1936, p. 11) reported that 86 percent of the lime sold in the United States in 1906 was used for building purposes, 8 percent for chemical and manufacturing processes (including refractory dolomite and flux stone), and 6 percent for agricultural purposes. By 1934 the trend

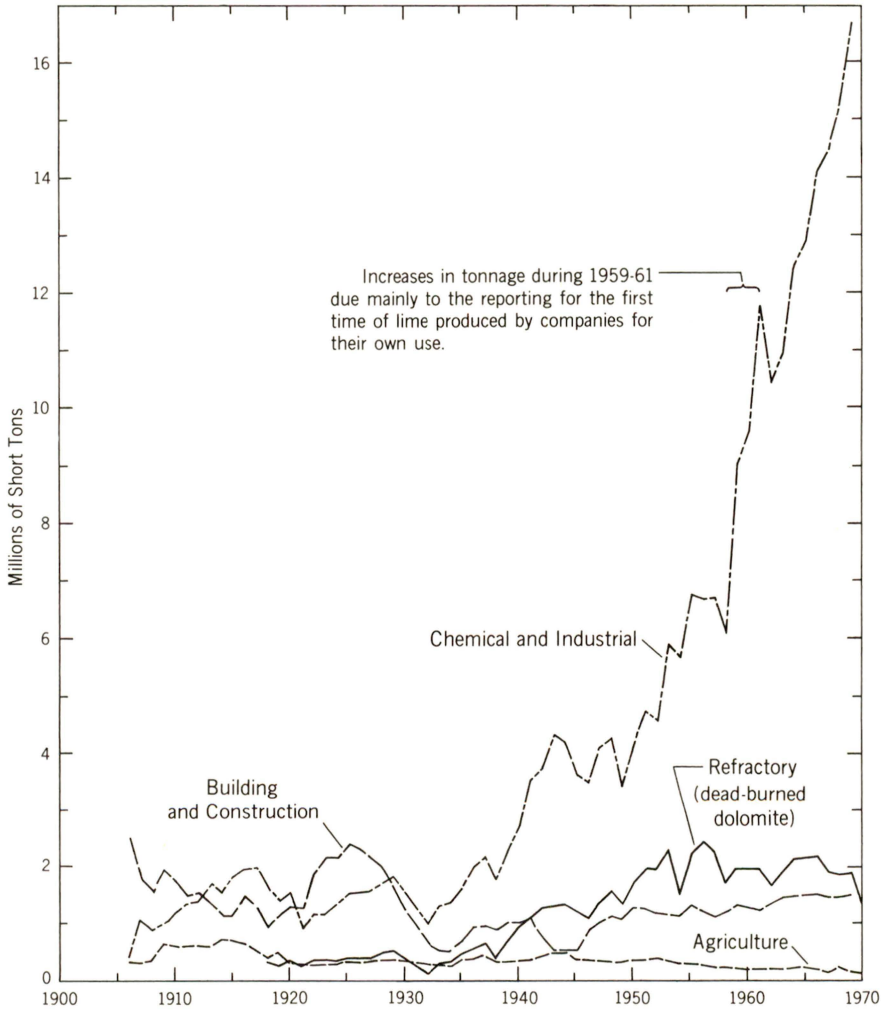

Figure 2. Major uses of lime in the United States, 1906-70. Data from U.S. Bureau of Mines.

had shifted, so that 27 percent was being used for building, 64 percent for chemical processes and manufacturing, and 10 percent for agriculture. By 1970 the proportions had reached 8 percent for building, 91 percent for chemical processes and manufacturing, and only 1 percent for agriculture.

Until recent years the major use of lime was for mortar (lime

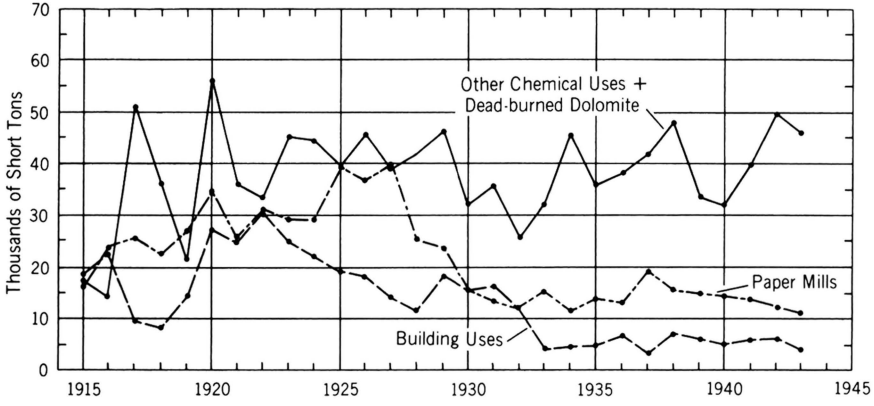

Figure 3. Major uses of lime in Indiana, 1915-43. Data from U.S. Bureau of Mines.

putty mixed with sand and water). In the 1890's, when portland cement was introduced on a large scale into the United States, it largely replaced lime as a mortar because it was stronger and set faster. Lime is still added to mortar, however, to improve its plasticity and workability. Between 1900 and 1930 much lime was mixed with portland cement for use in concrete, but technological advances have made portland cement alone more stable, and lime is no longer used.

Lime also can be used for making plaster. In the 1890's gypsum began to take over the plaster market because it set faster and produced a stronger plaster. By 1920 gypsum plaster had virtually replaced lime plaster for base coats, but lime is still sometimes used to give a smooth surface to the finishing coat. Lime is also used for exterior plaster or "stucco." For structural purposes, such as for mortar, high-magnesium lime is considered by many to be superior to high-calcium lime because of its slower setting, higher strength, and greater plasticity.

Sand-lime bricks are manufactured in some areas where sand and lime are available and other building materials are scarce. The bricks are made by mixing lime and quartzose sand, pressing them into bricks, and subjecting the bricks to high steam pressure. The sand grains become cemented by a hydrated calcium-silicate bond. These

bricks, widely used in western Europe and the U.S.S.R., have not been used extensively in the United States, where portland concrete bricks and blocks and clay bricks are used instead. The first sand-lime bricks in the United States were manufactured in 1901 in Indiana at Michigan City (Mance, 1915, p. 283).

Much of the lime produced during the early and middle 19th century was used to neutralize and condition the soil. It was for that reason that many farmers owned and operated their own kilns and thus accounted for much of the lime production in the United States (including Indiana) at that time. Later, fertilizers and low-cost ground limestone rapidly replaced lime, and the consumption of lime for agricultural purposes has steadily dwindled. Dolomitic lime has slightly more neutralizing capacity than high-calcium lime, but the two types are thought to work equally well.

Today the largest consumers of lime are the chemical and metallurgical industries. After sulfuric acid, lime is the most important chemical in terms of tonnage produced in the United States (Patterson, 1960, p. 464) and is the lowest priced alkali. In recent years the increasing public and industry awareness of the need for pollution control has increased the demands for lime for treatment of potable water and for treatment of sewage and trade wastes. These uses accounted for the consumption of more than 1.5 million tons of lime in the United States in 1969 (Gutschick, 1971, p. 55).

Lime has always been important to the steel industry. It is used in fluxing pig iron and acts as a scavenger to remove silica, sulfur, and phosphorus from the melt. Much more limestone than lime was used before the development of the basic-oxygen (BOF) in the 1950's. The BOF process uses only quicklime, about 7½ times more than does the open-hearth process. Because the BOF process is much more economical and faster than the standard processes, many steel producers are building new basic-oxygen furnaces to replace the older models. The use of lime for metallurgical fluxing has thus soared in recent years. For some time it was thought that high-calcium lime was the most desirable flux for making steel, but it appears that

dolomitic lime may work as well for the BOF process. Between 10 and 15 percent of the flux charge now used in basic-oxygen furnaces is dolomitic lime (Gutschick, 1971, p. 55).

A variety of lime called "dead-burned dolomite" is used as a refractory to line open-hearth steel furnaces and cover the costly refractory bricks. Dead-burned dolomite is calcined or burned twice and stabilized by iron oxide (Boynton, 1966, p. 166). The dolomite, after processing, has 4 to 8 percent iron oxide, which makes the lime less susceptible to hydration and easier to keep (Dixon, 1942, p. 869).

The demand for lime as a soil stabilizer has increased with the large-scale highway construction of the last decade. Lime makes fine clay particles adhere into coarser particles through the replacement of sodium ions by calcium and by forming bonds with silica and aluminum (Boynton, 1966, p. 410-412). Either high-calcium or dolomitic limes can be used for this purpose.

Historical Review of Lime Production in Indiana

METHODS OF PRODUCTION

Lime production in Indiana was begun in the late 18th century and expanded greatly in the 19th century. Early settlers burned limestone and dolomite in small, privately owned "log heaps" or "groundhog" kilns often for personal use (fig. 4). A glimpse into the method of manufacturing lime on log heaps was given by David A. Judah of Ellettsville. About 1922 David Judah assisted his father-in-law, Millard L. Easton, in producing lime in Monroe County about 1 mile northwest of Stinesville. (See pl. 1.) The land was leased from the Illinois Steel Co., which a few years earlier had aborted plans to build a steel mill near Gosport. The lime was produced solely for liming Mr. Easton's 480 acres.

At that time the land was heavily forested, and Mr. Easton was interested in clearing the land as well as burning lime. (See frontispiece.) Mr. Easton's men cut trees about 2 feet thick at the butt into logs as much as 40 feet long. The logs were hauled on a log sled, drawn by a span of mules, and placed together on the ground, so that

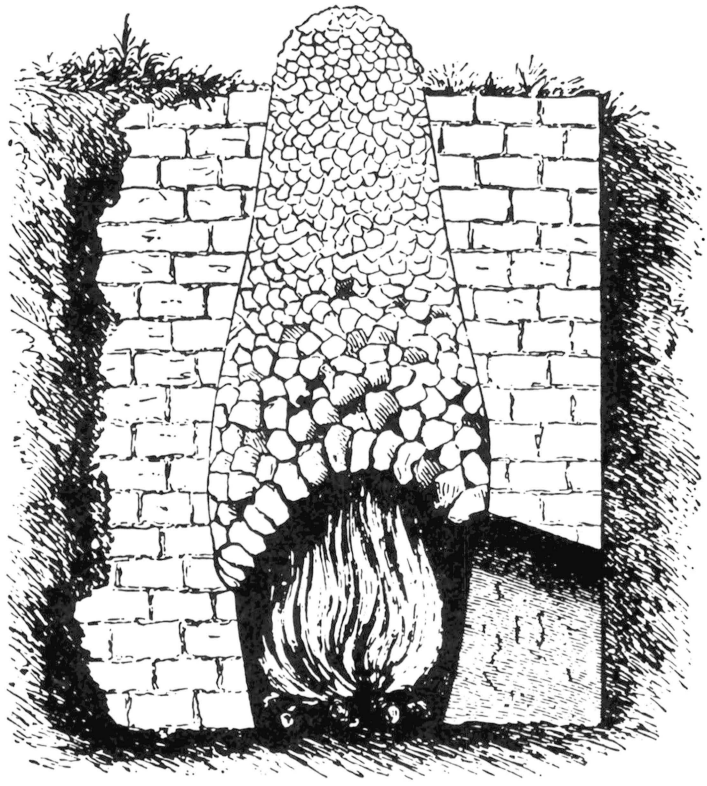

Figure 4. "Groundhog" or temporary lime kiln widely used in Indiana for lime burning during the 1800's. From Blatchley, 1904, fig. 1, p. 225.

the bottom course was about 40 by 60 feet in area. Smaller logs (about 10 inches in diameter) were laid on top of the first course at right angles. Brush was heaped on top of the logs to make the total height of the log heap about 5 feet. Limestone spalls were then brought in from the North Bedford Quarry, a Salem dimension stone quarry about one-quarter mile away. The stone was piled on the brush in the shape of a pyramid about 8 or 10 feet high at the peak. The log heap was left to dry for several months, perhaps 6, and then during the winter the four sides were soaked with kerosene and fired. The heap burned about 48 hours. The lime, which Mr. Judah stated was of excellent quality, was then shoveled into a tight-bedded wagon and spread on the fields.

