KENTUCKY GEOLOGICAL SURVEY
UNIVERSITY OF KENTUCKY, LEXINGTON SERIES X, 1969
Wallace W. Hagan, Director and State Geologist

High-Calcium and Low-Magnesium Limestone Resources in the Region of the Lower Cumberland, Tennessee, and Ohio Valleys, Western Kentucky

Garland R. Dever, Jr.
Preston McGrain

BULLETIN 5

LETTER OF TRANSMITTAL

May 1, 1969

Dr. Lewis W. Cochran
Vice President for Research
University of Kentucky

Dear Dr. Cochran:

New uses for old limestone deposits, new areas for exploration for high-calcium and low-magnesium limestones of chemical and metallurgical quality, are discussed and outlined in this report which should add materially to the economy of this eight-county region in western Kentucky located near a major industrial market and good transportation.

This report presents information on the stratigraphy and compositional variations of the deposits, and should prove useful in exploration.

Respectfully,

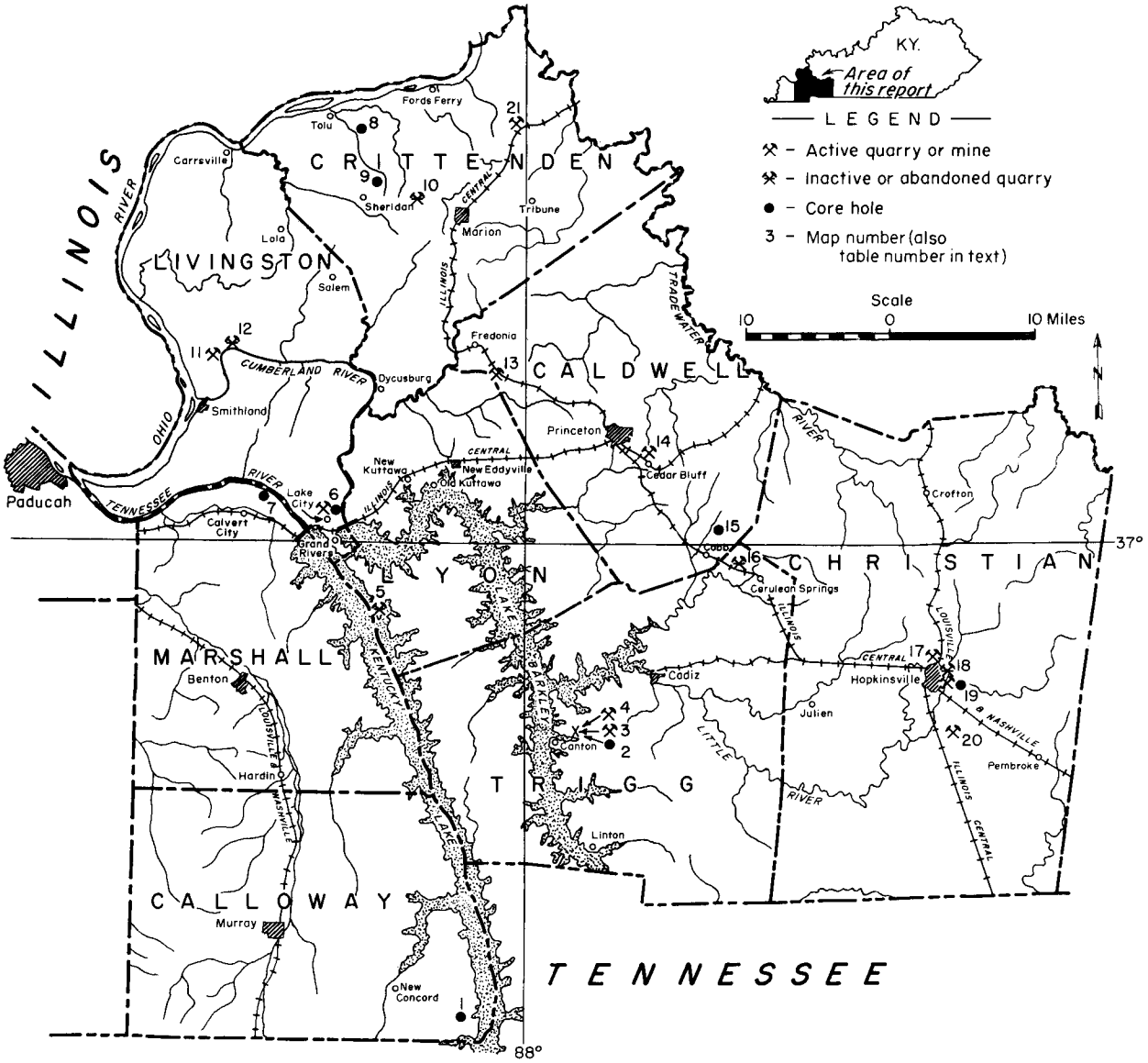
WALLACE W. HAGAN
Director and State Geologist
Kentucky Geological Survey

CONTENTS

CONTENTS — *Continued*

ILLUSTRATIONS

TABLES



MAP NO.	GEOLOGIC UNIT	TYPE OF SECTION	COUNTY	QUADRANGLE
1	Ft. Payne-Warsaw	Core	Calloway	Hamlin
2	Warsaw	Core	Trigg	Canton
3	Warsaw-Salem	Quarry	Trigg	Canton
4	Warsaw	Quarry	Trigg	Canton
5	Warsaw	Quarry	Lyon	Birmingham Point
6	Warsaw-Salem	Quarry & test hole	Livingston	Grand Rivers
7	Warsaw	Core	Marshall	Calvert City
8	Warsaw	Core	Crittenden	Cave In Rock
9	Ste. Genevieve-Renault	Core	Crittenden	Salem
10	Ste. Genevieve	Quarry	Crittenden	Salem
11	Ste. Genevieve	Quarry	Livingston	Smithland
12	Ste. Genevieve	Quarry	Livingston	Burna
13	Ste. Genevieve	Quarry	Caldwell	Fredonia
14	Ste. Genevieve-Renault	Quarry	Caldwell	Princeton East
15	Ste. Genevieve	Core	Caldwell	Princeton East
16	Ste. Genevieve-Renault	Quarry	Trigg	Gracey
17	Ste. Genevieve-Renault	Quarry	Christian	Kelly
18	Ste. Genevieve-Renault	Quarry	Christian	Hopkinsville
19	Ste. Genevieve-Renault	Quarry & core	Christian	Hopkinsville
20	Ste. Genevieve	Quarry	Christian	Hopkinsville
21	Kinkaid	Quarry	Crittenden	Repton

Figure 1. Geographic map of region and index of quarries and cores.

HIGH-CALCIUM AND LOW-MAGNESIUM LIMESTONE RESOURCES IN THE REGION OF THE LOWER CUMBERLAND, TENNESSEE, AND OHIO VALLEYS, WESTERN KENTUCKY

Garland R. Dever, Jr., and Preston McGrain

ABSTRACT

Detailed chemical analyses of foot-by-foot samples from 21 locations in 8 western Kentucky counties establish the presence of extensive limestone deposits of high chemical purity. Analyses of approximately 1,700 samples are reported. The average calcium carbonate content in the ledges of operable thickness ranges from 95.47 to 98.2 percent. These limestones warrant consideration as raw material for metallurgical, chemical, and special industrial uses.

The deposits are close to the complex of chemical plants at Calvert City, Ky.; water transportation to other chemical and industrial centers via the Cumberland, Ohio, and Tennessee Rivers; a network of railroads and modern highways; and low-cost electric power from hydro- and steam-generating plants in the region.

The purest stone is in the Warsaw and Ste. Genevieve Limestones of Late Mississippian age. Stratigraphic studies show that general correlations exist between established deposits, and indicate favorable zones within the two formations for further exploration.

INTRODUCTION

Large reserves of limestone suitable for a variety of industrial uses are located in western Kentucky in the drainage basins of the lower Cumberland, Tennessee, and Ohio Rivers. This region includes all or part of eight counties: Caldwell, Calloway, Christian, Crittenden, Livingston, Lyon, Marshall, and Trigg (Fig. 1).

A number of large quarries and mines are active in the region, and the limestone has long been an important source of rock for concrete aggregate, roadstone, ballast, riprap, fill, and related constructional uses. The suitability of the limestone for these uses is based upon its physical properties, and, with the exception of agricultural limestone, relatively little stone has been produced in the region for uses that are dependent upon its chemical properties.

The primary purpose of this report is to point out the occurrence of limestone deposits of sufficiently high chemical purity to meet the specifications for a number of metallurgical, chemical, and special industrial uses. These pure limestones, generally referred to as high-calcium limestones, may be utilized as raw material for the production of lime (also called quicklime and calcium oxide); for flux by the steel and metallurgical industry in basic oxygen and open-hearth processes; for the manufacture of portland cement; for the manufacture of calcium carbide, acetylene, and other chemical products; and for agricultural limestone, mineral feed, coal-mine dust, various fillers, and other chemical and industrial purposes. For many of these uses the stone must be essentially free of aluminum oxide, iron oxide, magnesium carbonate, silicon dioxide, phosphorus, and sulfur. A number of industry specifications, compiled from published reports, are listed at the end of the text. Many pure limestones possess the physical properties (hardness and soundness) that permit their use in construction projects, but the major part of the stone used as aggregate in Kentucky will not qualify as high-calcium limestone.

In this report, the term *high-calcium limestone* is used to designate carbonate rocks containing 95 percent or more calcium carbonate ($CaCO_3$). *Low-magnesium limestone* designates carbonate rocks containing 3 percent or less magnesium carbonate ($MgCO_3$). *High-carbonate limestone* designates carbonate rocks containing 95 percent or more total carbonates (calcium carbonate plus magnesium carbonate). For the purpose of this report, an operable limestone deposit is considered to be 20 feet or greater in thickness. Economic and geologic conditions may permit mining thinner units locally.

Earlier industrial-limestone investigations by the Kentucky Geological Survey indicated the presence of high-calcium limestones in the region, and chemical analyses were reported from a number of locations (Stokley, 1949; Stokley and Luttrell, 1952; Stokley and McFarlan, 1952; Stokley and Walker, 1953; McGrain, 1964). The foot-by-foot chemical analyses and geologic information from these earlier publications, some of which are out of print, are included in this report, with supplemental data on the phosphorus and sulfur content of the purer limestones. The earlier work in the region has been expanded and refined by the addition of chemical and geologic data from a number of locations that have been recently sampled or had not been previously published by the Survey. In addition, the report (1) shows the stratigraphic relationship between the individual deposits found in the Ste. Genevieve Limestone and in the Warsaw Limestone; (2) notes variations in the composition of the pure limestones; (3) outlines the geologic and geographic aspects of prospective areas in the region; and (4) points out several potentially commercial deposits of pure limestone disclosed by the current Kentucky geologic mapping project.

