

Dimension Limestone Resources of Indiana

BULLETIN 42-C



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DEPARTMENT OF NATURAL RESOURCES
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**Seascape of a Mississippian sea floor during deposition of the Salem Limestone
By Artist Robert E. Judah**



Dimension Limestone Resources of Indiana

By LAWRENCE F. ROONEY

DEPARTMENT OF NATURAL RESOURCES
GEOLOGICAL SURVEY BULLETIN 42-C



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Edgar D. Whitcomb, *Governor*
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John R. Lloyd, *Director*
GEOLOGICAL SURVEY
John B. Patton, *State Geologist*

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Dimension Limestone Resources of Indiana¹

By LAWRENCE F. ROONEY

Introduction

Most dimension limestone in Indiana is produced from the Salem Limestone (fig. 1). A significant amount is produced from the Laurel Member of the Salamonie Dolomite, the Louisville Limestone, and the Geneva Dolomite. Other strata, such as Ste. Genevieve and Ordovician limestones, have been used as dimension stone² in the past, and some limestone from such formations as the Brassfield, Waldron, and Harrodsburg is used for building purposes at present. But only dimension stone produced from the Salem, Laurel, Louisville, and Geneva is discussed in this report.

Laurel Member, Louisville Limestone, and Geneva Dolomite

HISTORY

During the last century, limestone of Silurian age, dominantly the Laurel Member (fig. 1), was used almost as widely in Indiana as the Salem is today. Quarries were opened in Delaware County as early as 1835 and in Cass County as early as 1840, but the specific locations and stratigraphic positions are unknown. The first recorded quarries in the Laurel were opened near Greensburg in Decatur County and near Laurel in Franklin County about 1850 (Collett, 1882, p. 25). By 1897, quarries had been opened in a broad area in southeastern Indiana (fig. 2). Many of the quarries were connected to major railroads by branch lines (Foerste, 1898, p. 196).

¹Reprinted in part from the Indiana Business Review, September 1965 issue, with permission of the Indiana Graduate School of Business.

²Dimension stone is stone quarried, cut, or broken to desired dimensions and shapes. Some stone has one dimension fixed by nature and is sawed or split in two dimensions. In the building stone industry, dimension limestone is used to refer to both limestone and dolomite or intermediate rock types.

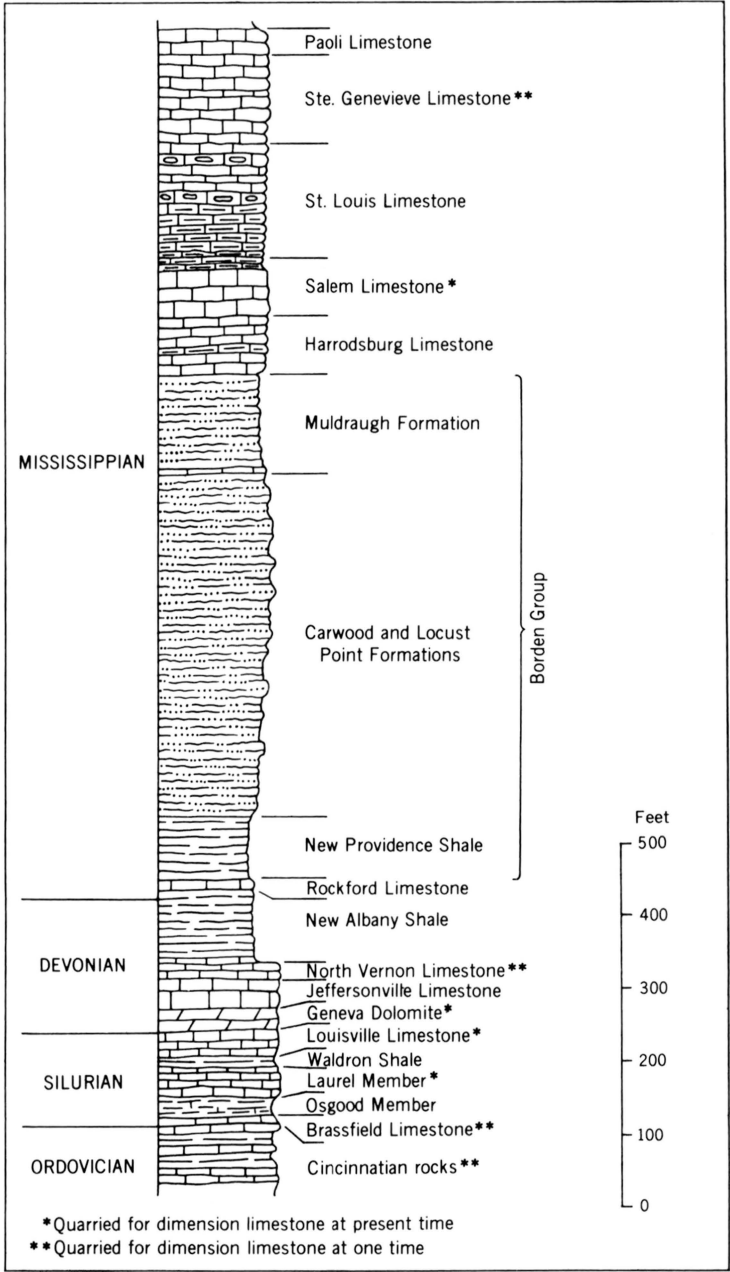


Figure 1. Stratigraphic section showing important dimension limestones in Indiana.

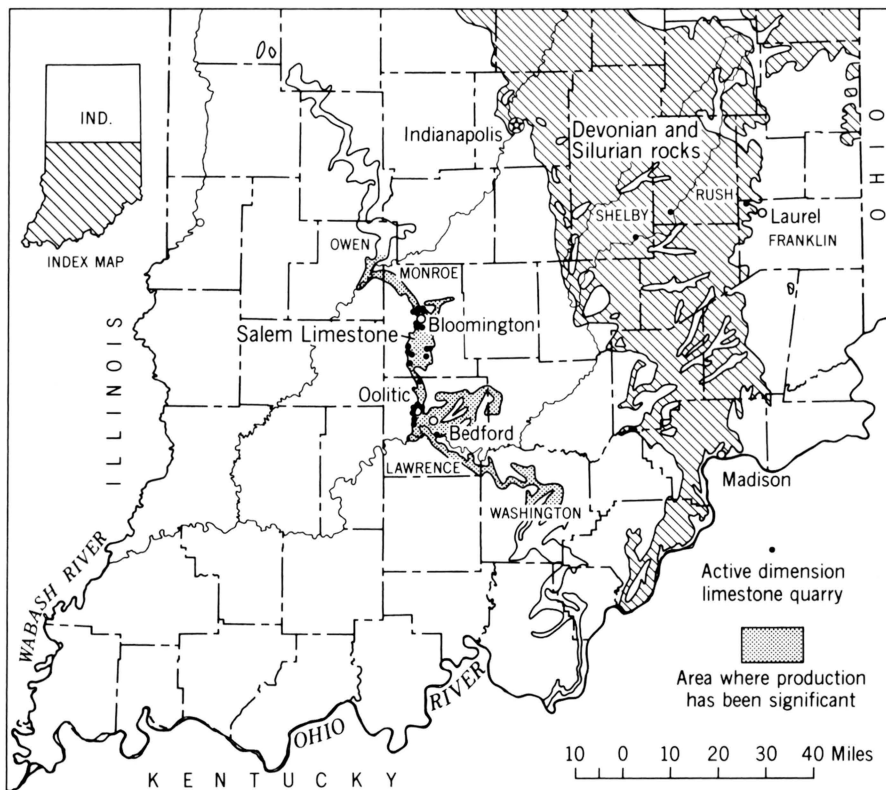


Figure 2. Map showing outcrop areas of the Salem Limestone and Devonian and Silurian carbonate rocks in southern Indiana and locations of quarries active in 1969.