"Groundhog" kilns were used more extensively than "log heaps" because of their greater efficiency. These kilns, cylindrical in shape, were built into the side of a hill so that stone could be dumped into the top of the kiln and fuel (generally wood) could be loaded into the bottom. An arch of stone to be burned was built in the lower part of the kiln. The fire, built under this arch, was raised to a "bright" heat (Blatchley, 1904, p. 226) and kept there for 3 or 4 days. After the fire had died out, the lime was removed from the bottom. These operations required only a few men but were inefficient in that the fire had to be built each time more stone was to be burned. At that time there were no continuously operating kilns.

"Groundhog" kilns could be found in almost every county and generally produced lime for local use. Although no statistics are available on the number and annual production of such kilns, Indiana probably had more lime kilns in operation in the early 1800's than at any other time in its history.

Because the daily production was small, kilns were operated even where the limestone beds were only a few feet thick, as in Vanderburgh County, or where limestone bedrock was not exposed, as in most of northern Indiana. In fact, some of the first lime manufactured in Indiana was made from marl, a poorly consolidated form of calcium carbonate that contains appreciable amounts of clay, sand, and water. The quality of lime produced from marl did not meet the standards of that produced from limestone, and the large water content added much to the cost of calcining.

As the population grew and cheap transportation became available, it became more economical to produce lime in larger, more efficient kilns and to ship it into areas lacking the raw materials for their own lime production. The capital investment in the "groundhog" kilns had been small, and their disappearance was rapid.

"Perpetual kilns," now known as continuous or continuously operating kilns, had come into common use by about 1875 (fig. 5). Vertical and rotary types have been the most generally used. Of the many types and innovations of vertical kilns, two types met popular

Figure 5. Abandoned vertical lime kiln near Milltown, Crawford County, used by J. B. Speed & Co. from 1887 to about 1915.

usage in Indiana, pot kilns and flame kilns. Pot kilns have also been called "vertical kilns with mixed feed," and flame kilns have been called "vertical kilns with separate feed" (Dixon, 1942, p. 866).

Pot kilns have vertical cylindrical shafts into which both the limestone and the fuel are loaded from the top in alternating layers. After the stone is calcined, it is removed from near the bottom of the shaft, and more stone and fuel are added at the top of the kiln. This method results in contamination of the lime by the fuel ash, but it is economical. Flame kilns also have vertical cylindrical shafts, but they are steel lined. Fire boxes on the side of the kiln heat the chamber, and the fuel does not come into contact with the limestone charge.

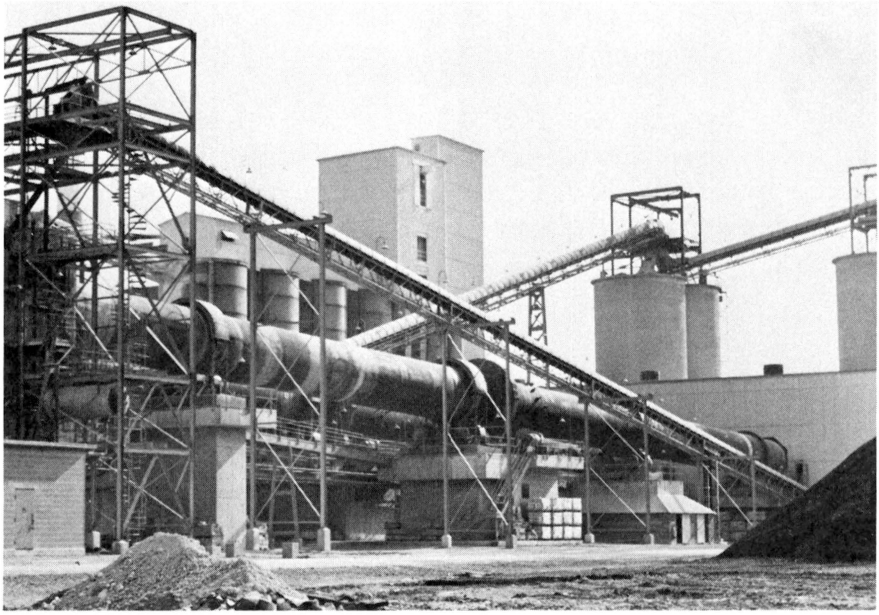

Figure 6. Modern rotary kilns at the Marblehead Lime Co. plant at Buffington near Gary.

These kilns are generally 6 to 10 feet in diameter and 40 to 50 feet high (Dixon, 1942, p. 867). Flame kilns used in Indiana were generally somewhat shorter.

A rotary kiln is a nearly horizontal revolving steel cylinder with a refractory brick lining (fig. 6). Limestone fed into a rotary kiln is first crushed to a lump size generally greater than three-eighths inch and less than 2½ inches (Boynton and Gutschick, 1960, p. 502). The cylinder is tilted at a slight angle from the horizontal so that the limestone charge will move by gravity to the hot end of the kiln.

More lime is produced from rotary kilns than from vertical kilns in the United States because of the quality product produced and the high capacity of the rotary kilns. Rotary kilns are particularly suitable for chemical lime where exact specifications are required. The rotary kiln operates essentially by heat transfer due to radiation and usually requires more fuel per ton of lime than the vertical kiln. In recent years high fuel costs have spurred the development of pre-

heaters for rotary kilns, which has resulted in greater production capacity and reduced fuel requirements (Parsons, 1973).

Recent advances in the construction and operation of modern vertical kilns promise greater competition with rotary kilns for producing some types of lime. Lime producers can now choose from among many kinds of both rotary and vertical kilns that can be tailored to meet the differing calcining requirements of different raw materials, fuels, and product specifications.

REGIONAL PRODUCTION IN INDIANA

Lime production has been reported from at least 40 counties in Indiana (appendix), but most of the lime has been produced in the Wabash River valley in northern Indiana and near limestone outcrops of Mississippian age in south-central Indiana (pl. 1).

As the industry grew in the late 1800's, the producers of lime gravitated toward a relatively few towns and cities where labor and cheap transportation were available. Although the methods of production were usually similar near these centers, there were many differences in rock sources, quality and types of lime produced, methods of transportation, and marketing areas.

NORTHERN INDIANA

Most of the lime industry in northern Indiana during the late 1800's and early 1900's owed its existence to inexpensive transportation and high-purity source rock, primarily organic reefs of Silurian age in the Wabash River valley. Reefs of the Wabash Formation (fig. 7), were exploited from near Delphi in Carroll County to east of Markle in Huntington County.

Much of the lime produced before 1874 was shipped on the Wabash & Erie Canal, which paralleled the Wabash River valley across northern Indiana from Huntington to Terre Haute. For several years the canal provided access to markets from Toledo, Ohio, on Lake Erie to Evansville in southwestern Indiana. The canal closed in 1874, and most of the lime was then shipped by rail.

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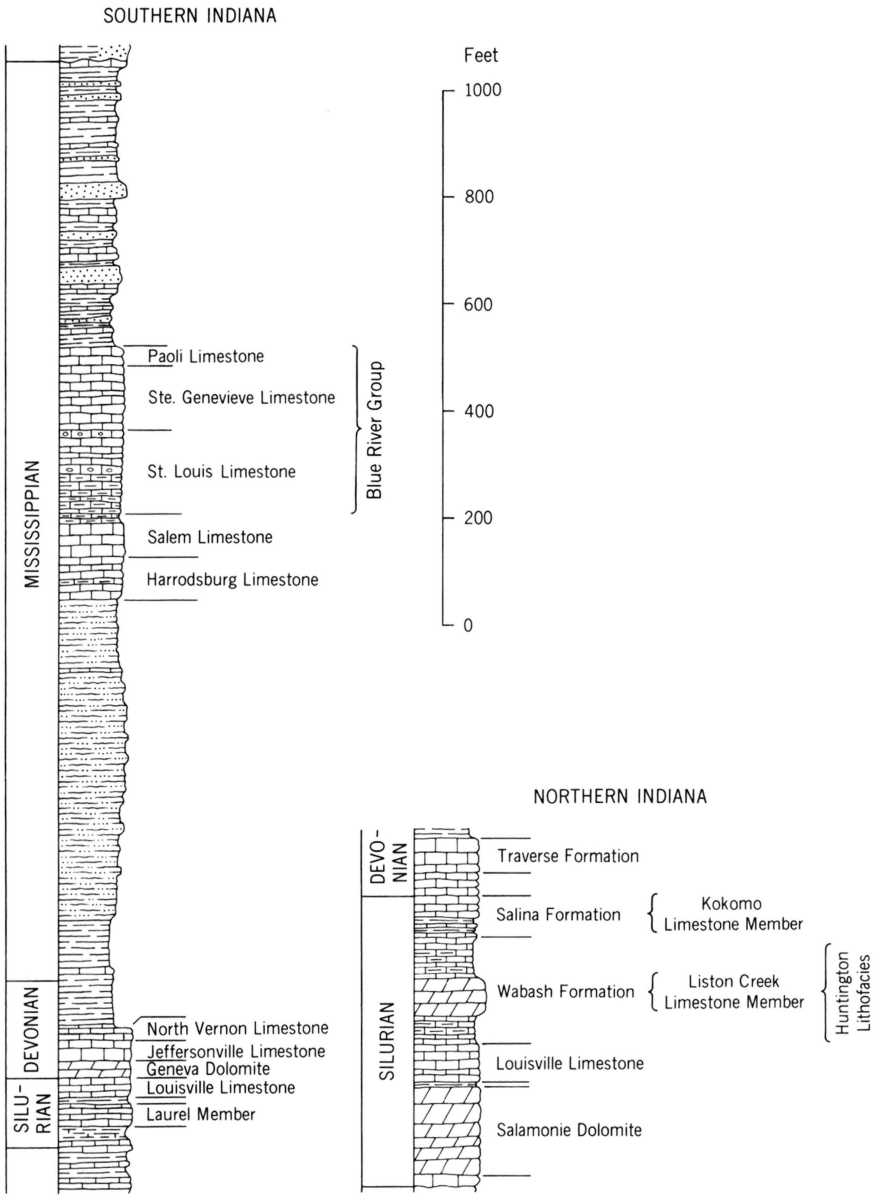

Figure 7. Generalized columnar sections showing major rock units used for lime in Indiana.

DELPHI: Mayhill (1953, p. 67) recorded the production of lime in Carroll County at Delphi as early as 1825 and placed the first regular trade in lime in 1840, the year the Wabash & Erie Canal opened at Delphi. The canal also carried the lime produced by one of the pioneer lime companies, E. W. Hubbard & Co., which started producing lime for shipment in 1858 (Blatchley, 1904, p. 228).

The first producers at Delphi burned lime from shallow dolomitized reefs found less than 2 miles north of the town. The dolomitic lime set slowly and was reported favored by brick masons over faster setting high-calcium lime. The dolomitic lime was also valued by the paper industry, a major market for the Delphi lime, because of its nonclogging properties. The dolomite was quarried from deposits that had inclined beds, which led early geologists to believe that the rocks were not laid down in place but that the strata were tilted by "upheaval" or "deformation." It was not until 1927 that the "islands" and "domes" quarried for the lime in the Wabash River valley were recognized as organic reefs formed in place (Cumings and Shrock, 1927), but this academic problem was of little concern to the lime manufacturers at Delphi who were quarrying dolomite from the reefs in increasing amounts in the late 1800's.

Several small lime producers in Delphi joined together to form the Delphi Lime Co. in 1870, and the Harley Bros. Lime Co. started producing lime from a reef on the north edge of town in 1875. Much detail on the operations of these companies and another, the Coble Lime Co., which began operation in 1902 and was typical of the companies operating in northern Indiana about 1900, can be found in Blatchley (1904, p. 228-233).

The Coble Lime Co. plant, containing four steel kilns, was constructed for $12,000. (In other areas plants with more kilns were constructed at proportionally higher costs.) The company had purchased 22½ acres of stone reserves 1 mile north of Delphi for $7,500 ($333 per acre). Each kiln had a daily capacity of about 200 bushels (about 7 tons) of lime, which sold for 13 cents per bushel (about $3.70 per ton) in carload lots. Coal was shipped in to fuel the kilns,

since wood, the preferred fuel, was scarce by this time in the Delphi area. The company employed 18 men in 1903 at an average wage of $1.50 per day.