Kentucky's statewide areal geologic mapping program, which is being conducted cooperatively by the Kentucky Geological Survey and the U. S. Geological Survey, is producing a series of new 7½-minute geologic quadrangle maps, scale 1:24,000, that depict the basic geologic framework of their respective areas. More than 35 of the maps have already been published for the region covered by this report (Fig. 2). These maps are particularly useful in the exploration and development of mineral resources. The stratigraphic nomenclature employed on the geologic maps has been used for this report.

Modern topographic maps, also on the scale of 1:24,000, have been published for this region as well as for the entire State as the result of other State and Federal cooperative endeavors (Fig. 2).

The locations of all quarries and core holes are described with respect to (1) the nearest town, highway, or body of water; and (2) Carter Coordinate section. In the Carter Coordinate system, the entire state of Kentucky has been divided into a series of quadrangles bounded by 5 minutes of latitude and longitude. The quadrangles are described with respect to their position of latitude by a letter, and with respect to their position of longitude by a number—for example, quadrangle G-15. Each 5-minute quadrangle is further divided into 25 1-minute sections (Fig. 2). For example, 21-H-20 means section 21 of quadrangle H-20. The quarry locations are described in terms of the Carter Coordinate section only. The locations of core holes are described in terms of the distance in feet from the north or south and east or west section lines, for example, 4600′ FSL (from south line) and 4450′ FEL (from east line), sec. 21-G-21.

Chemical analyses are reported in percentage by weight. The calcium (Ca), magnesium (Mg), iron (Fe), and aluminum (Al) content is determined directly by wet-chemical procedures, and the content of these elements as carbonates and oxides is calculated. Silica (SiO_2) is determined directly by wet-chemical procedure. Phosphorus (P) is determined colorimetrically. Sulfur (S) content is determined from the sulfur dioxide (SO_2) generated by combustion in an induction furnace. To insure accuracy, all analyses are performed in duplicate. Analyses for phosphorus and sulfur have been run predominantly on samples from the high-calcium zones because, in general, the percentage of these elements is critical only for uses that require a high-calcium limestone.

The foot-by-foot samples of the 21 quarries and cores described herein were taken by staff geologists of the Kentucky Geological Survey during the period from 1949 to 1968. These geologists are identified in the tables of analyses which follow.

Laboratory analyses were performed, primarily by Kentucky Geological Survey personnel, in the Mining Engineering Laboratory at the University of Kentucky. Special thanks are due Thomas A. Kendall, Analyst, College of Engineering, and Thelma C. Teater, Senior Laboratory Assistant, Kentucky Geological Survey. In addition to Mr. Kendall and Mrs. Teater, analytical work was performed by Doris Boggs, Eudelle Elliott, Zara Fain, Mary Martin, Lenora Stinnett, and Barbara Troutman. The writers also acknowledge the cooperation and assistance of numerous quarry operators

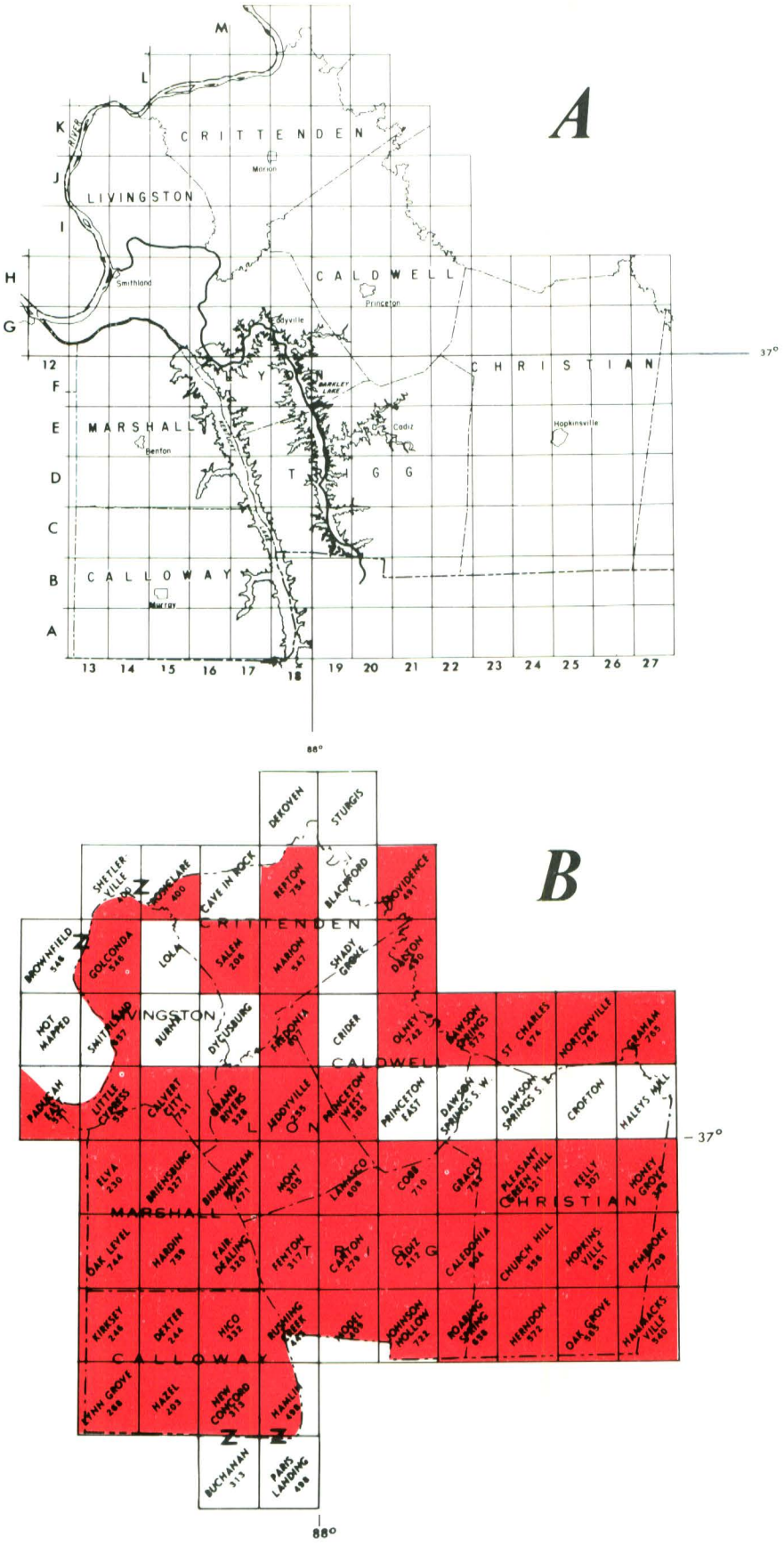


Figure 2. A, Carter Coordinate map of region. B, topographic index map with published geologic quadrangle maps shown in red.

and property owners; Robert D. Trace, U. S. Geological Survey, Princeton, Ky.; and the Geologic Branch, Tennessee Valley Authority, Knoxville, Tenn.

GEOLOGIC AND GEOGRAPHIC SETTING

The geographic area covered in this report includes parts of several geologic regions (Fig. 3). The western boundary of the area essentially parallels the eastern edge of the Mississippi embayment and includes the most westerly exposures of Paleozoic rocks in Kentucky. The northern part encompasses most of the western Kentucky fluorspar district. The south-central and southeastern portions are on the low, gently rolling, karsted plain of the Pennyroyal district of Kentucky, which is part of the Highland Rim of the eastern United States. The eastern boundary of the area is generally formed by the western edge of the Western Kentucky Coal Field.

The outcropping formations range in age from Devonian through Tertiary, with the Late Mississippian formations of the Meramec and Chester Series predominating. This Mississippian section contains a number of limestones of varying thicknesses and degrees of purity. The oldest rocks are exposed by faulting and are visible only in a few places along the Cumberland and Tennessee Rivers. Along the western margin of the area, gravels, sands, and clays of Cretaceous and Tertiary ages rest unconformably on an irregular erosion surface of Paleozoic rocks.

Faults are common throughout the area, particularly in the fluorspar district in Crittenden, Livingston, and Caldwell Counties. These structural features complicate the exploration for prospective deposits of purer limestones.

Figure 3. Regional geologic setting of Kentucky showing area of this report.

Local relief in the area varies from a nearly flat limestone plain in southern Christian County to the hilly terrain of northern Crittenden and Livingston Counties where sandstone-capped knobs rise 350 feet above the Ohio River.

Calvert City, one of the centers of Kentucky's rapidly growing chemical industry, is located in the western part of the area covered in this report. Hopkinsville, the seat of one of the State's largest counties, is at the southeastern edge; and Marion, the center of Kentucky's fluorspar industry, is near the northern edge of the area.

The most conspicuous geographic feature of the area is the network of large waterways—the Ohio River, Cumberland River-Lake Barkley, and Tennessee River-Kentucky Lake. All three of these streams are navigable. The 43 existing locks on the Ohio River are being replaced by 19 high-lift locks with dimensions of 110 feet by 1,200 feet. The lock chamber at Kentucky Dam, permitting barge traffic between the Tennessee River and Kentucky Lake, is 110 feet by 600 feet, the same size as the existing locks on the Ohio River. The dimension of the lock at the recently constructed Barkley Dam is 110 feet by 800 feet. Two miles upstream from Barkley Dam a canal connects Lake Barkley and Kentucky Lake and permits free access for barge traffic between these two large bodies of water.

The Calvert City complex of chemical plants is situated on the south bank of the Tennessee River a short distance downstream from Kentucky Dam. A number of the other chemical plants in Kentucky are located along the Ohio River upstream from this area.

Locations with respect to river mileage are given in this report for the quarries and cores adjacent to the Cumberland River and Lake Barkley, and the Tennessee River and Kentucky Lake. Cumberland River Mile 0.0 equals Ohio River Mile 922.5 and is located below the foot of Cumberland Island, 2.1 miles below Smithland. Tennessee River Mile 0.0 is between Ohio River Miles 934 and 935 and is located below the foot of Owens Island at Paducah.