During the early history of its use, Laurel limestone was prized because it was composed of beds that were mostly 4 to 9 inches thick and separated by clay partings. The stone could be stripped in slabs as large as 200 feet long and 50 feet wide (Cox, 1879, p. 90), then broken up for different uses. Thin layers were used for window sills, veneer, curbing, and gutters. Thicker layers were used for steps, landings, sidewalks, and porches. The thickest layers were used for foundation footings and bridge abutments. Some layers were named for a special purpose; for example, jailstone described a bed that provided large slabs suitable for floors or walls of a jail (Foerste, 1898, p. 203). Small blocks unsuitable for such purposes as those

listed above were used to line cellars and were called cellar stone. The early sidewalks of eastern Indiana and western Ohio were constructed of Laurel flags, many of which are still in use. Fence posts, especially cornerposts and gateposts of Laurel stone, are also still in use.

The first use of the Laurel was clearly based on its strength, its durability, and the ease with which it could be quarried by hand. In the wake of technological advances, however, portland cement and Salem limestone proved to be even more utilitarian, and to have other virtues as well. Although statistics are not available, production from the Laurel appears to have been negligible between the turn of the century and the 1960's. Apparently, each quarry was small, was operated intermittently if at all, and left few records.

GEOLOGY

LAUREL MEMBER AND LOUISVILLE LIMESTONE: The Laurel Member of the Salamonie Dolomite and the Louisville Limestone are partly exposed at many localities in southern Indiana and are sources of much stone used as aggregate. Until redefined by French (1967, p. 17), the Laurel Member was known as the Laurel Limestone. The rocks immediately underlying the Laurel were called the Osgood Formation. In northern Indiana, however, the Laurel and Osgood are impossible to distinguish, and the correlative strata are called the Salamonie Dolomite, which reaches a thickness of more than 200 feet (French, 1967, p. 19). The Laurel directly underlies the Waldron Shale, which in turn underlies the Louisville Limestone (fig. 1). The maximum thickness of both the Laurel and the Louisville is probably between 60 and 70 feet in southern Indiana. Because the Silurian formations in southern Indiana are thin, are generally covered by unconsolidated materials, and have not been mapped in detail, their areal distributions are not shown separately in figure 2.

The Laurel and Louisville limestones were deposited in shallow marine water as shells and other hard parts of marine organisms, which were later broken and reworked by wave action into a medium-to-coarse sand. Uninterrupted accumulation of thick beds was pre-

vented by repeated influxes of small amounts of terrigenous material, such as clay, which resulted in bedding generally less than 1 foot thick. Some of the limestone strata have been altered to dolomite, and both limestone and dolomite have been recrystallized, so that porosity is almost nil. As a result, Laurel, Louisville, and other Silurian rocks used as dimension limestone are hard and cannot be carved easily. The dominant color of Laurel and Louisville limestones is gray, but tints of green, blue, and brown are common.

GENEVA DOLOMITE: The Geneva Dolomite (fig. 1), whose outcrop belt lies just west of that of the Laurel, also is a source of much stone used as aggregate. Like the Laurel Member, it is identified only in the southern part of the state, but strata underlying the evaporites of the Detroit River Formation in northern Indiana closely resemble it. Its maximum recorded thickness is 35 feet (Patton, 1953a, p. 33). Its origin is similar to that of the Laurel, but it was deposited in a more saline and more reducing environment. It has been pervasively dolomitized, probably shortly after deposition. Geneva dolomite is medium to coarse grained and characterized by a dark brown color, high porosity, abundant megafossils, and masses of coarsely crystalline calcite.

PRESENT PRODUCTION

Laurel and Louisville limestones, along with stone from the Geneva Dolomite, are enjoying a minor renaissance today. Each limestone is in considerable demand as veneer for private homes and small public or semipublic buildings, such as churches, country clubs, and fraternities.

Some individuals produce Devonian, Silurian, and possibly some Ordovician limestones (fig. 1) on a part-time basis, and some crushed stone companies produce them as a by-product, but most current production is from three quarries (fig. 2) in Shelby (mostly from the Louisville Limestone), Rush (from the Geneva Dolomite), and Franklin (from the Laurel Member) Counties. In 1968, each of these quarries was operated full time and employed at least five persons. The current annual production of all dimension limestone in Indiana



Figure 3. Bulldozer equipped to rip large slabs of bedrock for dimension limestone production in the quarry of Blue Ridge Quarries near Waldron in Shelby County.

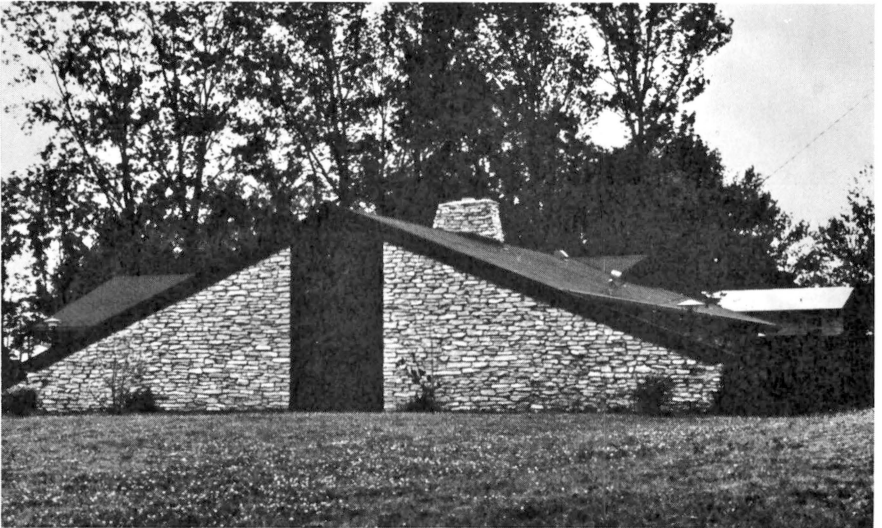


Figure 4. House on which thin-bedded rock from the Geneva Dolomite has been used as veneer.

outside Monroe and Lawrence Counties (fig. 2), that is, mostly from the Louisville, Geneva, and Laurel, is less than 10,000 tons.