Much of the lime first produced at Delphi was shipped by boat to Covington, Ind., and then loaded onto wagons and hauled to other points in western Indiana and Illinois. The Wabash Railroad purchased the canal and its lands and the canal was abandoned in 1874. The lime was then shipped by rail, and so the romantic era of the canal boats came to an end.

The production of lime at Delphi began to decline about 1914. Logan (1922, p. 774-775) listed only two companies in operation in 1922. Although information on the birth and growth of the industry at Delphi is easier to obtain than information on its decline and death, at least one source indicates that the industry had much the same problems there as in other areas. Mr. Robert Bradshaw (oral communication, 1970), a descendant of William Bradshaw, one of the leaders of the lime industry at Delphi, believed that the industry lacked the capital or initiative to modernize or rebuild, and thus failed to progress with the technology of the times. For example, even before 1914, it was recognized that hydration of lime allowed for safer and less expensive transportation and storage of lime, but the producers at Delphi did not invest in hydration equipment.

Today little trace remains of the industry at Delphi, for the last stone kilns were torn down in 1963. The abandoned quarries are gradually filling in with slump soil and debris.

HUNTINGTON: Lime burning was a leading industry in Huntington County in the late 1800's. The town of Huntington gained the name of "Lime City," and the industry contributed much to the prosperity of the area. The first mention of lime production is that of a small lime kiln built near Huntington in 1843 or 1844 (Bush, 1914, p. 250). Blatchley (1904, p. 233) recorded the building of permanent kilns east of Huntington about 1845, but most of the first lime was calcined west of the town and was shipped on the Wabash & Erie Canal, principally to Fort Wayne (Lucas, 1887, p. 436). Several

Figure 8. Dipping dolomite beds of the Huntington Lithofacies (Wabash Formation) exposed in the Erie Stone Co. quarry at Huntington. The tree-covered mound above the quarry lip on the left side of the photograph marks the remains of the kilns once used for lime burning by the Kelley Island Lime & Transport Co.

quarries were opened east of Huntington in 1860 and later. When the Wabash & Erie Canal was abandoned in 1874, the Wabash Railroad became the principal carrier of the lime.

Cox (1876, p. 122) listed 12 companies producing lime in 1875 near Huntington. The companies were gradually combined until 1887, when most were incorporated into the Western Lime Co., which was the largest lime-producing company in the state in 1903 (Blatchley, 1904, p. 234). The Western Lime Co. was incorporated into the Ohio & Western Lime Co. in 1906. By 1914 the Ohio & Western Lime Co. had one plant in Huntington, one plant in Bedford, and five plants in Ohio. From about 1918 most of the lime at Hunt-

ington was produced by the Kelley Island Lime & Transport Co. (fig. 8). In 1921 this company operated 18 vertical kilns and produced both lump lime and hydrated lime (Logan, 1922, p. 774).

As at Delphi, the Huntington lime was produced from reefal dolomite. Logan (1922, p. 774) listed various uses for the lime, including lime for agriculture, building, and chemical purposes. The lime had a good reputation and was shipped to markets in Indiana, Illinois, and Ohio. Wood was the principal fuel for the kilns prior to 1902; the demand for wood provided many nearby farmers with a second occupation. Later, coal was used for the most part, although fuel oil and natural gas were also used.

The Kelley Island Lime & Transport Co. stopped production early in 1940. Mr. Leslie Gamble, quarry boss and longtime employee of the company, stated (oral communication, 1970) that the lime plant had become outdated and that orders for lime, much of which was used by glass plants near Muncie and Anderson, were filled by the company's operations in Ohio. No kilns remain standing at Huntington today, though at least four large plants were erected east of the city and numerous other kilns were used in smaller operations. Several abandoned quarries used by the lime companies can still be seen east of the city, but practically no trace remains of the quarries or plants west of the city.

OTHER LOCALITIES: In Madison County, lime was burned north of Ingalls from 1891 to 1894. Blatchley (1904, p. 241) stated that production was discontinued because the plant had no railroad spur and the lime had to be hauled by wagon and loaded on railcars at Ingalls. Lime was produced briefly in the late 1800's and again in the early 1900's at Markle in Huntington County.

Lime was produced until 1943 at the France Stone Co. kilns (fig. 9) 2 miles east of Logansport. High-calcium lime was calcined from handpicked Traverse limestone of Devonian age. High labor costs and price controls during World War II contributed to the closing of the kilns, but competition from the Mississippi Valley Lime Corp. has been cited as the main reason for closing the plant (William Unsworth, oral communication, 1971).

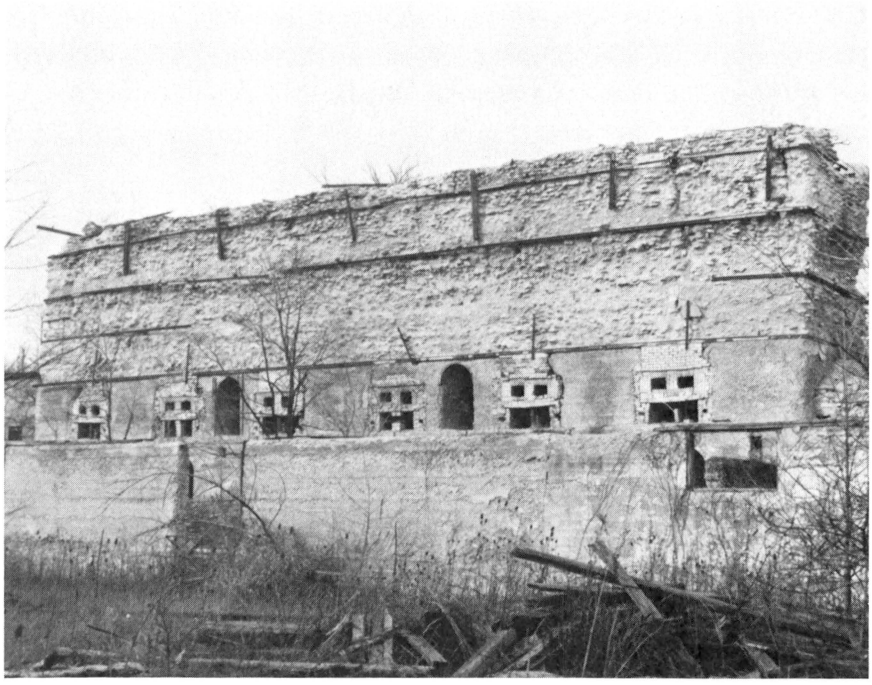

Figure 9. Abandoned vertical lime kiln used by the France Stone Co., Logansport, from about 1900 to 1943.

Early scattered production has been reported in Adams, Delaware, Grant, Howard, Jasper, Jay, Miami, Randolph, Wayne, and White Counties (appendix). The lime was usually consumed locally, and little data are available on the operations or exact locations of the kilns. Small amounts of fine-grained lime were produced from marl in the 1800's in Fulton, Noble, St. Joseph, and Steuben Counties, but this lime made a poor mortar and was eventually replaced by lime from the Wabash River valley (Blatchley, 1904, p. 224).

The Marblehead Lime Co. plant at Buffington near Gary (fig. 6) went on stream in 1966, more than 20 years after the last lime was produced in northern Indiana at Logansport. The plant opened with a capacity of 1,000 tons of lime per day and a stockpile (raw stone) capacity of 1 million tons (Herod, 1967). Three new rotary kilns were added to the plant in 1973, thereby increasing the capacity to more than 2,500 tons per day. Stone for the plant is obtained from

U.S. Steel's Calcite Quarry near Rogers City, Mich. Fuel for the calcining process is bituminous low-sulfur coal obtained from southern Illinois. The lime output of the Buffington plant is used, for the most part, in Indiana's steel mills. The rest is transported to Illinois for use in steel production.

The Inland Steel Co. is constructing (October 1973) a lime plant at their Indiana Harbor Works. The plant will have a capacity of 1,200 tons of burned lime per day to be used in steelmaking.

SOUTHERN INDIANA

Limestones of Mississippian age were used for many years for producing lime in south-central Indiana. The ready accessibility of limestone outcrops, purity of several limestone units, and rail transportation that served the dimension stone industry attracted lime producers to the area. In southeastern Indiana, lime was produced from the dolomitic limestone exposed on the bluffs near the Ohio River at Utica, but in southwestern Indiana, only a few thin Pennsylvanian limestones were available for source rock, and only a few small kilns were erected. As in northern Indiana, most lime producers clustered near the larger towns.

BEDFORD AND MITCHELL: The Salem Limestone (also known commercially as the Indiana Limestone), widely renowned dimension stone, has been quarried in south-central Indiana for more than 140 years. Much has been written about the dimension stone industry, and the sale of the stone for building purposes has received well-organized publicity and promotion. In fact, the attention given to this phase of the stone industry has obscured, to some degree, the potential of the limestone for other uses.

The Salem and Ste. Genevieve Limestones have been used as a source for lime near Bedford and Mitchell since before 1864 (Blatchley, 1904, p. 251). The earliest record of specific kilns is from Collett (1874b, p. 302), who in 1873 recorded an annual production of 17,500 bushels of lime from Asa Erwin's pot kilns 2 miles north of Mitchell. Many small "groundhog" kilns were in use at this

Figure 10. Abandoned quarry near Rabbitville, Lawrence County, where St. Louis and Ste. Genevieve limestones were quarried for lime from before 1895 to the 1920's.

time and many had been used earlier for local needs. In 1895 the Mitchell Lime Co. purchased or leased the Erwin operation and a similar one about 1 mile northeast of Mitchell near the present-day quarry of the Lehigh Cement Co.

By 1900 a town called Rabbitville, whose residents were mostly employees of the quarry and lime plant, had sprung up near the Erwin location. None of the buildings of the town still survive, but Mr. Earl Cooper, a resident of the area and past employee of the Mitchell Lime Co., remembered when the town boasted a schoolhouse, a general store, and a boarding house (oral communication, 1970). Mr. Cooper reported that the quarry (fig. 10) was closed in the 1920's, and Logan (1922, p. 775) listed only one plant in the district in 1922. Mr. Cooper believed that the high cost of removing thick overburden at the quarry was the basic reason for closing the plant at Rabbitville. Also, the Mitchell Lime Co. was producing lime at its Rock Lick plant only a mile to the southeast. But this plant, too, closed in the 1930's, probably because of economic reasons

rather than because of operational problems or unsuitable source rock. Limestone was quarried from the Salem Limestone, which was exposed in the valley on both sides of a small stream, the Rock Lick Branch.

In an interview in August 1970, Mr. J. H. Hensinger, manager of the Lehigh Portland Cement plant at Mitchell and longtime resident in the area, related some history of the Mitchell Lime Co. plant near Lehigh's present quarry. Although only the foundations remain today, the plant at one time was an imposing structure with five steel kilns. Many men and horse teams were hired to transport the stone from the quarry to the plant in the late 1800's. Higher wages were paid for the horses than were paid to the drivers, and the horses received annual vacations; in fact, it is reported that the horses were periodically sent to a nearby vacation farm to rest. In the early years of its operation, the quarry was worked by men who were paid by the amount of rock they could crush by hand. It was claimed that the rock on one side of the small valley was harder to break with sledges than the rock on the other side, but most of the rock used for lime was quarried on the alleged hard side despite complaints by the laborers.

Two pioneer lime producers, D. Kelly and J. Tomlinson, produced lime in the same valley in the late 1800's, and only in recent years were the old kilns torn down to make way for the crusher used at Lehigh Cement's present-day quarry.