The area is served by two branches of the Illinois Central Railroad, and a line of the Louisville & Nashville Railroad passes through Hopkinsville. Another line of the Louisville & Nashville Railroad (formerly Nashville, Chattanooga & St. Louis Railroad) is located west of this area in Calloway and Marshall Counties. Highways that extend into or through the area are U. S. 41, 60, 62, 68, and 641; a network of state and county roads; three state toll roads, Western Kentucky Parkway, Pennyrile Parkway (under construction), and Jackson Purchase Parkway (under construction), and Interstate 24 (under construction).

Electric power service, from both hydro- and steam-generating plants, is provided to the area by the Tennessee Valley Authority, Kentucky Utilities Company, and rural electric utilities. The area is crossed by major gas transmission lines of the Texas Gas Transmission Corporation and the American Louisiana Pipe Line Company. Coal is available from the nearby Western Kentucky Coal Field by river and rail transportation. A rail terminal with barge-loading facilities for coal is located on the eastern shore of Kentucky Lake, south of Grand Rivers.

MERAMEC LIMESTONES

Four formations constitute the rocks of the Meramec Series, and all are predominantly limestone (Fig. 4). The principal occurrences of high-calcium stone in the region are in two of the formations, the Warsaw Limestone and the Ste. Genevieve Limestone. Tables of foot-by-foot chemical analyses of the limestone in these formations and information on the geologic and geographic aspects of the high-calcium deposits are presented in the following section.

FORMATION AND MEMBER		THICKNESSES, IN FEET
STE. GENEVIEVE LIMESTONE	Levias Limestone	190-320
	Rosiclare Sandstone	
	Fredonia Limestone	
ST. LOUIS LIMESTONE	Upper member	180-280
	Lower member	230-310
SALEM LIMESTONE		70-145
WARSAW LIMESTONE		150-643+

Figure 4. Formations of the Meramec Series.

The lithologic character of the Salem Limestone and St. Louis Limestone in this region and the available chemical data, which are summarized in this section, generally indicate that these formations do not contain operable thicknesses of high-calcium limestone.

Warsaw Limestone

The Warsaw Limestone has been analyzed in the region on a foot-by-foot basis at six locations and on the basis of relatively even-spaced, representative samples at one location (Fig. 1). A total of 10 deposits of high-calcium limestone, ranging from 12 to 68 feet thick, have been found at 5 of the locations. Three of the deposits are from 50 to 68 feet thick; 5 are from 34 to 42 feet thick; and 2 are from 12 to 24 feet thick. The general chemical characteristics of the high-calcium stone in this formation are summarized below. The range in values was obtained by averaging the analyses of each deposit of pure limestone.

	50-68 feet	*34-42 feet*	*12-24 feet*
$CaCO_3$(%)	95.92 -97.13	95.59 -97.49	95.57-95.84
$MgCO_3$(%)	0.99 - 1.13	0.67 - 1.65	1.33- 1.62
SiO_2(%)	1.06 - 1.21	0.67 - 1.53	1.65- 2.29
Fe_2O_3(%)	0.02 - 0.11	0.00 - 0.04	0.03- 0.08
Al_2O_3(%)	0.09 - 0.52	0.07 - 0.90	0.31- 0.50
S(%)	0.017- 0.065	0.030- 0.145	- 0.053
P(%)	0.020- 0.033	0.017- 0.035	- 0.024

The chemical analyses, lithologic descriptions, and geographic information for the seven locations are presented in Tables 1-8 and their accompanying texts.

A very light- to medium-gray limestone consisting of fine- to very coarse-grained fossil fragments in a very light- to light-gray chalklike matrix characterizes most of the Warsaw high-calcium zones in the region. Crystalline calcite is prominent in the fossil fragments and also occurs as isolated crystals. The rock commonly has a speckled appearance from the texture of coarse shiny grains in a dull light-colored matrix.

There are two other general types of lithology in the Warsaw. One consists of all the bioclastic and crystalline limestones in which the chalklike matrix is absent or sparse. These limestones are in part high calcium but they are generally not as pure as the limestone containing the abundant chalklike matrix.

The other is characterized by the predominance of medium- to dark-gray, microgranular to very fine-grained limestones which are generally argillaceous, silty, and cherty. These occur as individual beds and in zones with some interbedded bioclastic and crystalline limestones. The chert in the Warsaw is mainly found in this lithology and occurs as nodules and irregular masses. Where chert is present in the purer limestone it is generally in the form of thin stringers.

Figure 5 shows the distribution of these three lithologies within the formation and their relationship with the high-calcium zones.

There is considerable variation in the thickness of the formation across the region. The changes in thickness are believed to have been caused by the deposition of the Warsaw Limestone on an irregular surface left after the Fort Payne Formation had been deposited, as suggested by Lineback (1966). The probable relationship between the two formations during deposition of the Warsaw is shown in Figure 6.

In this figure, the position of the zones of bioclastic and crystalline limestone in the formation suggests there is a general correlation across the region between the zones in the lower part of the formation and also between the zones in the upper part of the formation. The bioclastic limestone with the chalklike matrix has been found in the lower zone throughout most of the region, but in the upper zone operable thicknesses of this lithology are more restricted and up to this time (1968) have been found predominantly in the area of southern Livingston, western Lyon, and southwestern Crittenden Counties.

Outcrops of the Warsaw Limestone are found across a broad belt extending eastward from along the western shore of Kentucky Lake across the Land Between the Lakes to the eastern shore of Lake Barkley, and northward from the Kentucky-Tennessee border into southern Livingston County. The pattern of outcrop throughout the area is broken and offset by faulting, and in many parts of the area the Warsaw lies beneath a cover of Cretaceous, Tertiary, and Quaternary sediments.

The western parts of Trigg and Lyon Counties situated between Kentucky Lake and Lake Barkley are within the boundaries of the Land Between the Lakes, a national outdoor recreation and conservation development, and the limestone within this area is not considered available for exploitation.

The following four areas appear to warrant particular attention for exploratory programs prospecting for high-calcium Warsaw Limestone. For detailed information on the geologic and geographic aspects of each area, the reader is referred to the new geologic quadrangle maps and topographic maps (Fig. 2).

Eastern Shore of Lake Barkley, Trigg and Southern Lyon Counties

The Kentucky Geological Survey-U. S. Geological Survey core, taken east of Canton in Trigg County, encountered a 68-foot zone of high-calcium bioclastic limestone in the Warsaw (McGrain, 1964) (Table 2, this report). Zones of comparable lithology have been found in samples from the No. 1

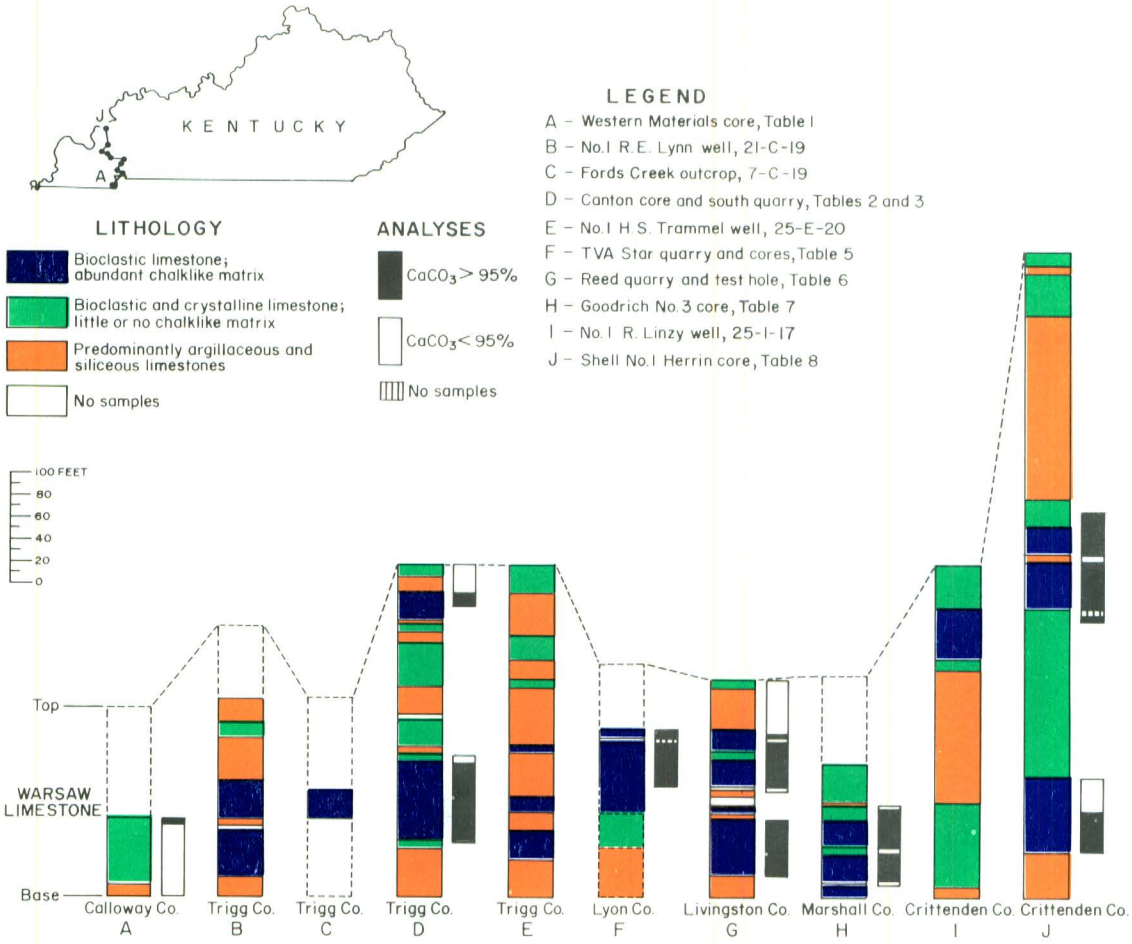


Figure 5. Distribution of high-calcium zones and lithologies in the Warsaw Limestone. Datum is base of Warsaw.

H. S. Trammel well, approximately 4 miles northeast of the Canton core; and in southern Trigg County in an outcrop along Fords Creek (Rogers, 1965) and in samples from the No. 1 R. E. Lynn well, southwest of Linton. The position of these zones in the formation, as shown in Figure 5, suggests that prospective deposits of high-calcium limestone in this area occur mainly in the lower part of the Warsaw. One zone of high-calcium limestone has been found in the upper part of the formation at the Canton quarry (Table 3).