Quarrying techniques are simple and require little capital equipment. Large slabs are ripped from thin layers of bedrock by a fork mounted on a bulldozer (fig. 3), broken to size in a machine resembling a guillotine, and then sorted by hand. Almost all stone is sold as rough irregular blocks, generally as 4-inch veneer known in the trade as "ruble" or rubblestone. Very little stone is sawed.

Even though the Silurian limestones are exceptionally strong and dense (table 1), the modern appeal of Devonian and Silurian limestone is aesthetic rather than utilitarian. The earthy colors of yellow, brown, and green are pleasing. But the major attraction appears to be the irregular and random shape of the blocks (fig. 4). In fact, such limestone is often called natural stone, probably because of its resemblance to fieldstone. In a sense, it is that: instant fieldstone, the bulldozer serving as water, frost, and time.

Salem Limestone

HISTORY³

The first recorded use of the Salem Limestone, now generally known in the trade as Indiana Limestone, was as the foundation and sills of the Monroe County Courthouse (Hopkins and Siebenthal, 1897, p. 366). The first quarry of record was opened near Stinesville in 1827 (Hopkins and Siebenthal, 1897, p. 340).

Until railroads linked the stone belt with outside markets, the Salem had limited use, such as bridge foundations, flagging, and tombstones. During the period from 1848 to 1870, railroads that later were to become the Monon, Pennsylvania, and Baltimore and Ohio were constructed through Monroe and Lawrence Counties and made it possible to ship stone to Chicago, St. Louis, Louisville, and the eastern seaboard. Although most of the early quarries were opened to provide stone for ballast, bridge abutments, and lime used along

³For a detailed history of the Indiana Limestone industry, the reader is referred to Batchelor (1944), Blatchley (1908), Hopkins and Siebenthal (1897), and Logan (1922).

the Monon, the first quarry and mill on record equipped specifically to produce dimension stone were not put into operation until 1855 (Hopkins and Siebenthal, 1897, p. 340 and 357). That date as well as any other marks the beginning of Indiana's largest dimension stone industry.

Shortly after the Civil War, Salem limestone began to make inroads into distant markets. In 1878, Salem was selected for construction of the state capitol in Indianapolis. About that time, numerous public buildings and private residences were constructed on the eastern seaboard. By 1896, more than 300 buildings in New York City had been constructed of Salem limestone, and hundreds of buildings had been erected in 25 states, 1 territory, and 1 foreign country (Hopkins and Siebenthal, 1897, p. 413). These buildings included many mansions as well as public or semipublic buildings, such as churches, post offices, offices, and schools. Ironically they also included the state capitol of Georgia, a state that produces much marble and granite.

From that period to the present, Salem limestone has dominated the domestic dimension limestone market, but it has lost steadily an increasing share of the total construction market. After the advent of the skyscrapers near the turn of the century, large buildings were no longer constructed of solid stone. Concrete rapidly took over virtually all uses for structural stone, and ultimately won a large share of the veneer market as well. In recent years, glass and metal have been popular, and granite production surpassed limestone production in 1962, 1964, 1965, and 1967 (U.S. Bureau of Mines Yearbooks).

GEOLOGY⁴

The Salem Limestone is overlain by the St. Louis Limestone and underlain by the Harrodsburg Limestone, both of Mississippian age (fig. 1). It is composed dominantly of comminuted shell fragments and microfossils deposited some 300 million years ago in a shallow sea that covered most of Indiana. Whole microfossils and shell frag-

⁴For more detailed discussions of the geology of the Salem Limestone, the reader is referred to Pinsak (1957) and Smith (1955, 1962, and 1966).

ments of one size were deposited in one area, and those of another size in another. The sea margins migrated landward or seaward with time, and deposition of this carbonate sand was interrupted in some areas by influxes of mud. In other areas deposition of sand was continuous, and thick, clean bodies of sand accumulated. Lagoons impeded circulation and caused local concentration of unoxidized matter. As a result, a geometrically complex network of lenticular bodies of skeletal debris was cemented into a wedge of rock identifiable in south-central Indiana and adjacent states as the Salem Limestone. Only part of the Salem is suitable for use as dimension stone, and only a small part of that stone has been exposed by uplift and erosion. Thus exploration for new deposits is not simply a matter of locating a thick wedge of the Salem Limestone. It is a matter of locating a pod of suitable stone within that wedge.

The Salem Limestone crops out from Montgomery County to the Ohio River (fig. 2) and beyond into Kentucky, but the thickest units of dimension stone quality are found in Monroe and Lawrence Counties, where all current production is centered. Dimension stone has also been quarried in significant amounts from both Owen and Washington Counties, which remain potential areas for new quarries.

Although the formation is in places more than 80 feet thick, most quarries contain less than 60 feet of usable stone. The Salem Limestone is virtually unique in that through much of that thickness it is uninterrupted by bedding planes prominent enough to affect its quarrying, and the stone has almost as much strength with the grain as across the grain. That quality outweighs by far its overall moderate strength and absorption (table 1).

An outcrop of the Salem Limestone is relatively easy to identify by its massive rounded ledges, gray color, and coarse texture, all of which remind one of an elephant's hide. Where not covered by younger rocks, it has been partly dissolved and has left a sculptured surface called lapies covered by red clay. The solution channels, called grikes (fig. 5), add much cost to quarrying because the clay that fills them must be removed, sometimes by hand.

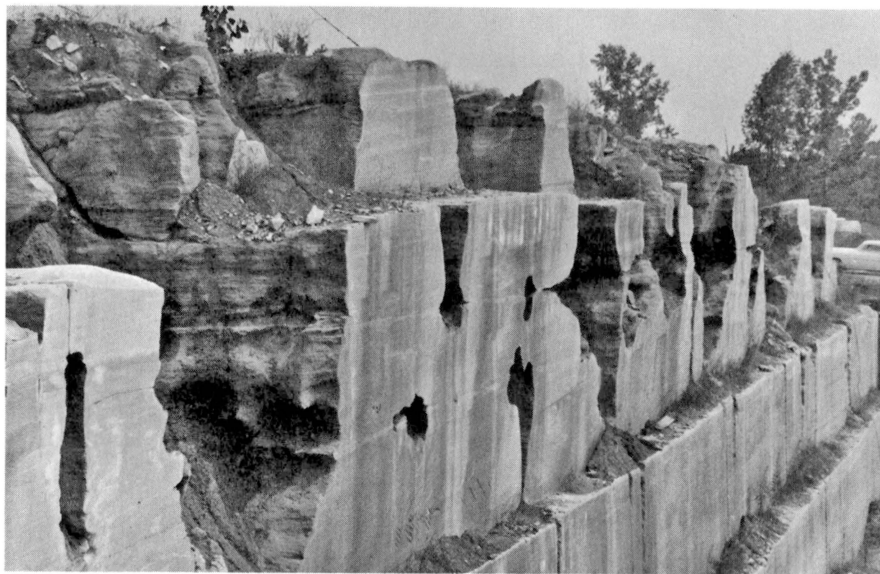


Figure 5. Solution channels exposed in the wall of a dimension stone quarry. These channels are called grikes by the quarriers, and the irregular upper surface of the limestone bedrock is called lapies by geomorphologists. Clay that filled these grikes has been removed.