The stone used near Mitchell was crushed for direct use in the lime kilns. In contrast, a lime operation north of Bedford near Oolitic used waste stone from a dimension stone quarry as a source of raw material (fig. 11). A glimpse into the history of lime production from this quarry was obtained in May 1967 through an interview in Bedford with Nick Conklin, who was then 88 years old. Mr. Conklin was superintendent of the Ohio & Western Lime Co. in Bedford from 1907 to 1915. The Ohio & Western Lime Co., whose Indiana headquarters were at Huntington, bought out the Horseshoe Lime Co. in Bedford and operated the lime plant from 1907 until 1915, when the

Figure 11. Waste blocks of Salem limestone at the Perry, Matthews & Buskirk (P.M. & B.) dimension stone quarry north of Oolitic. The blocks were crushed for lime burning in the early 1900's.

plant was sold to a dimension stone company that was to become the Indiana Limestone Co., Inc. Production from the plant ceased completely in the early 1930's.

Large blocks of Salem limestone quarried in the Perry, Matthews & Buskirk (P.M. & B.) quarry (later owned by the Indiana Limestone Co.) were the only raw materials used in the kilns. These blocks had been quarried for use as dimension stone but for some reason were deemed expendable. The large blocks were disintegrated by explosives and fed to vertical kilns less than 30 feet tall (fig. 12) by means of a tramway or inclined ramp. Mill spalls were never used for making lime because they were contaminated by quartz sand used in sawing.

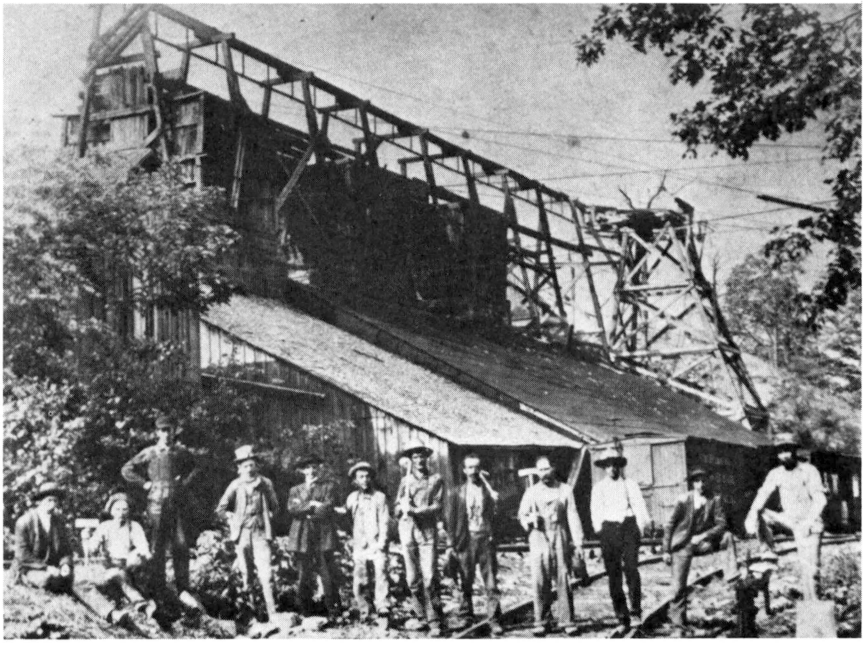

Figure 12. The Ohio & Western Lime Co. plant in the Perry, Matthews & Buskirk (P.M. & B.) quarry north of Oolitic as it appeared in 1907. Courtesy of Nick Conklin, plant manager, who is fifth from the left in the photograph.

About 35 men were employed in the Ohio & Western Lime Co. plant. In a good month 12,000 to 13,000 bushels of lime could be produced. The lime sold at 10 to 11 cents per bushel and was shipped by railroad on a spur of what is now the Monon Railroad. Workers were paid $0.15 to $0.175 per hour according to their job. Lime was marketed in Chicago, Cincinnati, Hammond, East Chicago, Indianapolis, Terre Haute, Bedford, and other places and was purchased by such companies as the Terre Haute Paper Co., the Bedford Building Supplies, Swift & Co. in Chicago, and the Illinois Steel Co. in Chicago. According to Conklin, the plant closed apparently because of the increased popularity of portland cement, which replaced lime in some construction uses.

Fifty percent or more of the stone quarried for dimension stone in south-central Indiana was (and is) eventually discarded as waste. The waste stone in the quarries would be an excellent source of crushed

stone for burning lime or for other purposes, but large-scale blasting and crushing of the waste blocks is evidently uneconomical. Batchelor (1944, p. 179) reported that several companies which had attempted to operate cement plants using the quarry waste found that it was cheaper to quarry the stone directly than to buy the waste and break up the blocks.

MILLTOWN: By far most of the lime near Milltown was produced from lime plants in and near quarries and underground mines of the Louisville Cement Co. on the banks of the Blue River at Milltown in northwestern Harrison County and northeastern Crawford County. The first lime produced in commercial amounts, however, was probably from small kilns near Mauckport along the Ohio River. Collett (1879, p. 402) wrote that lime was burned near Mauckport in the Stockslager quarry, one of the first commercial quarries in Indiana, active from about 1840 to about 1878. Prior to the Civil War, lime was produced from many hillside kilns along the banks of the Blue River and on the Ohio River where "oolitic" stone outcrops could be found (Collett, 1879, p. 414). Much of the "Blue River Lime" from the small kilns was shipped on flatboats to southern planters and merchants, but part of the output was used locally for mortar, plaster, and whitewash. The Civil War stopped trade to the South and most of the kilns were abandoned. After the war the kilns were never used again.

Selected beds of the Ste. Genevieve Limestone, normally the high-calcium oolitic beds, were the main sources of rock used for lime near Milltown, although parts of the St. Louis and Paoli Limestones were sometimes quarried or mined with the Ste. Genevieve.

J. B. Speed & Co. produced lime at a quarry and underground mine on the west side of the Blue River at Milltown from 1887 until the Louisville Cement Co. acquired the company and transferred all operations across the river about 1915. In the west-side operation, lime was produced from four kilns, two of steel and two of stone. The stone kilns are still standing, among the best preserved in the state today (fig. 5). The capacity of the stone kilns was 375 bushels

per day, somewhat less than the steel kilns, and the lime was drawn every 36 to 48 hours (Blatchley, 1904, p. 243). Blatchley (1904, p. 245) reported that this was the only plant in the state producing hydrated lime in 1903. The lime was used for top dressing for soils (much of which was shipped to Illinois), in mortar, and for other purposes.

In 1903, on the east side of the river at Milltown, the Eichel Lime & Stone Co. opened a lime plant that contained three steel kilns and operated in much the same manner as the J. B. Speed plant. Most of the lime was sold for mortar and plaster and shipped to markets in Indiana, Illinois, Kentucky, and Missouri. Some was ground and sold to glassworks and paper manufacturers.

The Louisville Cement Co. purchased the Eichel properties in 1913 and continued to produce lime for 40 years from rock derived from the Eichel quarry and a quarry immediately to the west. The company installed a rotary kiln in 1921. St. Louis and Ste. Genevieve limestone was mined underground intermittently at Milltown from 1901 until the last year of operation (fig. 13). The mine entrances were cut into the walls of the open-pit quarries when it became too expensive to remove the rock and soil overburden, though this problem was alleviated by crushing some of the rock overburden for sale as aggregate. The mines were used extensively, and much of the high ground near the old quarries is laced with the underground workings.

In the late 1800's the stone was crushed by hand in the quarries and carried to the kilns in wagons pulled by mule teams. Mr. Dennis Sarels (oral communication, 1970), a longtime employee of the Louisville Cement Co. and resident of Milltown, still remembered the teams and the improvement in working conditions in the early 1900's when trucks and crushers finally relieved the laborers of their toil in the quarries. (It also relieved many of them of their jobs.) Mr. Sarels worked in the mines and believed that one major cause for their abandonment was the increase in magnesium content in some of the stone (mag stone) and the presence of "soapstone"

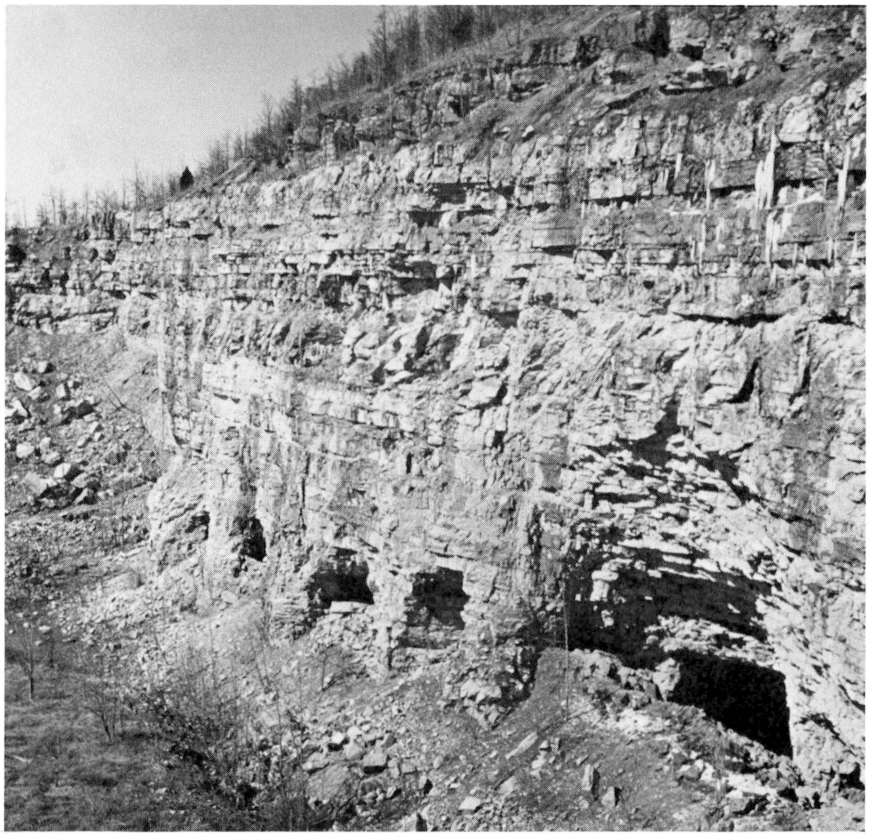

Figure 13. Abandoned underground mines near Milltown, Harrison County, where Ste. Genevieve and St. Louis limestones were mined intermittently for lime by the Louisville Cement Co. from 1903 to 1953.

(probably shaly limestone or shale). The company purchased land and opened an open-pit quarry 2 miles to the east for a supplementary source of rock for the kilns in the last years of the operation. The Louisville Cement Co. stopped producing lime at Milltown in 1953. No lime has since been produced in Indiana on a commercial basis from rock quarried or mined within the state.

SALEM: Lime was produced west of Salem from about 1884 intermittently to 1932, and some lime production was reported as late as 1945. The industry was centered near the present-day Hoosier Lime & Stone Co. quarry in the valley of the West Fork Blue River near

Figure 14. Abandoned underground mine near Salem, Washington County, where Salem limestone was used for lime burning in the early 1900's by the Hoosier Lime & Stone Co.

the southwest edge of Salem. Blatchley (1904, p. 248-250) and Logan (1922, p. 774) gave some history of the area and listed three companies producing lime at the west edge of Salem from 1884 to the date of formation of the Hoosier Lime & Stone Co., which burned lime until 1932.

As in the Bedford-Mitchell district, Salem limestone was the main source rock, and, as at Bedford, waste stone from dimension stone quarrying was used as a raw material for several years. The Salem Limestone near Salem contains thick beds that exceed 98 percent

Figure 15. Abandoned vertical lime kilns used before 1932 at the Hoosier Lime & Stone Co. quarry near Salem.

total carbonate, and the lime produced from these beds was highly regarded for its purity.

The limestone for the kilns was taken from open-pit quarries and from an underground drift mine (fig. 14) which was carved into the quarry face where overlying, less pure St. Louis limestone was too thick to be removed economically. Vertical stone and steel kilns were used to calcine the limestone; three stone kilns can still be seen standing in the Hoosier Lime & Stone Co. quarry (fig. 15). Wood, oil, and coal were used as fuel for the kilns. The coal in the very early 1900's was purchased in Huntingburg, more than 60 miles to the west.