In southern Trigg County a cherty limestone member, which varies in thickness from 0 to 100 feet, occurs in the middle part of the formation and locally may affect the thickness of prospective bioclastic zones.

The Warsaw outcrops along the eastern shore of the lake in this area. The outcrop is broken by a number of northeast-trending faults, and the equivalent section of the high-calcium zone in the Canton core may have been brought to or near the surface in the areas north of Little River and south of Terrapin Branch.

Calvert City-Lake City-Old Kuttawa Area, Marshall, Livingston, and Lyon Counties

Operable thicknesses of high-calcium limestone have been found at three locations in and near this area. Two zones, 41 and 50 feet thick, were found in the Reed quarry and test hole at Lake City (Table 6), and two zones, 34 and 24 feet thick, were encountered in the B. F. Goodrich Chemical Company no. 3 core, taken at the company's plant northeast of Calvert City (Table 7). Stokley and Walker (1953, p. 40-42) reported 47 feet of high-calcium limestone in the abandoned TVA Star quarry, located in the Land Between the Lakes recreation area south of Grand Rivers (Table 5). North of this area, a 45-foot zone of bioclastic limestone with an abundant chalklike matrix was encountered at a depth of 570 feet in the No. 1 Ray

Linzy well, 1¼ miles northeast of Dycusburg in southwestern Crittenden County. The position of these zones in the Warsaw indicates that deposits of high-calcium limestone are present in this area in both the upper and lower parts of the formation (Figs. 5 and 6).

Faulting has controlled the location of the Warsaw outcrops in Lyon County around Old Kuttawa, and in Livingston County northwest of Lake City and south of Grand Rivers. The exposures at Lake City are associated with a structural high.

The presence of the bioclastic limestone in the Linzy well at Dycusburg suggests that deposits of high-calcium limestone also may occur in the area to the north of the Reed quarry and the Goodrich core. The more favorable locations for prospecting will be in fault blocks where the limestone has been preserved at a minable depth. In general, where the Warsaw is found at the surface the formation has been partially removed by erosion and the limestone is deeply weathered.

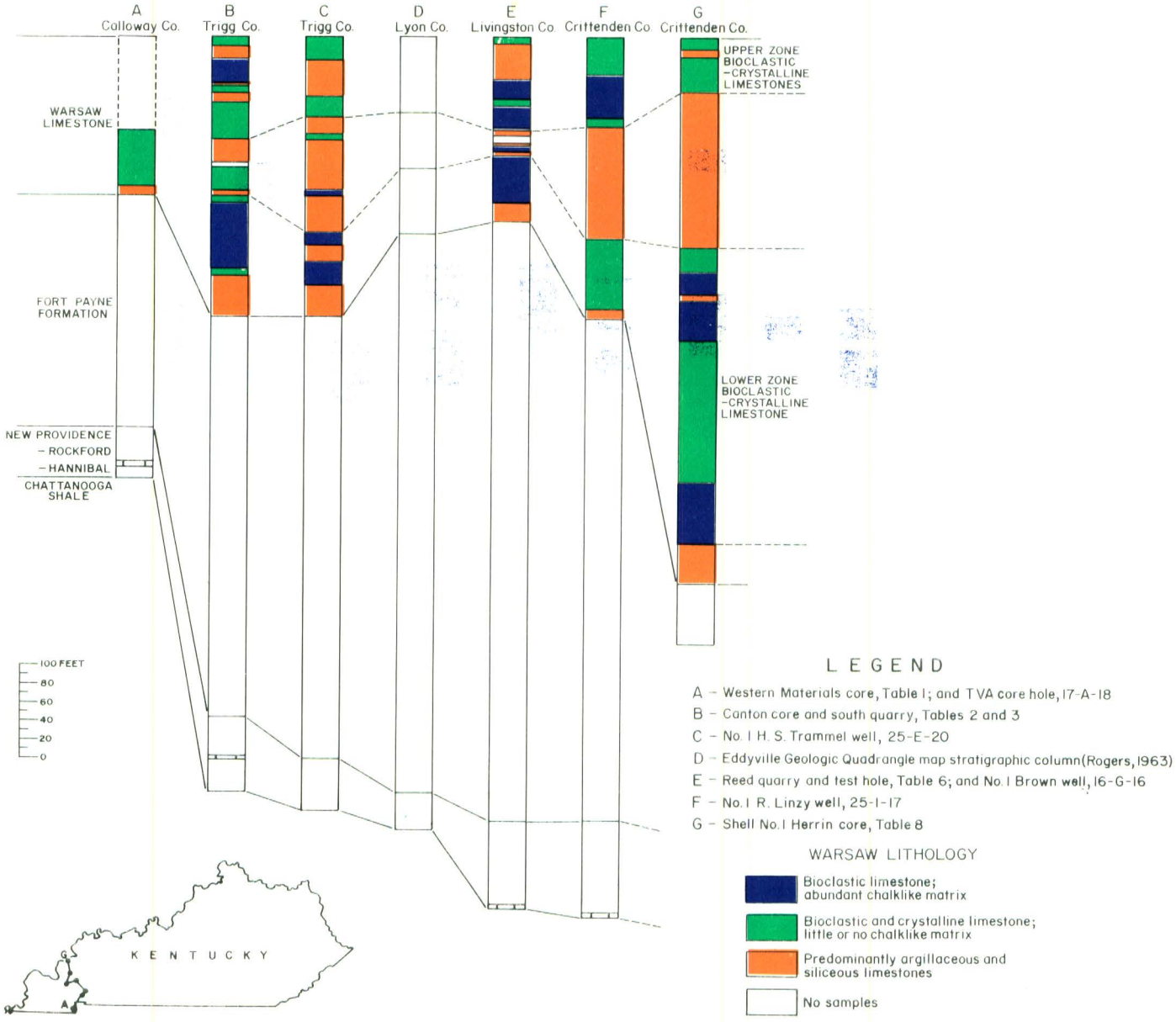


Figure 6. Relationship of the Warsaw Limestone and Lower Mississippian formations. Datum is top of Warsaw.

Western Shore of Kentucky Lake, Marshall and Calloway Counties

In southeastern Calloway County, a zone of high-calcium limestone was found in the upper 6 feet of the Western Materials core that recovered the lower 70 feet of the Warsaw formation (McGrain, 1968, Table 2) (Table 1, this report). The position of the high-calcium zones in the Warsaw at other locations, as shown in Figure 5, suggests this 6-foot zone may represent the basal remnant of a thicker zone of pure limestone that has been removed by erosion. Operable deposits of high-calcium limestone may be present in the surrounding area where a more complete section of the Warsaw has been preserved. Blade (1966) reported a total thickness of approximately 170 feet for the formation in this area of Calloway County.

The University of Kentucky's Agricultural Experiment Station determined the neutralizing value as agricultural limestone for 20 feet of Warsaw exposed at the site of the abandoned Patterson quarry on the north shore of the Shannon Creek embayment. The average value for the 20 samples was 93, and the values ranged from 91 to 96 (J. R. Todd, written communication, 1952). The position of this 20-foot interval above the base of the formation is not known.

In general, Warsaw outcrops in the two counties are deeply weathered and mainly consist of a cherty and clayey residuum. The fresh limestone found in small surface exposures and in cores is bioclastic and crystalline. The bioclastic limestone with a chalklike matrix, the predominant high-calcium lithology in the Warsaw formation, has been found on the eastern shore of the lake in the TVA Star quarry in Lyon County, and in western Trigg County in the Fords Creek section and in the No. 1 R. E. Lynn well (Fig. 5). This lithology may extend into the area along the western shore of the lake.

The occurrence of prospective deposits is restricted by the deep weathering of the limestone and the formation's complete or partial removal by erosion in much of the area. However, there are five fault blocks (grabens) where a complete or relatively thick section of unweathered Warsaw may be preserved. Three are in the Fairdealing quadrangle in Marshall County (Wolfe, 1964), where residuum of the St. Louis and Salem Limestones is found at the surface. They are located in the vicinity of (1) the mouth of West Fork of Bee Creek west of Mile 35.5, (2) the mouth of Bee Creek west of Mile 37, and (3) the mouth of Billie Branch west of Mile 40.5.

The other two fault blocks are located in the Hamlin and Paris Landing quadrangles in southeastern Calloway County (Blade, 1966). One is in the vicinity of the mouth of Boyds Branch west of Mile 54.5 where St. Louis and Salem residuum partially overlies the Warsaw. The second body of Warsaw Limestone extends along the lake shore from the southern border of the county to the mouth of Yellow Spring Branch, a distance of approximately two miles. The Western Materials core and the abandoned Patterson quarry are located in the latter fault block.