Figure 6. Lapies blocks used as free-form sculpture and lawn decoration.

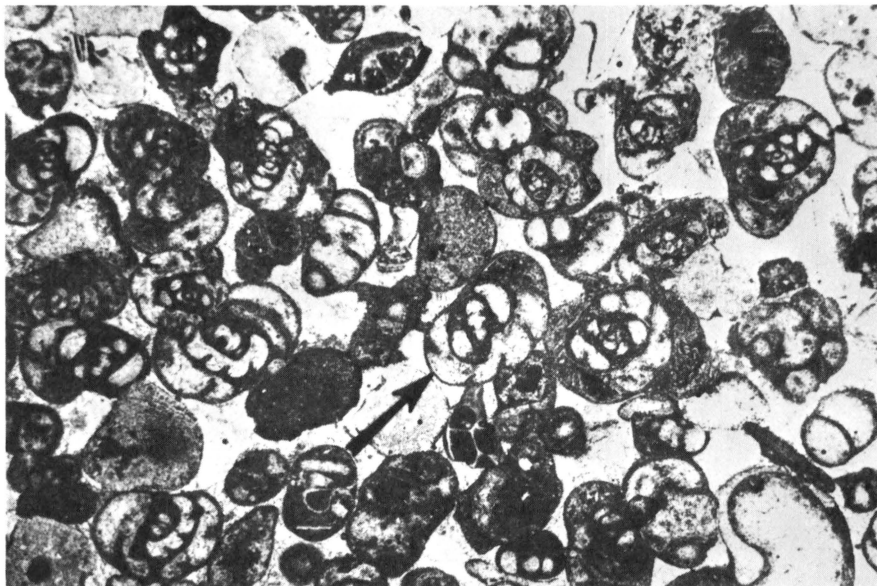


Figure 7. Photomicrograph of Salem Limestone. The arrow points to an *Endothyra baileyi*.

Chemically the Salem Limestone is almost pure calcium carbonate (97 percent) and is composed of a diverse assortment of fossils and fossil fragments (fig. 7), as much as several centimeters in length but generally about 0.7 mm in average diameter (Patton, 1953b, p. 331). A common microfossil, *Endothyra baileyi*, spheroidal in shape, gave rise to a misnomer, oolitic limestone, now municipally enshrined as Oolitic, Ind.

QUARRYING AND MILLING⁵

In the past, channelers—steam, gasoline, or electrically driven chisels mounted on tracks—were used almost exclusively to cut blocks of Salem limestone out of bedrock (fig. 8). Although still used, especially to remove the key blocks, channelers have been replaced largely by wire saws (fig. 9), which are more economical to operate. After a hole has been opened, great slabs, averaging 60 feet long, 4 feet wide, and 8 to 12 feet high, are cut from the quarry face, toppled onto

⁵For a recent discussion of quarrying and milling, the reader is referred to Bottge (1967).



Figure 8. Channeling machines at work in the Walsh Quarry, Lawrence County, in 1962. The steam channelers shown here are fired by coal, but most such channelers have been converted to use propane or are fed by a central boiler fired by natural gas. Many channelers are now powered by electricity.



Figure 9. Wire saws near completion of cuts in a limestone quarry near Oolitic. Arrows point to wire. Photograph courtesy Indiana Limestone Co. their sides by cables attached to standing derricks (fig. 10) or mobile cranes, cut into several blocks (fig. 11), and either discarded as waste



Figure 10. Large quarry block being toppled by a cable hitched to a standing derrick. Note the piles of stone placed to cushion the fall of the block.

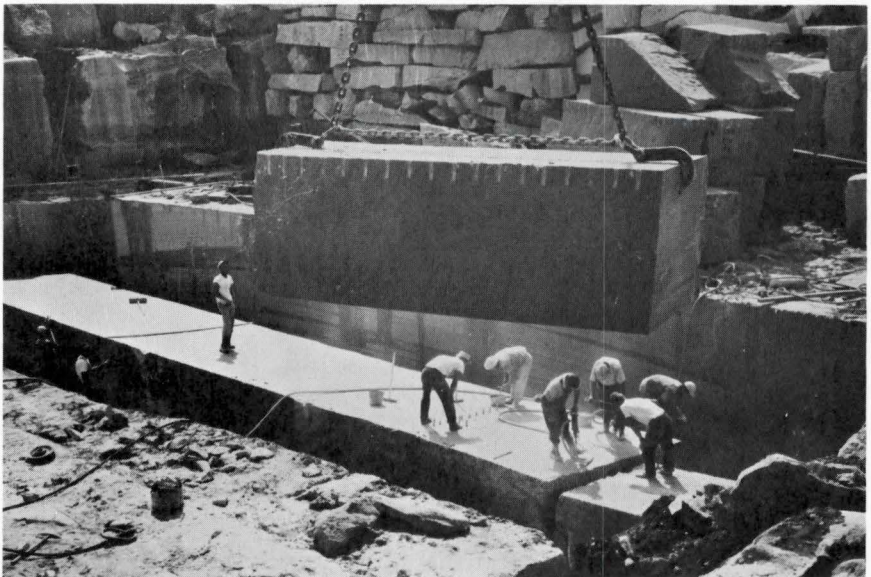


Figure 11. Quarry block being divided into smaller blocks for removal from the quarry. Note wedges or "feathers" being pounded into drill holes in the block to split it.