Several reasons have been advanced for the closing of the lime plants near Salem. Mr. Heber Hobbs and Mr. Orel May, president and superintendent respectively of the Hoosier Lime & Stone Co., sug-

gested that the following adverse conditions contributed to the decline in lime production at the Hoosier Lime & Stone Co. plant (oral communication, 1970): (1) production was slow and small; (2) overhead was high; (3) removal of thick overburden was expensive where the Salem was not mined; (4) the company was geared to crushed stone production, and production of lime was secondary; and (5) the amount of capital required to invest in new and more efficient kilns and accessory equipment was large, and money was scarce when the lime plant was abandoned in the early 1930's.

Lime production ceased in the Salem area in 1945, when the Salem Lime & Stone Co. lime plant, about one-half mile north of the present-day Hoosier Lime & Stone Co. quarry, burned down (Patton, 1947, p. 1).

GREENCASTLE: Limestones of Mississippian age that were used widely for lime near Mitchell, Milltown, and Salem have been mostly eroded north of Putnam County. The lime produced near Greencastle in central Putnam County was the northernmost commercial source of high-calcium lime produced from these rocks.

The Ste. Genevieve Limestone has been used as a source rock near Greencastle since the mid-1800's. Limedale, about 1 mile southwest of Greencastle, was the site of the first commercial lime production near Greencastle in 1856 (Anonymous, 1887, p. 223). Three other quarries and lime kilns commenced operation about 1874 near the railroad at Oakalla, about 3 miles west of Greencastle. The earliest kiln at Oakalla was operated by Joseph Torr from 1874 until his death in 1880, when his buggy was hit by a train at a crossing (Weik, 1910, p. 671).

It was ironic that Mr. Torr died in a train accident, for the railroad companies were the commercial lifeblood of Mr. Torr's business and the businesses of other nearby quarriers and lime producers; much of the crushed stone and probably much of the lime produced near Greencastle were shipped by rail. Lime production fell off, however, and by 1903 little or no lime was burned near Greencastle. No first-hand information accounting for the decline has been obtained, but lack of inexpensive transportation was probably a major factor.

Figure 16. Beehive kiln used for burning lime at the Indiana State Farm near Putnamville, Putnam County, from 1924 to 1969.

Small amounts of lime were burned at the Indiana State Farm near Putnamville from 1924 to 1969. The lime was produced for use on the farm in an unusual lime kiln, a beehive type (fig. 16), in which the limestone charge was wheeled in, stacked by hand, and fired much in the same manner as bricks.

UTICA: Most of the lime produced in southeastern Indiana was burned from dolomitic limestones of Silurian and Devonian age exposed along the Ohio River bluffs near Utica in Clark County. Lime produced at Utica during the late 1800's was shipped by barge on the Ohio, Mississippi, and Missouri Rivers.

Baird (1909, p. 399) recorded lime burning in brush and log fires by settlers near Utica as early as 1818. Several small companies

produced lime near Utica after 1826 (appendix), but Baird did not believe that the industry was profitable until the Louisville Cement Co. and the Utica Lime Co. began business in 1870. In 1871 J. B. Speed & Co. opened a plant (Blatchley, 1904, p. 242) which continued in operation until 1907.

The economic success of the industry in the late 1800's at Utica was directly tied to the Ohio River. Some of the first lime was shipped in flour barrels on flatboats to complete other loads to markets as far south as New Orleans. After 1870, when lime was produced in larger quantities, lime was shipped throughout the waterways of the Midwest, south to New Orleans on the Mississippi River, and along the Gulf Coast west from the Mississippi River to Louisiana and Texas and east to the west coast of Florida (Baird, 1909, p. 401).

Baird (1909, p. 401) offered an opinion for the demise of the smaller lime companies at Utica, but he did not account for the final cessation of production in 1907 when he wrote: "The patent (continuous) kiln was not responsible for the death of the lime industry in and near Utica; it was rather the ultimate result of the battle between the small burners and the wealthy company which finally controlled the industry."

OTHER LOCALITIES: Lime was produced mainly from the Salem Limestone in Monroe and Owen Counties from before 1880 to about 1900, mostly near Bloomington, Ellettsville, Ramona, and Stinesville (Greene, 1880, p. 446; Hopkins and Siebenthal, 1897, p. 336). Both waste dimension limestone and crushed limestone were burned. Hopkins and Siebenthal (1897, p. 337) listed high freight rates, lack of market, and lack of interest as reasons for the stagnation of the industry in Monroe, Owen, and Lawrence Counties.

Numerous scattered small lime-burning operations using carbonate rocks of Silurian and Devonian age for source rock have been reported in southeastern Indiana (pl. 1), but the output of the kilns was usually small and was sold locally. Perhaps typical of the operations were the several temporary kilns used by farmers in Franklin

County between 1870 and 1885 to supply lime to a paper mill near Laurel. (Only one kiln location is well enough documented in Franklin County to plot on pl. 1.) Blatchley (1904, p. 257) commented that all production in the district ceased when the paper mill burned down.

Collett (1876, p. 275-276) mentioned the locations of two early lime kilns near West Franklin in southwestern Indiana. One kiln produced lime mainly for local use, and the other kiln produced lime for markets on the Ohio River. The latter kiln produced an inferior grade of lime and could not compete successfully with higher quality lime manufactured upriver.

Production Status of Indiana and Neighboring States

Prior to 1922 Pennsylvania was by far the foremost producer of lime in the United States, but Ohio crept ahead of Pennsylvania in 1922 to become the country's largest producer and has continued to lead the states in lime production. Ohio had 19 active lime plants in 1971. Pennsylvania dropped to third behind Missouri in 1954 but has regained second rank in recent years. Pennsylvania had 12 active plants in 1971.

From 1904 to 1942, at least, Michigan's production trends closely paralleled Indiana's, but Michigan has shown a sharp increase in lime production because of the increased use of lime by the steel industry. In 1971 Michigan was the fifth largest producing state with 10 active plants. Illinois generally ranked high in lime production prior to 1955, the last year production figures were reported for the state. Much of the lime in Illinois is used for steelmaking, and more than 50 percent of the state's lime production has been shipped to Indiana in recent years. Kentucky has been a small producer in the past; production in the state ended completely from about 1936 until 1970, when the Black River Mining Co. began producing lime at a new plant at Carntown.

About 1900 Indiana ranked fairly high in lime production, usually in about 10th to 14th place among the states, and as late as 1920 it

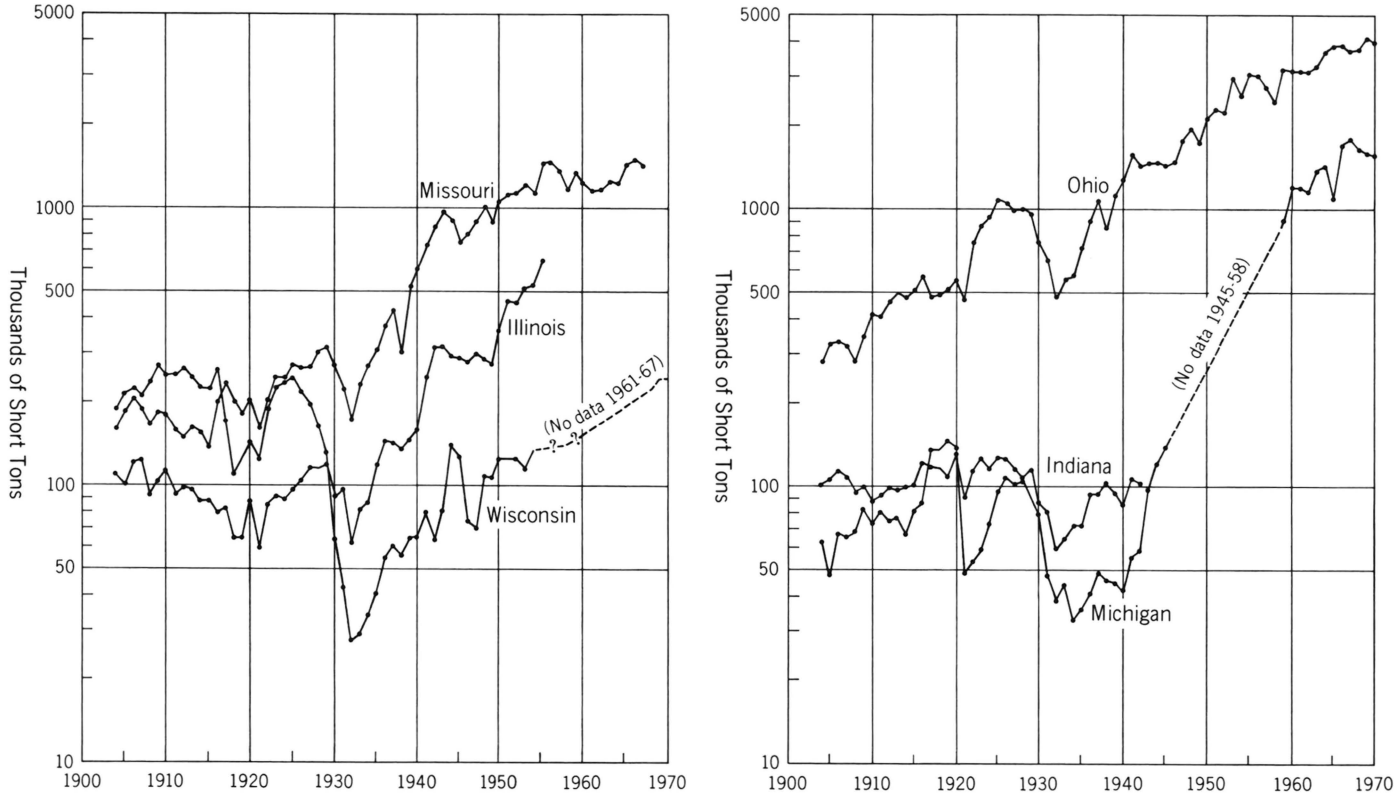

Figure 17. Lime production in midwestern United States, 1904-70.

ranked ninth. From 1904 until 1942 Indiana's lime production remained at a fairly constant level (fig. 17). Little information on production prior to 1904 is available; however, it is estimated that 567,043 bushels of lime (about 20,000 tons) was produced in 1879 in Indiana and 836,628 bushels (about 30,000 tons) was produced in 1882 (Collett, 1880a, p. 82; Collett, 1883a, p. 23). Production figures after 1943 are not available.

Sources of Limestone and Dolomite for Lime Manufacture

Limestone and dolomite resources are abundant in the Midwest, and the availability of limestone is not a limiting factor in lime production. In Ohio, lime is produced largely from high-magnesium dolomite of Silurian age in the western part of the state and from high-calcium limestone of Pennsylvanian age in the east. Wisconsin and Michigan are almost entirely covered by glacial drift, which prevents quarrying in many areas. Most of the lime in Wisconsin is produced from high-magnesium Silurian limestone which crops out along the shore of Lake Michigan in the eastern part of the state. In Michigan most of the limestone available for production of lime is found in the northern part of the Lower Peninsula and in the Upper Peninsula along Lake Michigan and Green Bay. The rocks in these areas are high-magnesium Ordovician and Silurian dolomites and high-calcium Devonian limestone. High-calcium Devonian limestone has also been quarried where it crops out along the southern border of the state. In Illinois, lime is produced from high-magnesium Silurian dolomite near Chicago and from high-calcium limestone of Mississippian age in the southwest along the Mississippi River. High-calcium Devonian limestone exposed in northwestern Illinois and high-magnesium Ordovician dolomite in north-central Illinois have also been used.

In Indiana the best sources of high-calcium limestone are the Salem and Harrodsburg Limestones and the Paoli and Ste. Genevieve Limestones, all of Mississippian age (fig. 7). Their outcrop extends from Putnam County to the Ohio River (pl. 1).

The Salem Limestone and Harrodsburg Limestone together contain the most dependably thick units of high-calcium limestone in

Indiana for which many chemical analyses are available. Deposits 50 feet thick of stone averaging 97 percent $CaCO_3$ are probably common in Owen, Monroe, Lawrence, and possibly Washington Counties. In Monroe and Lawrence Counties, however, the Salem is quarried as dimension stone, and much of the land is owned or leased by dimension stone companies.