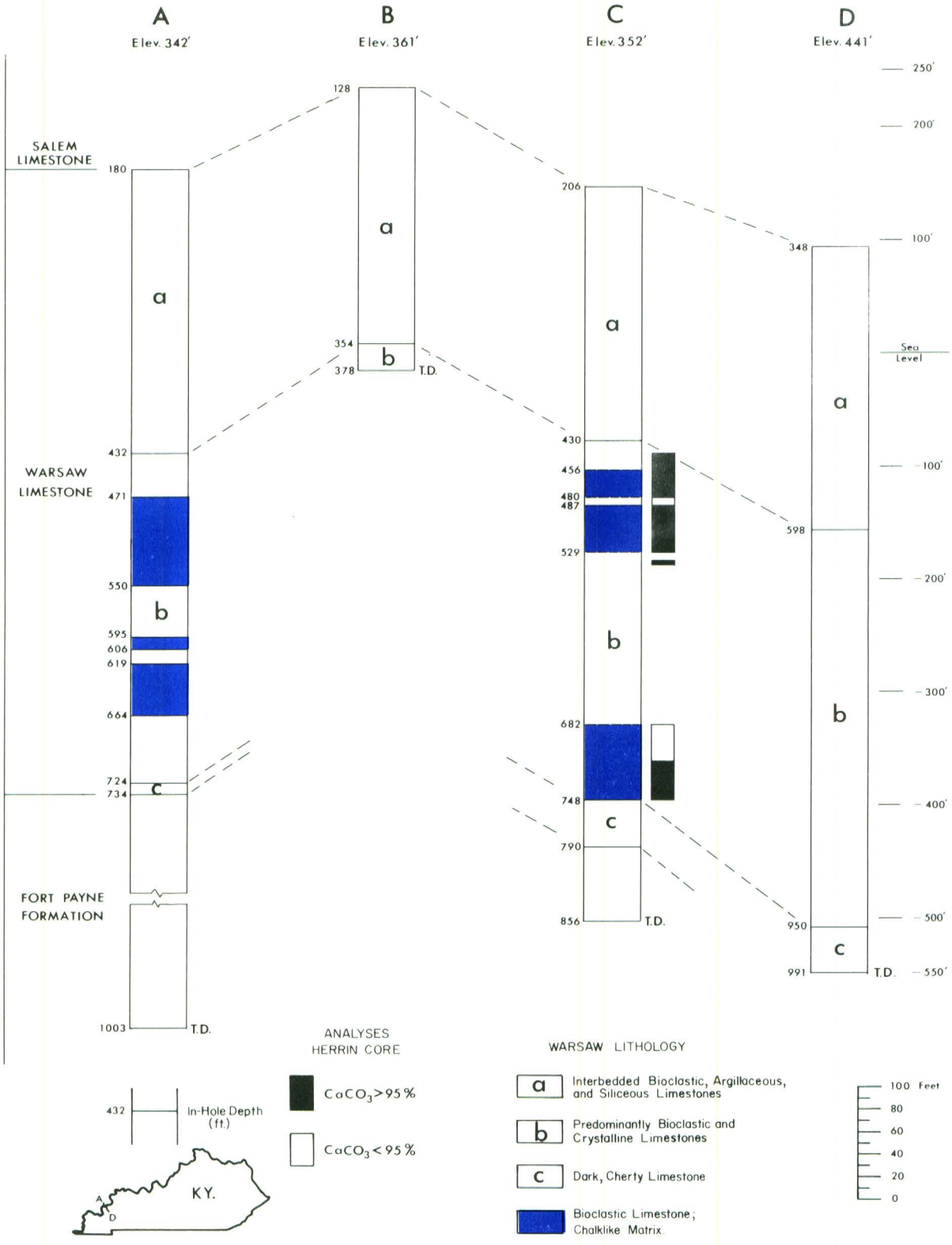
Tolu Dome, Crittenden County

Three intervals of high-calcium limestone, 35, 38, and 42 feet thick, have been found in the Shell Oil Company Herrin core, taken in northern Crittenden County near the Ohio River (Table 8). The core was one of several recovered as part of the company's preliminary investigation of the Tolu dome, a broad anticlinal structure. Shell later drilled an 8,821-foot wildcat well (McCann, 1956) in the center of the dome, approximately 1.3 miles northwest of the Herrin core hole.

The top of the Warsaw Limestone was encountered at a depth of 206 feet in this core hole, and the high-calcium bioclastic limestone occurred in the intervals from 442 to 480, 487 to 529, and 713 to 748 feet. Zones of similar bioclastic limestone have been found on the north side of the structure in the company's M. F. Page core. These two occurrences, on opposite sides of the dome, suggest that deposits of high-calcium limestone may be present in the center of the structure at shallower, potentially minable depths.

Figure 7 shows a north-south section across the structure. In this figure, the Warsaw Limestone has been divided into three lithologic zones: Zone A, interbedded bioclastic, argillaceous, and siliceous limestones; Zone B, predominantly bioclastic and crystalline limestones; Zone C, dark cherty limestone.

There are no samples available from the Mississippian interval in the deep test well, the No. 1 M. D. Davis. The Frazer core hole, drilled approximately 1,200 feet northwest of the site of the Davis well, is used to represent the approximate center of the structure in the cross section. It is estimated that the top of the interval containing the pure bioclastic limestone in the Herrin and Page cores occurs at a depth of 370 to 400 feet at the site of the Frazer core hole.



A—Shell Oil Co. No.1 M.F. Page core, 21-12S-9E, Hardin Co., Ill.
B—Shell Oil Co. No.1 Frazer core, 17-L-16, Crittenden Co., Ky.
C—Shell Oil Co. No.1 S. Herrin core, 23-L-16, Crittenden Co., Ky.
D—Shell Oil Co. No.1 E. Adams core, 12-K-16, Crittenden Co., Ky.

Figure 7. North-south section across the Tolu dome showing lithologic zones and high-calcium intervals in the Warsaw Limestone. Datum is sea level.

Western Materials of Kentucky Core

This core was taken from near the present site of the Western Materials of Kentucky quarry, which is the only active quarry in Kentucky's Jackson Purchase region. The open-face operation in the Warsaw Limestone produces crushed stone for concrete aggregate, roadstone, and agricultural limestone. The core recovered the lower 70 feet of the Warsaw and 30 feet of the underlying Fort Payne Formation. Foot-by-foot chemical analyses of this section have been reported by McGrain (1968, Table 2) and are presented again in this report in Table 1.

Average chemical analysis of the upper 6 feet, the purest zone in the core, is:

Samples (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)
12-18	95.33	2.50	1.49	0.08	0.29

The position of this zone within the Warsaw (Fig. 5) suggests that a thicker interval of pure limestone may have been present in the overlying section of Warsaw, which was later removed by erosion. The total carbonate content of the 39-foot interval from 21 to 60 feet averages 97.96 percent.

The core hole and quarry are located less than one mile west of the Shannon Creek embayment of Kentucky Lake. The site is approximately 15 miles southeast of Murray, by way of Ky. Highway 121 and a secondary road. Murray, the seat of Calloway County, is served by U. S. Highway 641, a network of state highways, and the Louisville & Nashville (formerly Nashville, Chattanooga & St. Louis) Railroad.

WWM

TABLE 1. CHEMICAL ANALYSES OF WESTERN MATERIALS OF KENTUCKY CORE

County: Calloway **Operator:** Western Materials of Kentucky, Inc.
Property Owner: Western Materials of Kentucky, Inc. Elevation: 420 feet est.
Location: $4\frac{1}{2}$ miles southeast of New Concord via Ky. Hwy. 121 and a secondary road
Carter Coordinate Location: 2150' FSL and 300' FWL, sec. 16-A-18 (Hamlin quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
94.80	2.28	1.60	0.06	0.28	99.02	NOT ANALYZED	
96.08	2.29	1.31	0.07	0.22	99.97		
95.60	2.25	1.36	0.07	0.37	99.65		
95.78	2.40	1.40	0.08	0.31	99.97		
94.36	2.80	1.96	0.11	0.42	99.65		
95.37	2.99	1.30	0.08	0.19	99.93		
91.95	3.88	3.58	0.08	0.22	99.71		
95.34	2.36	1.61	0.07	0.22	99.60		
70.70	0.85	25.82	1.56	0.11	99.04		
93.77	2.87	2.41	0.22	0.03	99.30		
91.99	6.53	1.32	0.10	0.03	99.97		
93.37	5.15	1.46	0.11	0.01	100.10		
93.06	5.03	1.84	0.13	0.01	100.07		
92.25	6.21	1.62	0.13	0.01	100.22		
92.97	5.--	1.93	0.07	0.02	99.99		
92.79	4.79	1.93	0.09	0.03	99.63		
92.52	4.87	1.97	0.10	0.17	99.63		
93.15	5.08	1.68	0.07	0.05	100.03		
94.21	3.76	1.47	0.08	0.12	99.64		
93.24	4.55	1.75	0.08	0.16	99.78		
91.36	6.79	1.50	0.07	0.25	99.97		
91.54	6.72	1.44	0.15	0.17	100.02		
92.07	6.63	1.24	0.07	0.25	100.26		
92.96	5.98	1.16	0.10	0.10	100.30		
94.39	4.02	1.74	0.15	0.02	100.32		
92.26	5.60	1.35	0.15	0.02	99.38		
92.25	5.87	1.66	0.15	0.01	99.94		
91.09	6.78	1.86	0.17	0.24	99.97		
91.45	6.60	1.70	0.14	0.19	99.94		
91.89	6.41	1.54	0.14	0.15	99.99		
89.76	9.23	1.22	0.14	0.02	100.37		
88.34	9.34	1.48	0.21	0.02	99.39		
90.92	7.66	1.34	0.15	0.24	100.31		
89.76	6.27	1.16	0.18	0.11	97.48		
92.25	6.35	0.94	0.18	0.39	100.11		
91.--	7.65	1.40	0.14	0.08	100.27		
92.17	5.77	1.23	0.18	0.36	99.53		
96.35	1.45	1.41	0.18	0.40	99.61		
90.47	7.38	1.76	0.18	0.40	99.99		
89.67	8.66	1.88	0.16	0.36	100.73		
69.44	27.44	2.46	0.18	0.32	99.84		
65.71	32.22	1.62	0.18	0.26	99.99		
81.34	15.84	2.30	0.26	0.32	100.06		
75.48	20.20	3.60	0.22	0.40	99.90		

Sampled by: Preston McGrain and Walter L. Helton
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: March 15, 1964

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF CORE HOLE	
0-12		12	Soil and weathered limestone.	
12-13				
13-14				
14-15				
15-16				
16-17				
17-18				
18-19				
19-20				
20-21				
21-22	1	20	Limestone, light-gray, with some thin dark-gray zones, medium- to coarsely crystalline; chert at 21 feet; stylolites common.	
22-23				
23-24				
24-25				
25-26				
26-27				
27-28				WARSAW LIMESTONE
28-29				
29-30				
30-31				
31-32				
32-33				
33-34				
34-35				
35-36				
36-37				
37-38				
38-39				
39-40				
40-41				
41-42				
42-43				
43-44				
44-45				
45-46				
46-47				
47-48				
48-49				
49-50	2	35	Limestone, light-gray, medium-crystalline; some dark-gray, coarsely crystalline zones below 61 feet; dolomitic, with some dolomite, below 52 feet; siliceous at 63 feet; stylolites sparse.	
50-51				
51-52				
52-53				
53-54				
54-55				
55-56				