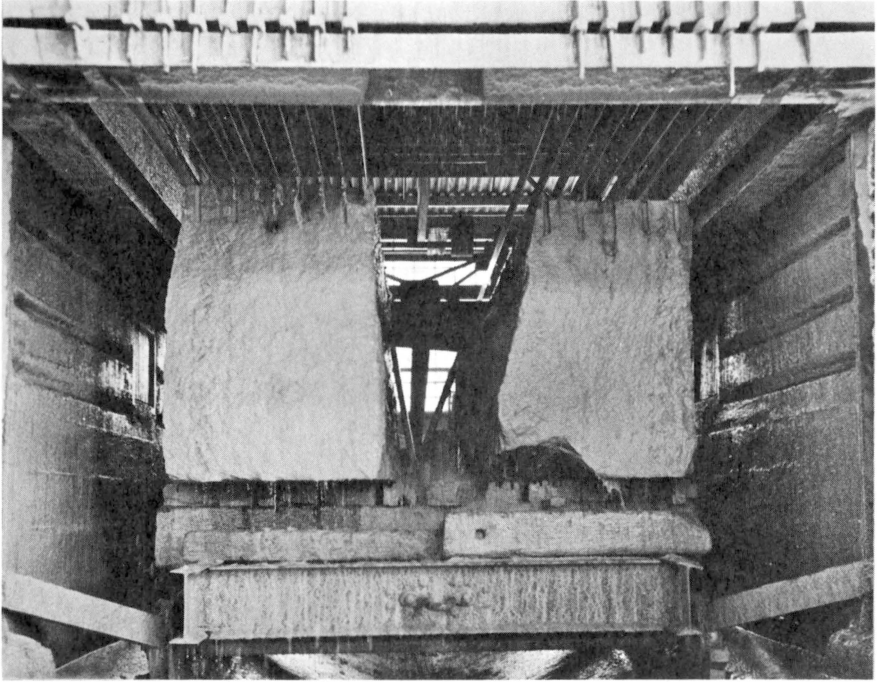


Figure 12. Gangsaw slicing quarry blocks into slabs. Most saws have low-profile “teeth” impregnated with diamond dust.

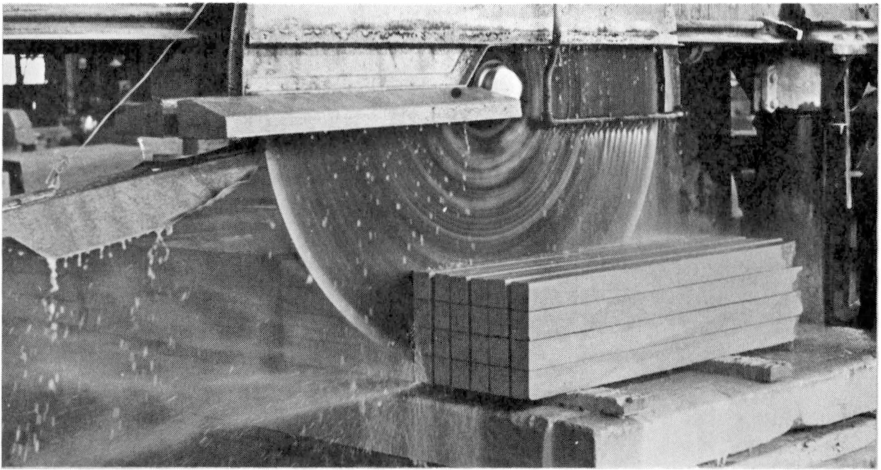


Figure 13. Circular saw cutting sills. Photograph courtesy Indiana Limestone Institute of America, Inc.

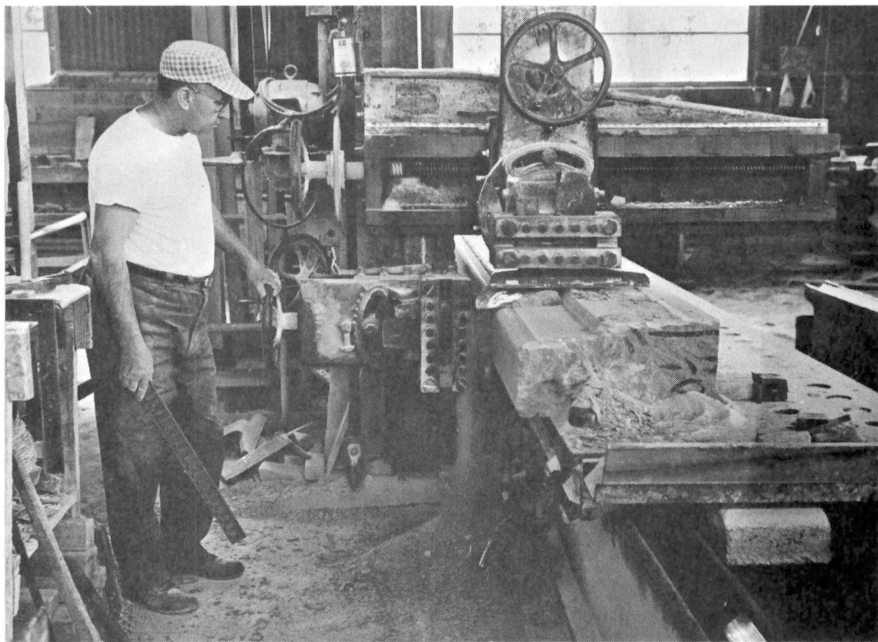


Figure 14. Planer fabricating a piece of cut stone.



Figure 15. Columns on U.S. Archives Building, Washington, D.C., erected in 1933 and 1934. The column capitals were carved on the job. Photograph courtesy Indiana Limestone Co.



Figure 16. Splitter breaking off a piece of split-face ashlar.

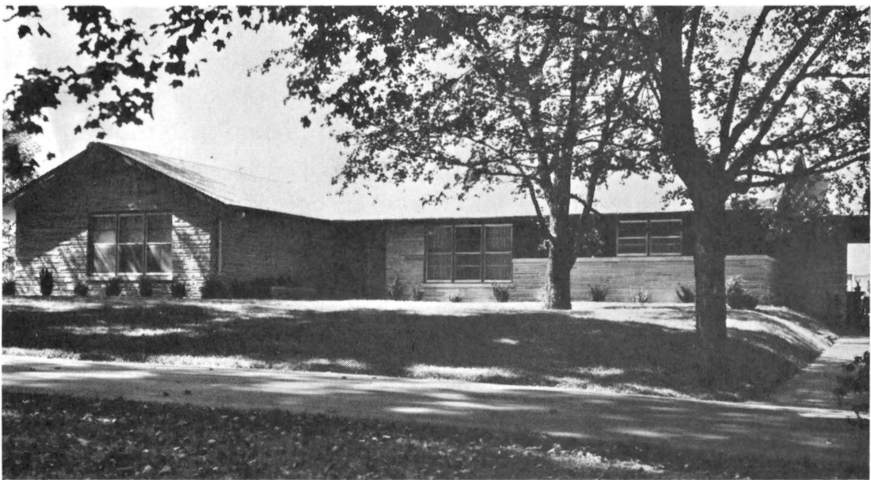


Figure 17. House on which split-face ashlar from the Salem Limestone has been used as veneer. Photograph courtesy Indiana Limestone Co.