The Paoli and Ste. Genevieve Limestones are quarried in many places as one unit. In general, units of high-calcium stone in these formations are not so thick as those in the Salem, but the purest and whitest high-calcium limestone in Indiana is the oolitic facies of the Ste. Genevieve. Twenty-eight feet of stone in one unit averaging 98 percent $CaCO_3$ has been sampled and analyzed in the Radcliff, Inc., quarry near Orleans (Rooney, 1970, table 3). Numerous exposures of thinner units of oolitic limestone are known along most of the outcrop belt. Limestone from the Paoli and Ste. Genevieve has been burned for lime at many localities.

Deposits of high-purity dolomite are found in the Salamonie Dolomite in northeastern Indiana and in Huntington reef deposits of the Wabash Formation in north-central Indiana. In fact, the stratigraphic and chemical data on file at the Indiana Geological Survey indicate that the Wabash Formation contains the thickest and purest deposits of carbonate rocks in the state. In most of northern Indiana, glacial drift as much as hundreds of feet thick covers the bedrock, but in some areas, especially stream valleys, the drift is thin and rock can be quarried economically. No dolomite from Indiana is now being manufactured into lime, but the increasing use of dolomitic lime for flux in basic-oxygen blast furnaces increases the possibilities for future exploitation of these resources.

High-calcium limestone deposits shallow enough for open-pit mining are rare in northern Indiana; the Traverse Formation, used for lime at Logansport, contains the only documented high-calcium deposit that has been quarried for lime that we are aware of, although some limestone of the Kokomo Limestone Member (Salina Formation) may have been burned for lime near Kokomo and Peru. High-calcium limestones of the Traverse and Detroit River Formations,

however, are present at moderate depths in northwestern Indiana (Rooney and Ault, 1970, p. 202). These limestones could be mined underground, perhaps as co-products with dolomite and gypsum.

Economics

The decline of the lime industry in Indiana is attributable to numerous economic factors, many of which have been mentioned previously. The data we collected from the literature and from people associated with the lime industry in Indiana do not present a simple picture (table 1). Only a few producers were affected by a high cost of overburden removal, a poor transportation facility, or destruction of a plant by fire. Several plants were abandoned because of local competition, but this had little effect on the total lime production in Indiana. From the late 1800's to about 1920, the number of active plants was greatly reduced because of consolidation of companies or acquisition of one company by another, but this did not lower the total production in Indiana, because increased production was obtained from new larger capacity plants.

The widespread economic depression of the 1930's was attended by a decrease in lime production in Indiana and neighboring states (fig. 17), and five of Indiana's six lime plants operating between 1930 and 1943 were abandoned. Although several reasons have been given for abandonment, it is significant that all five companies were producing crushed stone both for lime and for purposes other than lime. The producers' interests were divided, and their lack of enthusiasm for replacing old lime-burning equipment or for building expensive new kilns in a time of scarce money and depressed markets is understandable. Lack of investment capital and lack of producer interest, however, were serious problems which had affected segments of Indiana's lime industry even before 1900.

Competition has always been keen in the lime industry because there is an excess of limestone available for lime. Also, lime is not an easily stored commodity. It has a low-bulk density, about one-third less than cement, and quicklime hydrates easily and quickly on exposure to water, even moist air. Thus, a ready market is of vital

Table 1. Reasons for abandonment of lime plants in Indiana

[Data from personal interviews with people associated with Indiana's lime industry and from the literature on the industry]

	Before 1900	1900-20	1920-40	1940-53
Economic:				
Consolidation or acquisition of companies	[a]4	[a]3		
Lack of capital for modernization or new plants			[a]4	
High labor costs and price controls during World War II				1
Out-of-state competition				2
High overhead	1	[a]2		
High freight rate	1			
Lack or loss of market	2			
Geologic:				
Poor-quality source rock	[a]2			1
Excessive overburden			2	
Other:				
Lack of producer interest or initiative	2		2	
Poor transportation facility	1			
Increasing use of portland cement			1	
Destruction of plant by fire				1

[a]Actual number of plants abandoned not known, but greater than figure shown.

importance to the lime producer because he can afford to produce only what he can sell immediately. The result of such competition has been continuous pressure toward more efficient large-volume production and lower costs. Lime plants generally have capacity available for increasing production and attempt to expand production in buyers' markets. Price wars are the result (Boynton, 1966, p. 431).

Competition among the midwestern producing states is dominated by Ohio, which produces the most lime today. Ohio has control of most of the large lime markets principally because of its location in relation to the Great Lakes. The importance of transportation on the Great Lakes is shown by the fact that in the early 1900's stone was shipped by barge from Ohio to lime kilns in the distant city of Duluth, Minn. By water, dolomitic lime can be shipped cheaply from the Cleveland area to Detroit, Toledo, and Buffalo. Ohio has maintained a high price for lime in comparison with neighboring states

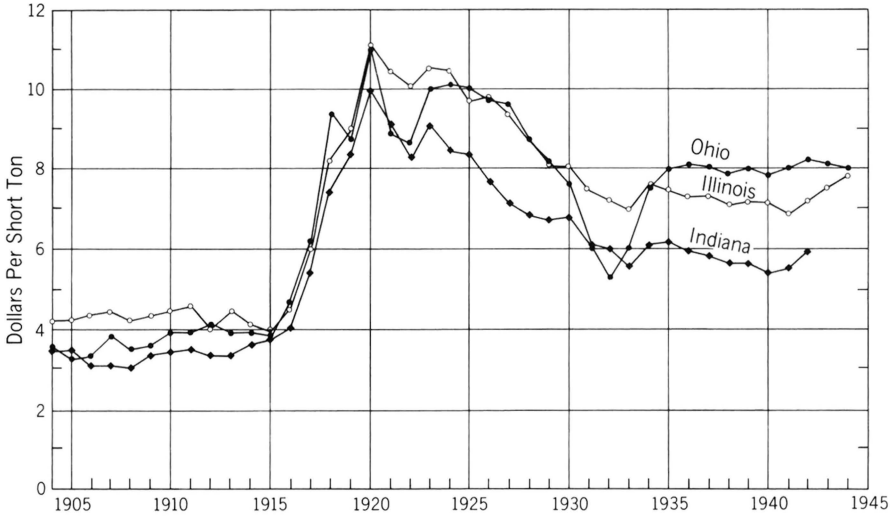

Figure 18. Average price per short ton of lime produced in Indiana, Illinois, and Ohio, 1904-44.

(fig. 18) probably because of the low cost of water transportation. High-calcium lime produced near the Marion area of Ohio does not have ready access to water transportation but has good railroads that provide transportation to Toledo, Cleveland, and Pittsburgh. Indiana's plant near Gary on Lake Michigan produces lime mostly for a neighboring mill and is not otherwise a factor in lake markets.

Although some ideal lime markets are close to the kilns, the market radius of lime plants reaches about 300 to 400 miles, and with a few exceptions as much as 2,000 miles (Boynton, 1966, p. 433-434). The large markets are the large industrial centers and their chemical industries, steel furnaces, and highways.

During the years of its lime production, Indiana had major markets in Indiana, Illinois, Pennsylvania, Michigan, Kentucky, and Ohio. The large producers near the growing metropolitan areas of other states, however, took over these markets, as the trend in lime production was to concentrate plants in the outskirts of large metropolitan areas. Chicago is one such area and is also accessible by water. Michigan, Ohio, and Wisconsin had previously supplied much of its lime, but the Chicago area is now approaching self-sufficiency (Boynton,

written communication, 1967). St. Louis is another large market for lime but is served by lime producers using stone from nearby deposits. Detroit, a large market, is on Lake Erie, which makes it possible to ship lime by water from Ohio. Louisville and Cincinnati were former markets for lime produced in southern Indiana but are now supplied by lime produced in southern Ohio.

Much lime is transported by truck today, but railroads are the major carrier (Boynton, 1966, p. 434). Although Indiana has good east-west railroads, many of the larger midwestern markets are closer to other sources of lime. But Indiana is close to some large markets. Indiana is the logical supplier for Kentucky, which has consumed as much lime as Indiana produced from about World War I, but Indiana producers did not capture that market. Chicago and Detroit are other large markets available to Indiana producers.

Summary

The lime industry in Indiana prospered from the mid-1800's through about 1900. Numerous companies produced lime near cities in north-central, south-central, and southeastern Indiana. Lime was shipped on the Wabash & Erie Canal, the Ohio River, and by railroad to markets throughout the midwestern United States and as far south and west as Florida and Texas. Although many old plants were abandoned in the early 1900's, a few larger capacity plants maintained production levels until the market for lime was reduced in the economic depression of the 1930's. By 1940 Indiana had only two lime plants, and the last commercial production from native stone ceased in 1953.

Many small plants were abandoned in the early 1900's because of consolidation of companies and local operational problems. Excessive distance to major markets and lack of capital for renovating old plants or for new construction were two major causes of the decline in Indiana after 1930. Production sagged in neighboring states during the 1930's, but picked up again during the 1940's and increased steadily. Lime production increased more rapidly in Ohio than in the other states because of cheap transportation on the Great Lakes and nearby large markets.

The attitude of Indiana's lime producers probably contributed to the decline of the industry in Indiana and the lack of resurgence after the economic depression. As early as 1896 Hopkins and Siebenthal (1897, p. 337) believed that the lime industry lacked an enterprising person to build it up and that all interest in the Salem dimension stone belt, at least, was in building stone. They further believed that although freight rates for the area discouraged the industry, this disinterest in lime was the fundamental reason why the lime industry remained largely undeveloped. Boynton (written communication, 1967) has commented that the decline of Indiana's lime industry was fundamentally caused by "apathy, unaggressiveness undoubtedly stimulated by the decline of building lime."

High-calcium limestones and high-magnesium dolomites are abundant in the state, and thick deposits of high-purity stone could be developed adjacent to major railroads and possibly near the Ohio River. The increased consumption of lime by the steel industry has expanded the market greatly, and the increasing use of lime for such purposes as soil stabilization and water and waste treatment holds promise for the future. Chicago, Cincinnati, Louisville, and major markets in Indiana are readily accessible by rail, and many markets in the midwestern United States are accessible by barge on the Ohio River. The revival of a lime industry based on Indiana materials is thus a real economic possibility.

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Appendix

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ABANDONED LIME PLANTS IN INDIANA

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Adams County					
Unknown	At Decatur, by St. Mary's River.	Huntington?	b1904	b1928	22-p. 168-169
Bartholomew County					
Unknown	Southwest of Hartsville at town limit, sec. 35 or 36-10N-7E.	Laurel?		b1899	42-p. 117
Sam Arbukle	Haw Creek Township, near Hartsville.	Louisville?	b1881	a1881	23-p. 184, 209
James Manley	Rock Creek Township, on Little Sand Creek, NE¼ sec. 6-8N-7E.	Jeffersonville	b1881	a1881	23-p. 189, 209
Carroll County					
David & Daniel Burn	At Delphi.	Huntington?	1825	a1825	35-p. 67
Cartwright & Co.	At Delphi.	Huntington	b1870	1870[4]	10-p. 309
E. W. Hubbard & Co.	At Delphi.	Huntington	1858	1870[4]	5-p. 228; 10-p. 309
F. Shelly & Co.	At Delphi.	Huntington	b1870	1870[4]	10-p. 309
Delphi Lime Co. (formed in 1870 from the three companies directly above)	1 mile north of Delphi, sec. 20-25N-2W.	Huntington	1870	a1922	5-p. 229; 33-p. 774
Harley Brothers Lime Co.	North edge of Delphi; moved ¼ mile north in 1891; NW¼SW¼ sec. 20-25N-2W; kilns torn down in 1963.	Huntington	1875	a1922	5-p. 230; 32-p. 418; 33-p. 775
Coble Lime Co.	1 mile north and a little east of courthouse between Harley and Delphi plants, SE¼NW¼ sec. 20-25N-2W.	Huntington	1902	1902-04?	5-p. 232-233