TABLE 1—*Continued*

County: Calloway **Operator:** Western Materials of Kentucky, Inc.
Property Owner: Western Materials of Kentucky, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
82.76	15.63	1.56	0.21	0.35	100.51	NOT ANALYZED	
83.73	14.50	1.70	0.25	0.13	100.31		
82.58	15.39	1.44	0.18	0.36	99.95		
84.36	13.79	1.33	0.20	0.24	99.92		
69.44	10.33	19.02	0.18	0.29	99.26		
87.02	10.08	1.50	0.12	0.28	99.--		
65.--	15.50	18.16	0.58	0.23	99.47		
70.86	12.44	15.84	0.24	0.16	99.54		
64.64	32.07	2.88	0.23	0.12	99.94		
75.12	21.46	2.47	0.24	0.10	99.39		
64.64	32.27	2.70	0.22	0.05	99.88		
59.67	37.65	2.37	0.20	0.11	100.--		
68.02	29.66	2.42	0.23	0.18	100.51		
73.34	23.30	3.58	0.23	0.05	100.50		
60.02	38.40	1.88	0.15	0.02	100.47		
62.51	36.25	1.68	0.15	0.11	100.70		
62.78	6.21	27.33	0.65	2.44	99.41		
52.75	4.75	38.98	2.02	1.34	99.84		
70.51	7.41	19.10	0.48	1.21	98.71		
73.52	8.22	15.64	0.18	1.68	99.24		
81.61	6.79	8.90	0.18	1.--	98.48		
83.21	5.22	10.02	0.18	0.36	98.99		
76.19	9.01	13.63	0.37	0.60	99.80		
77.61	7.88	12.50	0.37	0.81	99.17		
79.03	12.91	7.40	0.18	0.07	99.59		
76.28	11.55	11.35	0.45	0.07	99.25		
58.25	4.01	31.70	0.26	3.05	97.01		
55.41	3.49	35.25	0.31	3.21	97.67		
51.68	3.76	39.92	0.55	2.31	98.22		
59.85	3.92	31.85	0.37	2.10	98.09		
63.31	5.37	27.27	0.12	2.35	98.42		
54.43	4.87	36.11	0.70	2.39	98.50		
65.36	4.17	27.86	0.35	1.06	98.80		
69.44	5.09	20.98	0.13	2.09	97.73		
41.73	2.89	52.18	2.65	0.55	100.--		
71.21	2.90	21.16	0.33	2.27	97.87		
53.10	5.49	33.75	0.72	3.33	96.39		
55.06	5.29	33.32	0.32	3.34	97.33		
59.76	5.46	32.20	0.39	1.44	99.35		
63.58	7.04	25.03	0.32	2.25	98.22		
66.78	3.93	24.28	0.37	2.63	97.99		
50.53	4.69	38.82	1.52	2.96	98.52		
76.54	2.49	20.27	0.25	0.41	99.96		
66.15	3.69	25.68	0.32	2.97	98.81		
58.43	2.84	30.78	0.25	2.60	94.90		
56.39	3.45	33.01	0.38	2.88	96.11		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
56-57				
57-58				
58-59				
59-60				
60-61				
61-62				
62-63				
63-64				
64-65				
65-66				
66-67				WARSAW LIMESTONE
67-68				
68-69				
69-70	3	5	Dolomite, light-gray, finely to medium-crystalline, porous.	
70-71				
71-72				
72-73				
73-74				
74-75				
75-76				
76-77	4	9	Limestone, dark-gray, finely to medium-crystalline, siliceous; numerous thin dark-gray to black clay partings.	
77-78				
78-79				
79-80				
80-81				
81-82	5	1	Limestone, light-gray, coarsely crystalline, dolomitic.	
82-83				
83-84				
84-85				
85-86				
86-87				
87-88				FORT PAYNE FORMATION
88-89				
89-90				
90-91				
91-92				
92-93				
93-94				
94-95				
95-96				
96-97	6	30	Limestone, dark-gray, finely to coarsely crystalline, siliceous, argillaceous; scattered blue and black chert, more abundant near base; numerous carbonaceous clay partings; petroliferous odor when freshly broken.	
97-98				
98-99				
99-100				
100-101				
101-102				

TABLE 1—*Continued*

County: Calloway **Operator:** Western Materials of Kentucky, Inc.
Property Owner: Western Materials of Kentucky, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
55.41	3.64	33.98	0.35	3.14	96.17	NOT ANALYZED	
54.17	3.36	34.14	0.25	3.68	95.60		
55.85	3.78	33.75	0.55	2.95	96.88		
52.92	4.07	34.70	0.33	4.21	96.23		
53.19	4.25	34.54	0.47	3.68	96.13		
53.55	4.88	33.32	0.33	3.82	95.90		
53.19	5.23	34.69	0.28	3.82	97.21		
50.88	4.63	37.24	0.62	3.44	96.81		
54.17	5.37	33.91	0.42	3.74	97.19		
54.52	5.35	33.64	0.25	3.30	96.81		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
102-103				FORT PAYNE FORMATION
103-104				
104-105				
105-106				
106-107				
107-108				
108-109				
109-110				
110-111				
111-112				

BOTTOM OF CORE HOLE

Kentucky Geological Survey-U. S. Geological Survey Canton Core

This core hole was drilled for stratigraphic information as part of the cooperative Kentucky Geological Survey-U. S. Geological Survey statewide areal geologic mapping program. The core provided data on the stratigraphic section from the upper part of the Warsaw Limestone through the upper part of the Chattanooga Shale. McGrain (1964) reported that a remarkably uniform zone of pure, very light-colored, bioclastic limestone was found in the Warsaw in the interval from a depth of 122 feet 5 inches to 200 feet. Foot-by-foot chemical analyses for this interval, reported by McGrain, are repeated here in Table 2. Values for phosphorus content, previously reported as phosphorus pentoxide (P_2O_5 - %), have been converted to elemental phosphorus (P - %) for this report.

Calcium carbonate content of individual samples is as great as 98.22 percent. Average chemical analysis of the high-calcium section and the purest zone within this section are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
130-198	97.13	1.13	1.06	0.06	0.21	.030	.033
131-191	97.26	1.08	0.93	0.06	0.22	.028	.033

The high-calcium zone in this core is in the lower part of the formation (Figs. 5 and 6). The average magnesium carbonate content of the total analyzed interval is 1.20 percent.

McGrain (1964, p. 12) suggested that the equivalent section within the Warsaw may have been brought up to or near the surface by faulting in the northern part of the Canton quadrangle and the adjoining portion of the Lamasco quadrangle. Occurrences of similar limestone in the area surrounding the core hole are reported in a previous section covering the eastern shore of Lake Barkley.

The core hole was drilled in the floor of the Cedar Bluff Stone Company's Canton quarry, which exposes the uppermost part of the Warsaw formation. Chemical analyses of this quarry are reported in Table 3.

The drill site is on the north shore of the Hopson Creek embayment of Lake Barkley, between Cumberland River Miles 62 and 63. The embayment is bridged for access to U. S. Highway 68-Ky. Highway 80, on the south shore. Cadiz, the seat of Trigg County, located 8 miles to the northeast, is served by a spur line of the Illinois Central Railroad.

WUN

TABLE 2. CHEMICAL ANALYSES OF KENTUCKY GEOLOGICAL SURVEY-U. S. GEOLOGICAL SURVEY CANTON CORE

County: Trigg **Operator:** Ky. Geol. Survey-U.S. Geol. Survey
Property Owner: Sam Downs (now Cedar Bluff Stone Co., Inc.) Elevation: 405 feet
Location: At Cedar Bluff Stone Co. quarry, 1 mile east of Canton on U.S. Highway 68
Carter Coordinate Location: 1400' FSL and 1600' FWL, sec. 9-D-19 (Canton quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
						✓	✓
56.07	2.54	38.85	2.25	0.76	100.47	.082	.038
86.68	1.72	10.45	0.65	0.67	100.17	.030	.024
94.91	1.89	2.15	0.10	0.58	99.63	.072	.031
96.61	1.56	1.30	0.07	0.41	99.95	.028	.021
72.99	1.63	24.63	0.50	0.77	100.52	.060	.041
96.43	1.51	1.69	0.05	0.56	100.24	.046	.025
97.23	2.07	1.03	0.05	0.52	100.90	.014	.025
80.86	2.01	15.02	0.20	0.45	98.54	.054	.040
95.62	1.71	1.60	0.05	0.27	99.25	.030	.059
97.86	1.31	0.74	0.02	0.18	100.11	.016	.017
97.77	1.37	1.01	0.05	0.07	100.27	.002	.020
97.86	1.31	0.88	0.05	0.08	100.18	.012	.028
98.04	1.22	0.69	0.05	0.12	100.12	.014	.031
97.94	1.25	0.69	0.05	0.11	100.04	.006	.027
97.41	1.24	1.06	0.10	0.23	100.04	.032	.057
98.22	1.21	0.52	0.03	0.31	99.29	.012	.020
97.50	1.01	0.73	0.05	0.20	99.49	.016	.039
97.32	0.88	0.74	0.05	0.22	99.21	.012	.031
97.23	0.69	0.87	0.07	0.19	99.05	.020	.030
97.41	0.86	0.93	0.05	0.20	99.45	.020	.025
97.41	0.68	0.85	0.05	0.30	99.29	.030	.025
97.59	0.79	0.82	0.05	0.19	99.44	.022	.023
97.59	0.57	0.82	0.05	0.22	99.25	.022	.022
97.14	0.88	0.91	0.07	0.25	99.25	.030	.034
96.96	1.56	0.94	0.07	0.11	99.64	.030	.044
97.05	1.42	1.06	0.07	0.05	99.65	.030	.034
97.41	1.37	0.84	0.05	0.16	99.83	.036	.029
97.32	1.34	0.62	0.05	0.07	99.40	.026	.031
97.41	1.39	0.65	0.05	0.13	99.63	.026	.024
96.96	1.53	0.73	0.07	0.19	99.48	.040	.034
96.78	1.57	0.99	0.07	0.24	99.65	.054	.045
96.87	1.59	1.00	0.10	0.18	99.74	.036	.037
97.41	0.66	0.91	0.07	0.16	99.21	.034	.029
97.32	0.72	0.77	0.07	0.17	99.05	.040	.029
97.05	0.77	0.97	0.10	0.26	99.15	.054	.032
97.05	0.83	1.02	0.07	0.12	99.09	.020	.034
96.87	0.77	0.68	0.07	0.30	98.69	.024	.033
97.32	0.85	0.73	0.05	0.21	99.16	.022	.030
97.32	0.82	0.89	0.07	0.17	99.27	.018	.019
96.25	1.09	1.63	0.07	0.24	99.28	.054	.036
97.14	0.66	0.76	0.10	0.18	98.84	.028	.039
97.32	0.83	0.86	0.10	0.19	99.30	.042	.042
97.32	0.77	0.63	0.05	0.24	99.01	.018	.038
96.96	0.95	0.84	0.07	0.26	99.08	.018	.033
97.05	1.--	0.76	0.07	0.32	99.20	.032	.034
97.14	1.08	0.80	0.05	0.27	99.34	.016	.031
97.14	0.92	0.76	0.05	0.29	99.16	.040	.032