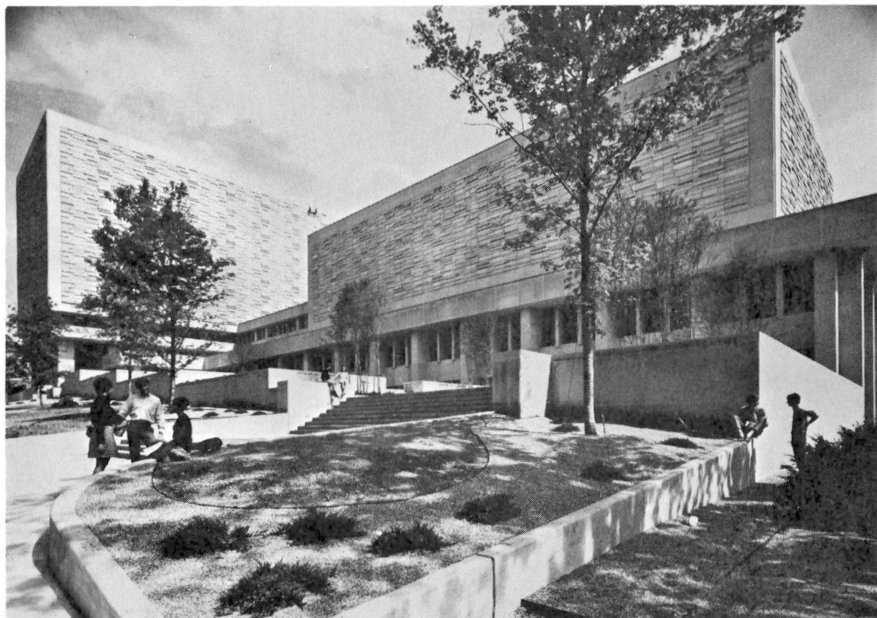


Figure 18. Main library at Indiana University showing the use of geometrically arranged blocks of cut stone glued by epoxy to concrete panels. Photograph courtesy Indiana University News Bureau.

or shipped to mills where gangsaws, resembling lumbermen's cross-cuts, slice the block into a dozen or so slabs (fig. 12). The slabs in turn may be cut by circular saws (fig. 13) into sills, coping, panels, or the rectangular veneer called ashlar seen on many residences. Some of the blocks, of course, are cut and planed into more special shapes required for ornamental buildings (fig. 14). Few pieces of cut stone match the size of the 100 one-piece columns, 36 feet long and 6 feet in diameter, turned out on a lathe for the Mellon Memorial Library in Pittsburgh. Many thousands of pieces, however, do exceed them in complexity of design (fig. 15).

Two major advantages of Salem over most other building stone are its softness and its lack of pronounced rift or grain, which permit it to be carved in fine detail. In fact, the golden age of Indiana's stone industry was reached late in the Victorian epoch and climaxed during the Roaring Twenties, a period that favored stone amenable to intri-

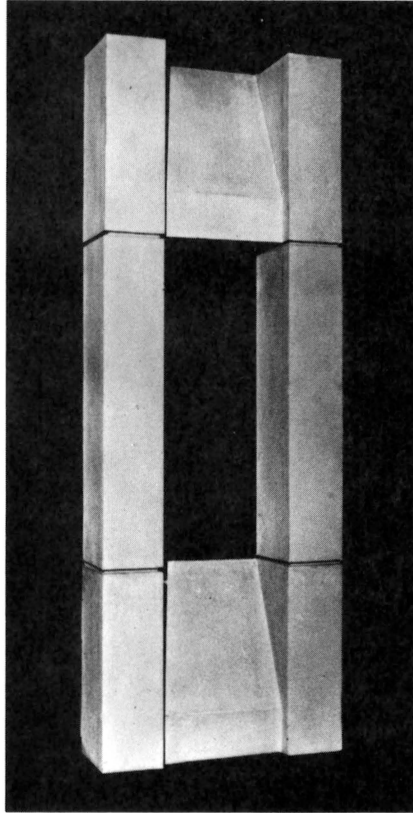


Figure 19. Column veneer and sills assembled in mill by epoxy to form window frame. Photograph courtesy Indiana Limestone Co.

cate carving. In the past few decades, architects have emphasized simplicity and functional design, but a return to ornamental carving is possible.

Special textural effects on the stone are achieved in several ways. Sawing with steel shot or chert produces a coarsely textured surface. Much of the ashlar is broken longitudinally to produce the split face so popular in residences (figs. 16 and 17). Large panels can be fabricated with a split-face surface. Wall panels having pronounced shadow relief and regular geometric raised surfaces challenge concrete

on its own terms (fig. 18). Complete window frames and other architectural units can be assembled in the mill by use of epoxy (fig. 19).

CLASSIFICATION

The number of different stone products marketed (generally as Indiana Limestone) may appear large and confusing because two independent natural qualities, color and texture, are concerned, as well as the way the stone has been fabricated.

COLOR: The colors of Salem limestone are various shades of buff and gray or a mixture of the two. Although dominantly composed of calcium carbonate, the Salem contains a number of minor constituents, such as organic matter and pyrite, that in the unoxidized state give the stone a gray color, and in the oxidized state, a buff color. Because oxidation occurs when the stone is exposed to the air or to oxygenated groundwater, gray stone turns buff where it has been above the water table for a sufficient length of time. Variegated stone is found both at the water table and along fractures and solution channels that have permitted the rapid percolation of groundwater below the water table.

TEXTURE: Most Salem dimension stone falls into three textural grades: rustic, standard, and select. According to one definition (Martindale, 1961, p. 19), these categories are based primarily on the size of the pores. In rustic stone the pores may be more than 2 mm in diameter; in standard they may be as much as 2 mm; in select they should be less than 1 mm. In practice, stone is classified according to visual examination by the producer.

Grade also corresponds to a decrease in grain size from rustic to select. Exceptionally coarse-grained stone, termed gothic by members of the industry, and exceptionally fine-grained stone, termed statuary, might be considered to enlarge the number of grades to five, but the total output of gothic and statuary stone is small. Individual companies may give trade names, many with exotic connotation, to varieties of these five grades.

Stylolites, called crow's feet by the industry, are considered a textural defect. Appearing in cross section like a Dow-Jones graph, stylolites are the result of the interstratal solution of limestone and accumulation of residual clay along irregular layers. Under tensional stress, they also may be planes of weakness. Stylolitic stone, however, is attractive, especially in ashlar, and is used for decorative purposes.

Some clay layers not associated with stylolites and some unannealed fractures may be almost invisible to the naked eye, but they are also planes of weakness. These layers, called dry seams, cause the waste of what otherwise appears to be good stone. Glass seams, on the other hand, are vein fillings of coarsely crystalline calcite and do not necessarily decrease the strength of the rock. They are also considered a defect, however, because they detract from the uniform appearance of the stone. Much stone that cannot be used for dimension stone is called bastard stone. Most of it is dark, fine grained, tightly cemented, slightly argillaceous, silty, or dolomitic.

The industry's emphasis on homogeneity of texture and color has been both a blessing and a curse. Before the appearance of portland cement at about the turn of this century, Salem limestone probably was this country's cheapest durable building material that was homogeneous in both color and texture. It remains one of the most uniformly textured stones on the market. Concrete made from portland cement, however, named for its resemblance to the famed Portland dimension limestone of England (but which resembles Salem limestone equally well), can be manufactured to achieve even greater color and textural homogeneity than limestone. Keen competition between concrete and Salem limestone was inevitable and continues to this day.