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Carroll County—Cont.					
Unknown, but probably includes some of the companies listed above.	Five kiln locations in sec. 20-25N-2W, north side of Delphi: SW¼ NW¼NE¼, kiln foundations still visible; NW¼NE¼NW¼; NE¼ SW¼NW¼; SE¼NW¼NW¼; SW¼NW¼SW¼.	Probably all Huntington		b1922?	48
Unknown	Two kilns in sec. 19-25N-2W, Delphi Limestone Co. workings, west side of Delphi: SW¼SW¼SW¼ and NW¼SW¼SW¼.	Huntington		b1922?	48
Cass County					
R. Donaldson	4½ miles east of Logansport, sec. 26 or 27-27N-2E.	Traverse?	b1872	a1872	10-p. 312
Bowen & Grayen	1 mile west of Kerfoot?	Unknown	b1872	a1872	10-p. 313
D. Keipert	4½ miles east of Logansport, sec. 26 or 27-27N-2E.	Traverse?	b1872	a1872	10-p.312
E. N. Talbott & Co.	2 miles west of Logansport.	Salina?	b1872	b1894	10-p. 318; 26-p. 24
A. B. Keeport & Co.	4 miles east of Logansport, NE¼SE¼ sec. 27-27N-2E.	Traverse?	1868	1901	5-p. 240-241; 26-p. 28; 32-p. 420
Logansport Stone & Lime Co. (c1900-29); France Stone Co. (1929-43)	4 miles east of Logansport, SW¼NE¼ sec. 27-27N-2E; stone kiln still standing (fig. 9).	Traverse	c1900	1943	22-p. 177
Harry Lux	Sec. 2, southeast of Logansport.	Unknown	b1903	a1903	32-p. 419

Clark County					
Starkwethers	Nicholas Lentz place ½ mile above Utica on river front, S½ CMG 17.	Jeffersonville-Louisville	1826	1847	2-p. 399
Peabody	CMG 16 or 17.	Unknown	1830	b1873?	2-p. 399
R. S. Wood, J. Sweeney & W. Brendell	Near Utica.	Unknown	1830	b1873?	2-p. 399
A. Summers, J. Sweeney & J. Hogg	Near Utica.	Unknown	1840	1873?	2-p. 399
H. C. Emerke & Meshac Jones	Near Utica.	Unknown	1857	1868?	2-p. 399
M. H. Tyler & H. C. Emerke	Near Utica.	Unknown	1868	1870[4]	2-p. 399; 5-p. 242
Louisville Cement Co. (bought out above company)	Near Utica, SW¼ CMG 16.	Jeffersonville-Louisville	1870	1885	2-p. 400; 7-p. 145
Utica Lime Co.	CMG 16.	Unknown	1870	1885	2-p. 400; 7-p. 145
J. B. Speed & Co.	¼ mile northeast of Utica, S½ CMG 17.	Jeffersonville-Louisville	1871	1907	5-p. 242-243; 7-p. 145
Jacob Robinson	At Robinsons Landing a few miles above Utica, near center CMG 41.	Louisville	b1873	b1900	7-p. 145
J. K. Sharp	Charlestown Landing, a short distance above Utica, S½ CMG 56.	Louisville?	b1873	a1873?	7-p. 146
Capt. S. C. Rucker	At Charlestown Landing, E½ CMG 56.	Louisville	b1873	a1873?	7-p. 146
J. Howard	At the Falls of the Ohio.	Jeffersonville?	b1873	a1873	7-p. 145
Union Lime & Cement Co.	Near Utica.	Jeffersonville-Louisville?		c1900	5-p. 242
Crawford County					
J. B. Speed & Co.	West side of Blue River at Milltown, SW¼NE¼ sec. 15-2S-2E; kiln still standing (fig. 5).	Ste. Genevieve-Paoli	1887	c1915	5-p. 242-245

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Dearborn County					
Unknown	Temporary kilns in Dearborn, Ohio, and Switzerland Counties.	Unknown	b1872	a1872	45-p. 415-416
Decatur County					
Albert Smith	West side of Greensburg, 100 yards south of bridge over Muddy Fork, NE¼NW¼ sec. 10-10N-9E.	Geneva		b1882	24-p. 131; 42-p. 90-91
Z. Boicourt	Near Westport, SW¼SE¼ sec. 32-9N-9E.	Laurel	b1882	a1882	24-p. 125
A. Forsyth	Just north of Decatur County cemetery.	Unknown	b1882	a1882	24-p. 131
Eva Eck	At Adams, NE¼NE¼ sec. 25-11N-8E; stone kiln still standing.	Geneva	b1882	a1882	24-p. 138; 42-map facing p. 81
Unknown	¼ mile below Ewington Post Office, SW¼SW¼ sec. 13-10N-8E.	Geneva		b1884	42-p. 92
Unknown	NW¼NW¼ sec. 3-10N-8E.	Geneva	b1899	a1899?	42-map facing p. 81
Delaware County					
Unknown	Kilns at one of several quarries east of Yorktown on White River, sec. 14?-20N-9E.	Unknown		b1881	38-p. 138
Unknown	On White River east of Muncie, sec. 11 or 14-20N-10E.	Unknown	b1881	a1881	38-p. 138

Delaware County—Cont.					
Unknown	SE¼ sec. 2-21N-11E.	Unknown	b1881	a1881?	38-map facing p. 126
Mr. Kirp	Upstream from quarry in municipal park, east side of White River at Muncie, NE¼NW¼ sec. 14-20N-10E.	Unknown	b1881	a1881-b1928	22-p. 172; 38-p. 139
Franklin County					
Many small kilns	Near Laurel and 3 miles east of Laurel.	Mostly Laurel	c1870	c1885	5-p. 257
Laurel Steam Stone Co.	Near Derbyshire Falls, sec. 20-12N-12E.	Laurel?	b1903	a1903?	5-p. 257
Fulton County					
Unknown	Near Rochester.	Marl		b1903	5-p. 224
Grant County					
Unknown	Between Jonesboro and New Cumberland along the Mississinewa River.	Limestone boulders of glacial origin		b1883	40-p. 143
Unknown	Kilns near Mier and in Franklin Township.	Liston Creek?		b1883	40-p. 146
Unknown	On Mississinewa River bank in city park in Marion, NW¼SE¼ sec. 30-25N-8E; part of stone kiln still standing.	Huntington	1894	1901	
Harrison County					
Jacob Stockslager	2 miles north of Mauckport, SE¼SW¼ sec. 21-5S-3E.	Ste. Genevieve	c1840	c1878	14-p. 402, 411-412; 29-p. 315, 320, 397
Unknown	Haunted Hollow, center of section line between secs. 30 and 31-5S-3E.	Ste. Genevieve		c1900	

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Harrison County—Cont.					
Eichel Lime & Stone Co. (1903-13); Louisville Cement Co. (a1913)	East side of Blue River near Milltown, NE¼NE¼ sec. 15-2S-2E.	St. Louis-Ste. Genevieve	1903	a1913	3-p. 1; 5-p. 218, 245-247; 33-p. 775
Louisville Cement Co.	East side of Blue River ¼ mile northwest of Eichel plant (fig. 13); vertical kilns SW¼SE¼ sec. 10-2S-2E; rotary kilns NW¼NE¼ sec. 15-2S-2E.	St. Louis-Ste. Genevieve	1903	1953	3-p. 1; 31-p. 381
Henry County					
Unknown	SW¼SW¼ sec. 12-16N-9E.	Laurel	b1886	b1903	32-p. 427; 41-p. 102
Howard County					
A. Bernard	Near the road leading to Kokomo.	Kokomo?	b1872	a1872	10-p. 336
Detenbough	Near Kokomo.	Kokomo?	b1872	a1872	10-p. 336
Huntington County					
Michael Hauseman	Unknown.	Unknown	1843 or 1844	a1844	9-p. 250
Louis Gephart	1 mile east of Huntington, sec. 13?-28N-9E.	Unknown	c1845	b1887?	5-p. 233
James Fulton	Unknown.	Unknown	1860		9-p. 250
Thirty-one small operations (gradually merged into the three companies listed immediately below)	Kilns along the Little Wabash River east and west of Huntington.	Huntington and other rock units	b1876	1876-87[4]	5-p. 234; 20-p. 121-124

Huntington County—Cont.					
Huntington White Lime Co.	East side of Huntington near Little Wabash River.	Huntington	1876-87	1887[4]	5-p. 234
Baltes & Martin Co.	East side of Huntington near Little Wabash River.	Huntington	1876-87	1887[4]	5-p. 234
Beck & Purviance Co.	East side of Huntington near Little Wabash River.	Huntington	1876-87	1887[4]	5-p. 234
Western Lime Co. (incorporated above three companies in 1887) (1887-1906); Ohio & Western Lime Co. (1906-b1928)	East side of Huntington, NW¼ sec. 13 and SE¼ sec. 12-28N-9E.	Huntington	1887	b1928	5-p. 234-238
Mr. E. S. Wheeler	Just south of Markle, sec. 1-27N-10E.	Huntington	1888	b1928	5-p. 240; 22-p. 174
Unknown	1½ miles northwest of Warren on west bank of Salamonie River, SE¼NW¼ sec. 19-26N-10E.	Huntington		b1928	22-p. 174
Consolidated Lime Co.	2½ miles east of Huntington, NW¼ SW¼ sec. 8-28N-10E.	Huntington	1893	b1928	5-p. 238
Kelley Island Lime & Transport Co.	1 mile east of Huntington, SE¼SE¼ sec. 12-28N-9E (fig. 8).	Huntington	c1918	1940	22-p. 179; 33-p. 774
Jasper County					
Unknown	Near Iroquois River southwest of Rensselaer.	Unknown	b1883	a1883	17-p. 70
Jay County					
Portland Stone & Lime Co.	1 mile southwest of Portland, north bank of Salamonie River, SE¼SE¼ sec. 24-23N-13E.	Salamonie	b1906	b1928	22-p. 171; 34-p. 165
Unknown	At Jay City, sec. 4?-24N-15E.	Salamonie	b1882	a1882	34-p. 166

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Jefferson County					
Unknown	Clifty Falls State Park, on Promenade Ridge, NW¼SW¼ sec. 33-4N-10E.	Laurel		c1900	19-p. 13
Unknown	Clifty Falls State Park, at entrance of hollow, SE¼ sec. 29?-4N-10E.	Laurel		c1900	19-p. 13
Knox County					
Cox	Near High Point.	Unknown	b1873	a1873	11-p. 326
Lawrence County					
Asa Erwin	Rock Lick Creek, NW¼ sec. 24-4N-1W.	St. Louis-Salem	b1864	1895[4]	5-p. 251; 12-p. 302
D. Kelly & J. Tomlinson	NW¼NE¼ sec. 30-4N-1E.	Salem	b1874	a1874	12-p. 303
Unknown	SW¼ sec. 22-5N-1W.	Salem		b1896	29-p. 387
Unknown	Along Monon Railroad ¼ mile south of Bedford.	Salem		b1896	29-p. 387
Unknown	Two kilns ¼ mile south of above kiln on east side of railroad.	Salem		b1896	29-p. 388
Bedford Building Stone quarry	NE¼ sec. 28-5N-1W.	Salem	1891	1893	29-p. 387
Big Four Lime Co.	Main fork of Rock Lick Creek, NW¼ sec. 30-4N-1E.	Salem?	b1895	1895[4]	5-p. 251
Mitchell Lime Co. (purchased Asa Erwin and Big Four Lime Co. 1895); Lehigh Cement Co. Rabbitville plant	Monon spur 2½ miles north of Mitchell, SE¼NW¼ sec. 24-4N-1W (fig. 10).	St. Louis-Salem	b1895	1920's	5-p. 251-253