Sampled by: Preston McGrain
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: January 22, 1964

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF SAMPLED INTERVAL IN CORE	
122'5"-123'				
123-124				
124-125				
125-126				
126-127				
127-128				
128-129				
129-130				
130-131				
131-132				
132-133				
133-134				
134-135				
135-136				
136-137				
137-138				
138-139				
139-140				
140-141				
141-142				
142-143				
143-144				
144-145			Limestone, light-gray, medium- to coarse-grained,	
145-146	1	77'7"	bioclastic, in a very light-gray chalklike matrix;	
146-147			homogeneous, stylolitic, thick-bedded; contains	
147-148			very little chert.	
148-149				
149-150				
150-151				
151-152				
152-153				
153-154				
154-155				
155-156				
156-157				
157-158				
158-159				
159-160				
160-161				
161-162				
162-163				
163-164				
164-165				
165-166				
166-167				
167-168				
168-169				

WARSAW LIMESTONE

TABLE 2—*Continued*

County: Trigg **Operator:** Ky. Geol. Survey-U.S. Geol. Survey
Property Owner: Sam Downs (now Cedar Bluff Stone Co., Inc.)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
96.78	0.98	1.20	0.10	0.26	99.32	.004	.043
97.03	1.39	1.33	0.02	0.18	99.95	.048	.051
97.12	1.51	1.11	0.02	0.16	99.92	.028	.040
97.12	1.25	1.15	0.02	0.26	99.80	.040	.037
97.21	1.43	1.23	0.05	0.24	100.34	.022	.034
97.47	1.45	0.82	0.02	0.19	99.95	.024	.027
97.56	1.37	0.73	0.05	0.31	99.93	.014	.038
97.29	1.42	1.35	0.05	0.23	100.34	.010	.036
97.48	1.34	1.18	0.05	0.28	100.23	.052	.037
98.01	0.80	0.58	0.03	0.36	99.78	.036	.032
97.56	0.85	0.73	0.05	0.38	99.57	.018	.037
97.12	0.68	1.22	0.05	0.37	99.46	.046	.036
97.56	0.91	1.30	0.05	0.45	100.27	.022	.031
96.94	0.73	1.06	0.10	0.29	99.12	.030	.044
97.39	0.94	0.55	0.08	0.27	99.23	.038	.030
97.47	0.82	0.95	0.07	0.25	99.56	.036	.030
97.21	1.07	1.01	0.10	0.29	99.68	.048	.033
97.56	1.15	1.10	0.07	0.37	100.25	.032	.031
96.85	1.22	1.09	0.07	0.15	99.38	.028	.028
97.12	1.03	1.21	0.07	0.13	99.56	.040	.037
97.12	1.21	1.16	0.07	0.11	99.67	.036	.026
96.23	1.53	1.77	0.10	0.43	100.06	.046	.028
93.73	3.25	2.38	0.10	0.33	99.79	.058	.038
96.58	1.10	1.76	0.07	0.30	99.81	.038	.028
96.76	1.21	1.99	0.08	0.10	100.14	.038	.027
96.76	1.01	1.87	0.12	0.11	99.87	.038	.031
95.96	1.10	2.02	0.10	0.11	99.29	.034	.029
96.50	1.25	2.21	0.10	0.08	100.14	.068	.031
95.87	1.74	2.25	0.08	0.03	99.97	.056	.026
62.73	0.82	35.10	1.10	0.37	100.12	.078	.027
95.69	1.59	2.59	0.10	0.11	100.08	.066	.031

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
169-170				
170-171				
171-172				
172-173				
173-174				
174-175				
175-176				
176-177				
177-178				
178-179				
179-180				
180-181				
181-182				
182-183				
183-184			Limestone, light-gray, medium- to coarse-grained,	WARSAW LIMESTONE
184-185	1	77'7"	bioclastic, in a very light-gray chalklike matrix;	
185-186			homogeneous, stylolitic, thick-bedded; contains	
186-187			very little chert.	
187-188				
188-189				
189-190				
190-191				
191-192				
192-193				
193-194				
194-195				
195-196				
196-197				
197-198				
198-199				
199-200				

BOTTOM OF SAMPLED INTERVAL

NOTE: The base of the Warsaw Limestone was at a depth of 250 feet in the core hole.

Cedar Bluff Stone Company's Canton Quarry (South and North Sites)

This quarry is an active open-face operation producing crushed limestone for concrete aggregate, roadstone, and agricultural limestone from two sites located approximately 2,000 feet apart. At the south site, the stone is quarried from the Warsaw and Salem Limestones (Fig. 8), and Warsaw alone is quarried at the north site (Fig. 9). Foot-by-foot chemical analyses of the south and north quarries are reported in Tables 3 and 4, respectively.

Calcium carbonate content of individual samples is as great as 96.95 percent. The purest zone is the bioclastic Warsaw limestone exposed in the lower part of the south quarry; its average chemical analysis is:

Samples (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)
13-25	95.57	1.62	2.29	0.08	0.50

Exposures uncovered by further quarrying at the south site show that all of the lower 20 to 25 feet of this face is essentially the same lithology as the interval from 13 to 25 feet, and may be of similar chemical quality. The position of this zone of bioclastic limestone in the Warsaw formation is shown in Figures 5 and 6.

The sample intervals for the two sites are approximate stratigraphic equivalents, because the quarry floors at both sites, at the time of sampling, were within 2 to 3 feet of the same elevation; structure contours on the Canton geologic quadrangle map (Fox and Seeland, 1964) show that the two quarries are essentially on strike. A comparison of Tables 3 and 4 shows that the interval of bioclastic limestone at the south site, 0 to 25 feet, changes to the north in lithologic and chemical character. Although the bioclastic limestone may extend in other directions from the south site and form an operable deposit of high-calcium stone, the comparison suggests that lateral changes in lithology within the upper part of the Warsaw should be anticipated in this area.

The Kentucky Geological Survey-U. S. Geological Survey Canton core hole was drilled in the quarry floor at the south site (Fig. 8). A zone of pure bioclastic limestone was encountered in the Warsaw in the interval from 122 feet 5 inches to 200 feet. Chemical analyses for this interval were reported by McGrain (1964) and are repeated in the present report in Table 2.

The two quarry sites are 1 mile east of Canton, on the north side of the Hopson Creek embayment of Lake Barkley, between Cumberland River Miles 62 and 63. The embayment is bridged for access to U. S. Highway 68-Ky. Highway 80, on the south shore.

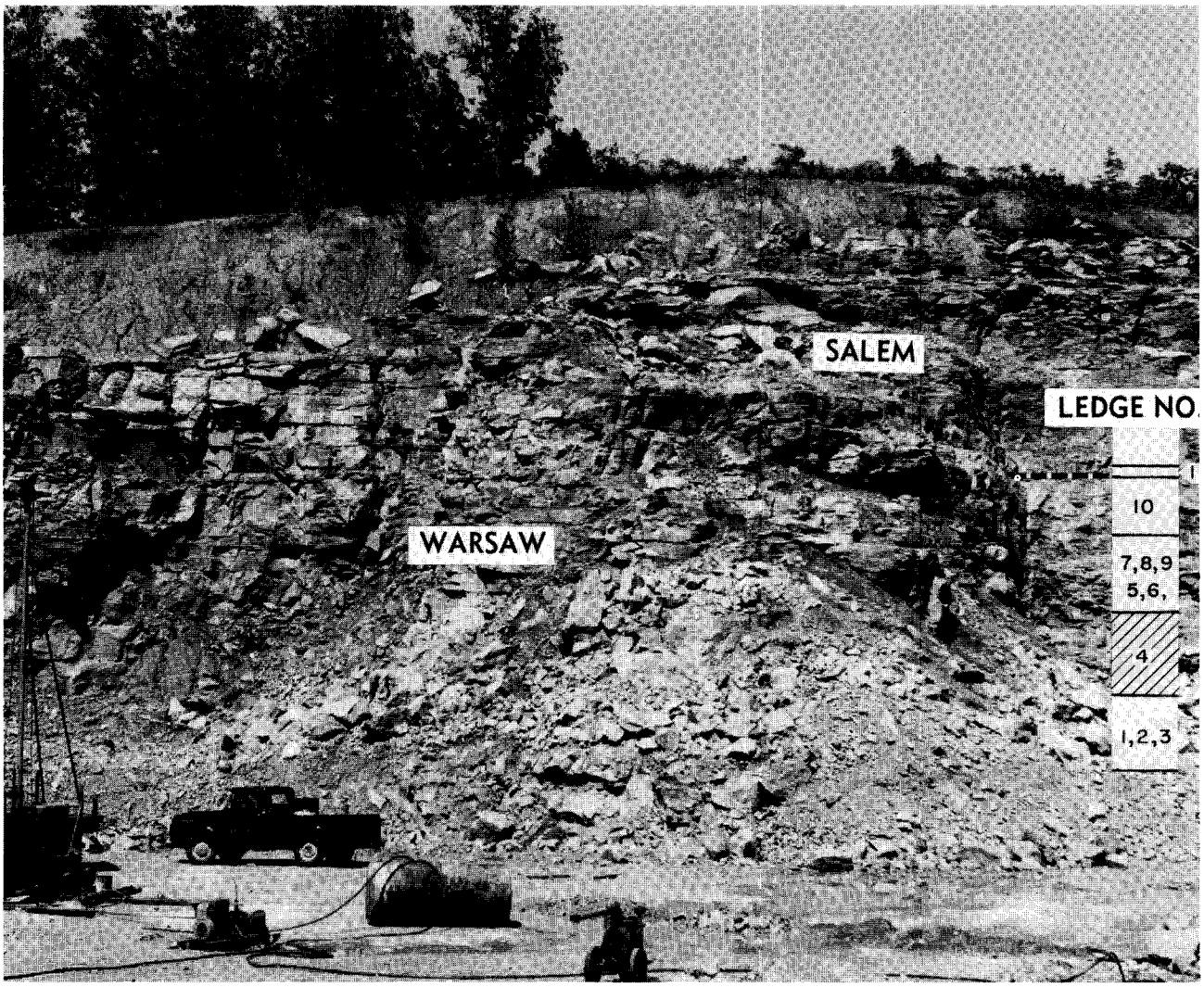


Figure 8. Photograph of Cedar Bluff Stone Company's Canton quarry (south site) showing ledge designations and high-calcium limestone stratum. The drilling rig in the left foreground marks the location of the core described in Table 2.