Classification and pricing by the Indiana industry itself have perpetuated the emphasis on homogeneity and color. The most homogeneous, finest grained buff stone demands the highest price, and variegated, nonuniformly textured stone the lowest. Residence veneer, estimated at less than 20 percent of the total market, cannot absorb all the stone rejected as what the trade calls cut stone. As a

result of many factors—high specifications; the real and supposed defects of crow's feet, dry seams, and glass seams; rock overburden; bastard stone; and the normal waste of quarrying and milling—much of the quarried stone is wasted.

Efflorescence and Staining

Efflorescence and staining mar the appearance of limestone in some buildings. Both of these effects result in general from water percolating through the limestone (Kessler and Sligh, 1927, p. 533). Salem limestone contains a small amount of organic matter; in fact, the limestone in a few quarries contains tarry petroleum residues and even, though more rarely, bleeds oil. Shortly after being removed from the ground, blocks of limestone from some quarries turn dark gray because of the organic matter that is brought to the surface by capillary action. Such stone is cured in the air because in a matter of months the staining organic matter is oxidized by the elements.

If water is allowed to percolate from mortar or concrete behind stone veneer installed in a building, the water becomes alkaline, dissolves part of the organic matter in the stone, and deposits it on the veneer surface. As is true of quarry blocks, the elements will oxidize the stain generally in a matter of months (Anderegg and others, 1928, p. 79). Proper installation of the stone, however, can minimize efflorescence and staining.

Some persons, including me, believe that the random discoloration that comes to most stone is desirable. It gives a more aesthetic connotation of time than does the rusting of metal.

Waste

The Indiana Limestone industry might be said to suffer from the artichoke syndrome: There appears to be more waste stone above the ground after quarrying than there was stone in the ground before quarrying began. In fact, the spectacular pyramids of waste block or "grout" (fig. 20) that dot Monroe and Lawrence Counties are a minor tourist attraction. No one knows how much of the stone removed from bedrock is wasted, but the usual estimate is about 50 percent, including grout, mill spalls, and mill slurry.

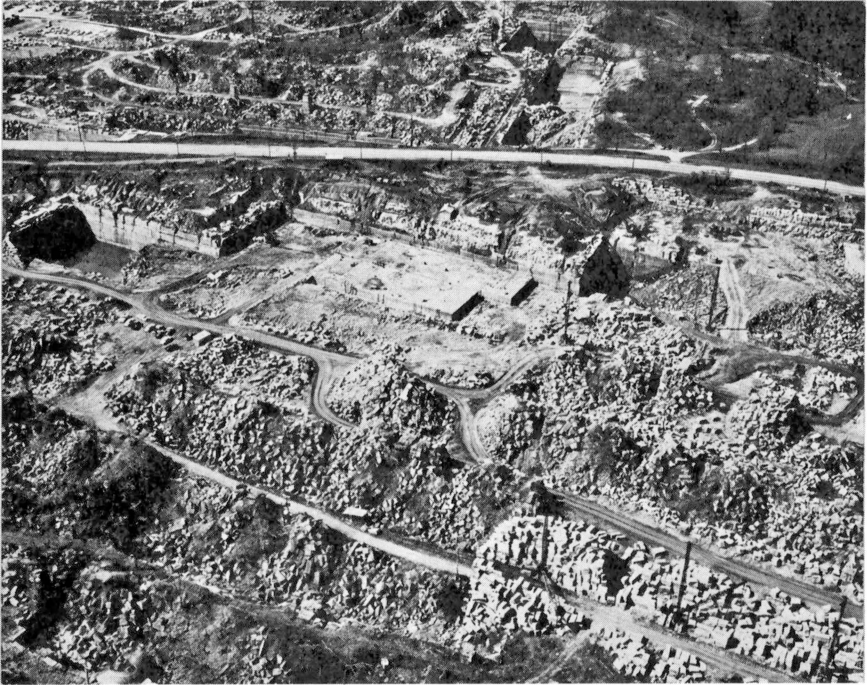


Figure 20. Waste blocks of Salem limestone ("grout") near the P. M. & B. Quarry, Oolitic. Photograph courtesy Indiana Limestone Co.

Little change in the utilization of waste stone has occurred in the 60 years since a comprehensive report on this problem was published (Mance, 1915a and b). The major use of large quarry blocks then, now, and probably in the future is breakwater, especially in Lake Michigan. Although most blocks in the grout piles probably average 95 percent CaCO_3 , no one has devised a way to retrieve and crush them economically so that they could be sold as high-calcium limestone. The use of lapies as lawn sculpture (fig. 6) provides a market for a small number of waste blocks, but insofar as I know, no company recovers such stone and stocks it on a regular basis. Where the St. Louis Limestone forms part of the overburden, of course, no lapies is available.

Limestone spalls recovered in some mills have been put to profitable use. Two ground-limestone companies have collected spalls from some of the largest mills and marketed the product mostly as filler

and agricultural limestone. The maximum annual production of these companies, of course, depends on the production of the dimension stone mills, and contamination by metal and sand used in the mills is a problem. Spalls are also sold as veneer ("ruble stone") and have been rounded in cylindrical mills for sale as cobbles ("round-stone").

In milling, a small but significant amount of limestone is lost as slurry. Moreover, the slurry must be disposed of, and dumping in streams is undesirable even though the pollution problem appears inconsequential compared with that of most mineral industries. In some places the waste is pumped into abandoned quarries. The limestone carried in the slurry has potential value in that it is fine grained and chemically pure, but it is diluted by water and contaminated by abrasives. In spite of the abrasives, it would qualify as agricultural limestone if it were allowed to settle and were windrowed.

Transportation

Transportation has always been an important factor in determining the industry's rate of growth because a large part of the ultimate cost of dimension stone is the cost of moving it out of the quarry, through the mill, and finally to the job site. In most areas, competing products, such as concrete and clay products, equally bulky and heavy, have a considerable cost advantage because they are manufactured near their place of use.

Rail transportation was particularly important between the late 1870's and World War I. During that time, numerous short rail lines were constructed into new areas of the building stone district. The companies engaged in stiff competition and court litigation. Some lines were abandoned; others were successful, then merged, and changed names in a kaleidoscopic series of events between the time the New Albany and Salem Railroad was extended to Bedford in 1852 and the final emergence of the six railroads that serve the area today. Of these six, the Monon Railroad serves the greatest part of the building stone belt. Between its terminals in Chicago and Louisville, it passes through the active producing region in Lawrence and

Monroe Counties and the former producing regions in Washington and Owen Counties.