Lawrence County–Cont.					
Mitchell Lime Co. Rock Lick plant	1 mile northeast of Mitchell on B & O Railroad, NE¼SW¼ sec. 30-4N-1E.	Salem	b1903	1930's	5-p. 253; 33-p. 775
Horseshoe Lime & Cement Co. (1902-07); Ohio & Western Lime Co. (1907-15); Indiana Quarries Co. (1915-30's)	Spur of Monon Railroad just north of famous horseshoe curve, SW¼NE¼ sec. 33-6N-1W (figs. 11 and 12).	Salem waste blocks	1902	1930's	5-p. 255-257
Madison County					
Ingalls Lime & Stone Co.	¾ mile north of Ingalls, SW¼SE¼ sec. 25-18N-6E.	Liston Creek	1891	1894	5-p. 241
Unknown	North bank of Fall Creek 1 mile north of Alfont, center sec. 35-18N-6E.	Liston Creek	b1903	a1903	32-p. 427
Miami County					
Unknown	1 mile east of Peru in north-central part of Reserve 5-27N-4E.	Huntington		b1903	22-p. 176; 32-p. 420-421
Wallick's Mill	On Little Pipe Creek where the Nickel Plate Railroad crosses stream, NW¼NE¼ sec. 5-26N-4E.	Huntington	b1872	a1891	10-p. 322; 22-p. 176; 28-p. 181; 44-p. 43
Unknown	North bank of Wabash River opposite mouth of Little Pipe Creek, SE¼ NW¼ sec. 32-27N-4E.	Kokomo?		b1955	44-p. 43
Duke's quarry	North part of Peru.	Unknown		b1872	10-p. 321
Charles Trippier	South side of Wabash River ¼ mile east of Peru.	Unknown	b1872	a1888	10-p. 322; 28-p. 181

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Monroe County					
Unknown	Near the old University building at Bloomington.	Salem		b1896	5-p. 219; 29-p. 336
Unknown	Near Terre Haute quarry ½ mile west of Stinesville.	Salem?		b1896	29-p. 361
Unknown	At Ellettsville.	Salem	b1896	1896-1903	5-p. 219; 29-p. 336
Noble County					
Unknown	Near Albion.	Marl		b1903	5-p. 224
Ohio County					
Unknown	Temporary kilns in Dearborn, Ohio, and Switzerland Counties.	Unknown	b1872	a1872	45-p. 415-416
Owen County					
Gosport Stone & Lime Co. (c1868-85); Romona Oolitic Stone Co. (1885-a96)	At Romona, sec. 10-10N-3W.	Salem	c1868	a1896	5-p. 219; 29-p. 351
White River Stone & Lime Co. Bienert quarry (1870-96); Keever Stone Co. (1896-1900)	½ mile south of Romona, NE¼SW¼ sec. 10-10N-3W.	St. Louis-Salem	1870	c1900	4-p. 360-361; 29-p. 354-355
Posey County					
Unknown	At West Franklin and nearby bluffs, sec. 24-7S-12W.	West Franklin		b1884	18-p. 56

Putnam County					
Hellens, Butcher & H. C. Steeg; William Steeg	Greencastle Junction (Limedale), NE¼ sec. 32-14N-4W.	Ste. Genevieve	1856	c1900	1-p. 63; 15-p. 413; 47-p. 223
Torr Brothers	Adjoins Eppinghausen and Johnson quarry on the east, S½S½ sec. 26-14N-5W.	St. Louis-Ste. Genevieve	1874	c1900	15-p. 414-415; 30-p. 263; 46-p. 671
Eppinghausen & Johnson	At Oakalla, 5 miles west of Greencastle, S½S½ sec. 26-14N-5W.	Ste. Genevieve	c1875	c1900	15-p. 414; 30-p. 263
Moss & Hillis & Co.	½ mile east of Oakalla, S½SE¼ sec. 26-14N-5W.	Ste. Genevieve	c1875	c1900	15-p. 416; 30-p. 263
A & C Stone Co.	Greencastle.	Ste. Genevieve		c1900	6-p. 34
Indiana State Farm	Near Putnamville, near center W½ sec. 17-13N-4W; beehive kiln (fig. 16).	Paoli-Ste. Genevieve	1924	1969	
Randolph County					
J. C. Brickley	Along south bank of White River at Macksville, S½N½ sec. 20-20N-13E.	Salamonie	b1859	b1928	22-p. 109, 171; 36-p. 81; 39-p. 184-185
Unknown	On Cabin Creek, E½ sec. 8-19N-13E.	Unknown	b1882		39-p. 185
Ripley County					
John Jackson	3 miles southwest of Versailles, sec. 15-7N-11E.	Laurel?	b1876	a1876	8-p. 193
St. Joseph County					
Unknown	At college of Notre Dame.	Marl	b1859	a1859	5-p. 224; 36-p. 200
Shelby County					
John L. Scanlon	Western St. Paul, NE¼NE¼ sec. 9-11N-8E.	Laurel	b1881	a1882	16-p. 79-80; 24-p. 131

ABANDONED LIME PLANTS IN INDIANA—Continued

Company[1, 2]	Location and remarks[1]	Rock unit or raw material	Erected[2]	Abandoned[2]	References[3]
Shelby County—Cont.					
Gregory lime quarry	A short distance above the bridge, on west side of Flat Rock near Geneva, NW¼NW¼ sec. 23-11N-7E.	Geneva	b1898	a1898	27-p. 235
Steuben County					
Unknown	At Lime Lake, sec. 18-38N-12E?	Marl		b1903	5-p. 224
Unknown	At Silver Lake, sec. 29 or 30-37N-13E.	Marl		b1903	5-p. 224
Switzerland County					
Unknown	Temporary kilns in Switzerland, Dearborn, and Ohio Counties.	Unknown	b1872	a1872	45-p. 415-416
Vanderburgh County					
Michael Gluck	SE¼SW¼ sec. 32-6S-11W.	West Franklin	b1875	a1875	13-p. 275
Unknown	1 mile east of West Franklin, SE¼NW¼ sec. 19-7S-11W.	West Franklin		b1875	13-p. 276
Wabash County					
J. Hilderbrand & Co.	Northern part of Wabash, south south side of river opposite Wabash.	Wabash?	b1872	a1872	10-p. 327
Phillip Davis	Sec. 27-26N-6E.	Liston Creek		b1891	25-p. 236
Washington County					
Salem Stone & Lime Co. (c1884-b96); Salem-Bedford Stone Co. (b1896-96); Union Cement & Lime Co. (1896-?); Hoosier Lime & Stone Co., Inc. (?-1932)	½ mile southwest of Salem, NW¼NW¼ sec. 19-2N-4E and NE¼NE¼ sec. 24-2N-3E; stone kilns still standing (fig. 15); underground mine (fig. 14).	Salem	c1884	1932	5-p. 248

Washington County–Cont.					
Salem Lime & Stone Co.	SE¼SE¼ sec. 13-2N-3E.	Salem		1945	37-p. 1
Wayne County					
Boyd & Cook; Cox Mills	In Middleboro, 100 yards from stream, NW¼SW¼ sec. 12-14N-1W.	Salamonie	b1878	1878-1903	5-p. 222; 21-p. 181-183
White County					
Unknown	At railway crossing at Monon.	Huntington	b1888	a1888	32-p. 417; 43-p. 141

Footnotes for appendix are on p. 62.

[1]Unknown indicates that information was not available to the authors.

[2]Abbreviations:
a - after
b - before
c - about

[3]References:

No.	Author	Year	No.	Author	Year	No.	Author	Year
1	Bailey	1970	17	Collett	1883b	33	Logan	1922
2	Baird	1909	18	Collett	1884	34	McCaslin	1883
3	Baylor	1932	19	Cottman	1925	35	Mayhill	1953
4	R. S. Blatchley	1908	20	Cox	1876	36	Owen	1862
5	W. S. Blatchley	1904	21	Cox	1879	37	Patton	1947
6	W. S. Blatchley	1907	22	Cumings & Shrock	1928	38	Phinney	1882
7	Borden	1874	23	Elrod	1882	39	Phinney	1883
8	Borden	1876	24	Elrod	1883	40	Phinney	1884
9	Bush	1914	25	Elrod & Benedict	1892	41	Phinney	1886
10	Collett	1872	26	Elrod & Benedict	1894	42	Price	1900
11	Collett	1874a	27	Foerste	1898	43	Thompson	1889
12	Collett	1874b	28	Gorby	1889	44	Thornbury & Deane	1955
13	Collett	1876	29	Hopkins & Siebenthal	1897	45	Warder	1872
14	Collett	1879	30	Johnson	1966	46	Weik	1910
15	Collett	1880b	31	Kaufman & Patton	1953	47	Anonymous	1887
16	Collett	1882	32	Kindle & Breger	1904	48	E. F. Stuntz, Delphi, Ind., oral communication	1973

[4]Indicates year of change of ownership; lime plant not necessarily abandoned.

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OVERSIZED DOCUMENT

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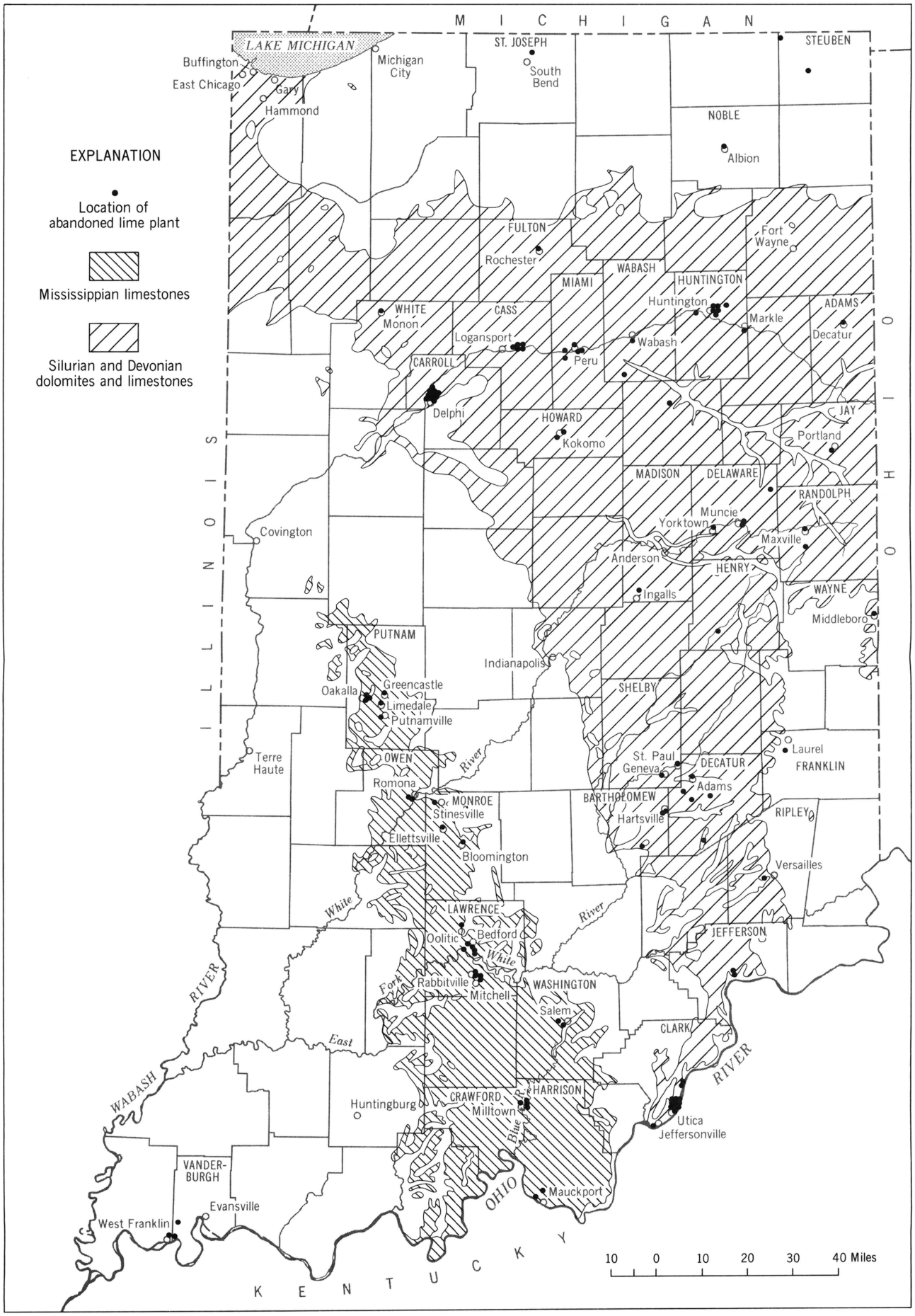

MAP OF INDIANA SHOWING DISTRIBUTION OF PRINCIPAL CARBONATE ROCKS AND KNOWN LOCATIONS OF ABANDONED LIME PLANTS