In the 1930's trucks began to compete with the railroads for the dimension stone business. Although the development of large flatbed trucks during the thirties enabled stone to be shipped longer distances at lower rates, trucking firms had obtained less than 10 percent of the total shipping before World War II (Batchelor, 1944, p. 329). As highways and trucks improved, however, the railroads steadily lost business. The maneuverability of a truck, which permits it to load at the quarry site or mill and to unload at a mill or job site, gave the trucking interests the competitive edge they still enjoy.

Production

Although Indiana produces more than 60 percent of the dimension limestone quarried in the United States, dimension limestone accounts for only 5 percent of the state's total mineral output. Nevertheless, since 1877 approximately 55 million tons has been produced with a value in 1968 dollars of more than \$1.6 billion.⁶

Peak production was reached between 1920 and 1930, before mineral statistics were regularly reported in any detail. Even now, production statistics are unreliable because some stone is sold once as block or sawed stone and then is sold a second time as cut stone. The value is probably greater than \$1.6 billion because the production reported to the U.S. Bureau of Mines is only that of the primary producing companies and not the independent fabricators.

The major market for Salem limestone lies within 200 miles of a line drawn from Chicago to New York. Most of the stone is used in Indiana and adjacent states. In the past, however, a larger proportion was shipped to the eastern seaboard, especially the New York and Washington, D.C., areas (Rooney, 1964). The relative drop in sales is largely due to the popularity of synthetic veneers, such as concrete, steel, and glass.

⁶The figure is based on an assumed average value of \$30 per ton. Pre-1940 production figures were compiled from J. A. Batchelor (1944). Post-1940 figures are from U.S. Bureau of Mines Yearbooks.

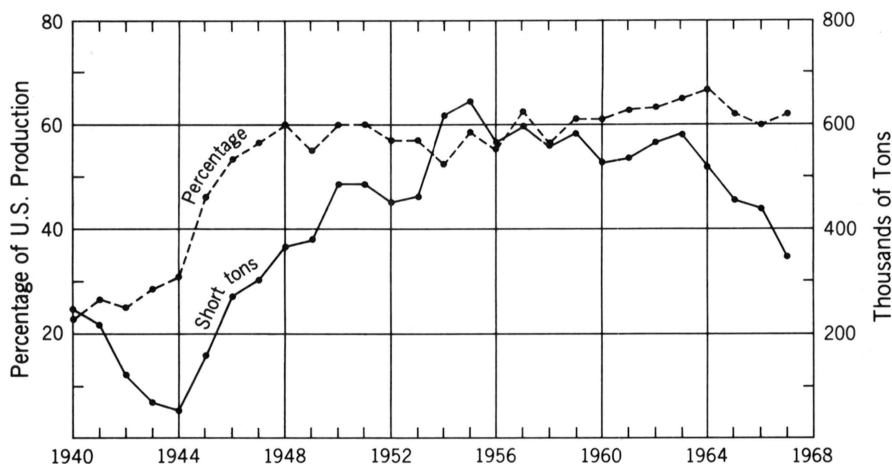


Figure 21. Quantity of dimension limestone produced in Indiana and percentages of U.S. production 1940-67. Data from U.S. Bureau of Mines Minerals Yearbooks.

After World War II, production climbed fairly steadily to 1955, leveled off at about 600,000 tons per year, and has declined since 1963 (fig. 21). The industry has made a vigorous effort to increase its efficiency and to unite in promotional efforts. For example, the proportion of wire saws used in the quarries has increased; diamond gangaws have reduced the time required to saw a quarry block by as much as 75 percent; mobile cranes are replacing some of the stationary derricks; new architectural effects and more rapid installation have been achieved through use of epoxy adhesives. In short, emphasis is being placed on finding new ways to do the job better.

Promotional efforts have met with less success. An organization called the Indiana Limestone Institute was formed in 1928 to establish standards and encourage the use of Salem limestone. The institute performed many useful services and published a valuable handbook in 1961, but it failed to maintain the support of the industry and disbanded in 1963. In the same year, the National Association for Indiana Limestone, Inc., which emphasized promotion rather than research, was formed, but it disbanded in 1964. During that year, the Indiana Limestone Institute of America, Inc., was formed, and, in cooperation with independent research groups, has undertaken an active promotional and research program, partly financed by a federal grant.

Despite its chronic difficulty in speaking with one voice, the dimension limestone industry of Indiana is healthy. Reserves of stone will last indefinitely. Competition from synthetic and other natural products will continue to be vigorous: Synthetic products, of which concrete is paramount, will dominate that part of the market where price and utilitarian values are of first consideration. Other natural stones, such as marble and granite, will offer considerable competition where price is immaterial. But where aesthetic values are important and cost must be considered, Salem limestone will probably remain the premier dimension limestone of the country.

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OVERSIZED DOCUMENT

**The following pages are oversized and
need to be printed in correct format.**

TABLE 1. SOME PHYSICAL CONSTANT DATA OF DIMENSION STONE PRODUCED FROM THE SALEM LIMESTONE, GENEVA DOLOMITE, LOUISVILLE LIMESTONE, LAUREL MEMBER, AND CININNATIAN ROCKS

	Abrasion resistance C 241-51 ¹					Absorption by weight (pct) C 97-47 ¹				
	Number of samples	Mean	Minimum	Maximum	Standard deviation	Number of samples	Mean	Minimum	Maximum	Standard deviation
Salem Limestone ²	121	8.8	4.9	15.9	2.5	154	5.4	2.8	8.6	1.2
Geneva Dolomite						9	2.7	0.4	5.0	
Louisville Limestone						11	1.6	0.4	2.9	
Laurel Member	6	17.7	13.7	25.7		17	1.6	0.5	3.7	
Cincinnati rocks	2	29.7	29.5	29.9		2	0.4	0.4	0.4	

	Specific gravity C 97-47 ¹					Compressive strength (psi) C 170-50 ¹					Modulus of rupture (psi) C 99-52 ¹				
	Number of samples	Mean	Minimum	Maximum	Standard deviation	Number of samples	Mean	Minimum	Maximum	Standard deviation	Number of samples	Mean	Minimum	Maximum	Standard deviation
Salem Limestone ²	154	2.28	2.14	2.42	.06	65	9,640	5,830	14,800	2,260	61	1,070	656	1,640	241
Geneva Dolomite	9	2.51	2.34	2.71		9	10,700	5,690	16,100						
Louisville Limestone	10	2.63	2.57	2.69		13	>17,615	11,600	>24,000		1	2,490	2,490	2,490	
Laurel Member	17	2.56	2.30	2.78		18	>13,440	7,400	>24,000		8	2,209	1,004	3,730	
Cincinnati rocks	2	2.72	2.71	2.72		2	22,400	19,980	23,270		2	1,990	1,740	2,240	

¹American Society for Testing Materials test number.

²Test data from "Physical Constant Data of the Salem Limestone," unpublished report by Myra H. Fox, 1964, on open file at the Indiana Geological Survey.

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