WCN

TABLE 3. CHEMICAL ANALYSES OF CEDAR BLUFF STONE COMPANY'S CANTON QUARRY (SOUTH SITE)

County: Trigg **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.
Location: 1 mile east of Canton on U.S. Highway 68
Carter Coordinate Location: 9-D-19 (Canton quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
76.96	13.--	7.37	0.27	1.68	99.28	NOT ANALYZED	
84.87	5.91	6.65	0.22	1.15	98.80		
94.62	1.38	2.28	0.40	0.61	99.29		
92.50	1.21	4.69	0.20	0.67	99.27		
91.86	0.80	5.79	0.25	0.87	99.57		
46.07	0.36	50.03	1.90	0.81	99.17		
93.05	1.66	4.16	0.22	0.27	99.36		
95.44	1.18	1.68	0.05	0.10	98.45		
94.25	1.21	3.23	0.15	0.09	98.93		
96.09	1.24	2.13	0.12	0.16	99.74		
96.18	0.95	1.01	0.05	0.04	98.23		
94.52	1.62	2.99	0.10	0.45	99.68		
62.99	5.17	31.95	0.45	0.25	100.81		
95.17	1.81	2.36	0.10	0.13	99.57		
94.98	1.89	2.47	0.10	0.63	100.07		
86.80	5.44	4.88	0.15	1.51	98.78		
84.50	8.24	6.39	0.05	1.02	100.20		
88.64	6.02	3.87	0.15	1.05	99.73		
94.98	2.33	1.45	0.05	0.57	99.38		
88.82	5.44	3.60	0.10	1.22	99.18		
93.79	2.19	2.54	0.05	0.72	99.29		
91.58	2.37	4.12	0.10	1.11	99.28		
93.79	2.06	2.68	0.05	0.21	98.79		
94.90	2.12	2.20	0.05	0.30	99.57		
94.25	2.98	2.62	0.05	0.26	100.16		
54.10	3.10	40.24	1.30	1.28	100.02		
94.53	1.68	3.01	0.05	0.46	99.73		
96.30	1.71	2.08	0.05	0.37	100.51		
94.72	1.91	3.68	0.05	0.39	100.75		
95.37	1.81	3.11	0.05	0.41	100.75		
96.95	1.51	1.53	0.10	0.19	100.28		
95.18	1.87	2.42	0.10	0.60	100.17		
94.34	1.72	3.13	0.10	1.10	100.39		
96.20	1.06	2.53	0.15	0.35	100.29		
93.51	1.83	1.37	0.12	0.46	97.29		
96.67	1.34	1.94	0.10	0.43	100.48		

Sampled by: Edward N. Wilson and William D. Rose
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 27, 1962

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
			Approximately 35 to 45 feet of Salem Limestone is exposed above Ledge 11.	SALEM LIMESTONE
50-51 49-50	11	2	Limestone, dark-gray, laminated, silty, with local sandy zones.	
48-49 47-48 46-47 45-46 44-45 43-44 42-43 41-42 40-41 39-40	10	10	Limestone, medium-gray, bioclastic, in a finer grained matrix; 4- to 8-inch layer of black chert at 45 feet.	
38-39	9	1	Limestone, dark-gray, fine-grained, bioclastic, with 2-inch layers of chert.	
37-38 36-37	8	2	Limestone, medium-gray, coarse-grained, bioclastic; microgranular to very fine-grained in upper part; 2-inch shale near top.	
35-36 34-35 33-34	7	3	Limestone, dark- to medium-gray, microgranular to very fine-grained; irregular cherty layer near middle; 2- to 5-inch shale at 35 feet.	WARSAW LIMESTONE
32-33 31-32 30-31 29-30 28-29 27-28	6	6	Limestone, medium-gray, coarse-grained, bioclastic, massive.	
26-27 25-26	5	2	Limestone, dark-gray, microgranular to very fine-grained, with layered and nodular chert; some interlayered fine-grained bioclastic limestone in upper 1 foot.	
24-25 23-24 22-23 21-22 20-21 19-20 18-19 17-18 16-17 15-16	4	12	Limestone, light- to dark-gray, bioclastic, in a finer grained matrix, massive, with stylolites.	

TABLE 3—*Continued*

County: Trigg **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
96.48	1.60	1.35	0.10	0.44	99.97	NOT ANALYZED	
96.67	1.40	1.40	0.05	0.78	100.30		
NO SAMPLES							
NO SAMPLES							
NO SAMPLES							

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
14-15				
13-14				
8-13	3	5	Covered zone.	WARSAW LIMESTONE
2-8	2	6	Limestone, medium-gray, bioclastic, in a finer grained matrix; massive, with stylolites.	
0-2	1	2	Covered zone.	

BOTTOM OF QUARRY (August 27, 1962)

Figure 9. Photograph of Cedar Bluff Stone Company's Canton quarry (north site) showing ledge designations. Ledges 6-8 are not shown.

TABLE 4. CHEMICAL ANALYSES OF CEDAR BLUFF STONE COMPANY'S CANTON QUARRY (NORTH SITE)

County: Trigg **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.
Location: 1 mile east of Canton on U.S. Highway 68
Carter Coordinate Location: 9-D-19 (Canton quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
94.23	1.63	2.83	0.05	0.53	99.27	NOT ANALYZED	
96.30	1.33	1.72	0.15	0.48	99.98		
95.76	1.64	1.89	0.07	0.25	99.61		
94.95	1.84	2.44	0.07	0.36	99.66		
95.04	1.80	2.10	0.07	0.18	99.19		
			NO SAMPLE				
92.43	2.10	3.84	0.07	0.41	98.85		
91.71	2.01	5.40	0.10	0.16	99.38		
92.25	1.79	4.83	0.10	0.23	99.20		
95.58	1.74	1.90	0.07	0.16	99.45		
89.28	2.32	6.92	0.07	0.57	99.16		
90.99	2.26	6.09	0.10	0.50	99.94		
85.05	3.12	11.05	0.25	0.67	100.14		
92.43	2.24	4.63	0.10	0.76	100.16		
92.88	2.49	4.--	0.10	0.61	100.08		
93.15	2.09	4.76	0.10	0.68	100.78		
86.94	5.68	5.38	0.15	1.23	99.38		
75.33	12.56	8.39	0.20	2.46	98.94		
79.02	11.02	7.35	0.15	2.--	99.54		
91.80	4.38	2.30	0.15	0.83	99.46		
91.98	3.24	3.81	0.10	0.35	99.48		
96.21	1.62	1.85	0.05	0.27	100.--		
96.84	1.62	1.25	0.12	0.21	100.04		
96.27	2.06	1.29	0.07	0.43	100.12		
92.23	1.87	5.40	0.05	0.76	100.31		
94.62	1.69	2.--	0.07	0.47	98.85		
91.67	1.69	5.98	0.15	0.58	100.07		
92.41	1.51	4.98	0.07	1.--	99.97		
92.41	1.30	4.72	0.07	0.61	99.11		
91.67	1.27	3.50	0.10	0.69	97.23		
95.63	1.48	2.43	0.10	0.62	100.26		
94.98	1.66	2.28	0.10	0.63	99.65		
88.82	2.40	7.65	0.20	0.50	99.57		
88.--	2.53	8.01	0.20	0.68	99.42		
86.34	2.48	10.--	0.20	1.01	100.03		
87.81	2.13	8.51	0.20	0.73	99.38		
			NO SAMPLES				

Sampled by: Edward N. Wilson and William D. Rose
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 27, 1962

DESCRIPTION				
Sample Level (Feet)	**Ledge No.**	**Thickness (Feet)**	**Lithology**	**Formation**
			TOP OF QUARRY	
38-42			Weathered siliceous, bioclastic limestone, black blocky chert, and soil.	
37-38 36-37 35-36 34-35 33-34	8	5	Limestone, gray, medium-grained, fossiliferous, dense, with stylolites.	
32-33	7	1	Covered zone.	
31-32 30-31 29-30 28-29 27-28 26-27 25-26 24-25 23-24 22-23 21-22	6	11	Limestone, medium- to dark-gray, fine- to very fine-grained, fossiliferous, dense, with stylolites; interbedded dark-gray and black shale.	WARSAW LIMESTONE
20-21 19-20	5	2	Limestone, dark-gray, shaly, with thin wavy banding, dolomitic; $\frac{1}{2}$-inch shale at top.	
18-19 17-18 16-17 15-16 14-15	4	5	Limestone, medium- to dark-gray, fine- to very fine-grained, with stylolites; 2-inch shale near middle.	
13-14 12-13 11-12 10-11	3	4	Limestone, dark-gray, very fine- to fine-grained, with stylolites; scattered fossils in lower 1 foot; dark-gray calcareous shale with black nodular chert at top of ledge, which thins laterally to 0 feet.	
9-10 8-9 7-8 6-7 5-6 4-5 3-4 2-3	2	8	Limestone, light- to dark-gray, fine- to coarse-grained, bioclastic, in a finer grained matrix, in part crystalline, with stylolites; at top of ledge, limestone grades laterally into fossiliferous chert.	
0-2	1	2	Covered zone.	
			BOTTOM OF QUARRY (August 27, 1962)	

NOTE: Samples and ledge measurements are from the southwest corner of the quarry.

Tennessee Valley Authority Star Quarry

This quarry, now abandoned, was operated by the Tennessee Valley Authority for a source of concrete aggregate and riprap during the construction of Kentucky Dam. The stone was quarried from the Warsaw Limestone. Figure 10 shows the upper part of the quarry face, which remains exposed above the water level of Kentucky Lake. The quarry site is now within the area of the Land Between the Lakes, a national recreation and conservation development. Foot-by-foot chemical analyses of the exposed face are reported in Table 5. The quarry analysis was previously reported by Stokley and Luttrell (1952) and Stokley and Walker (1953, p. 40-42), but the values for phosphorus and sulfur content are presented here for the first time. The previous lithologic descriptions have been modified to note the presence of a light-colored chalklike matrix in the limestone, which is characteristic of most of the high-calcium zones in the Warsaw in the region.

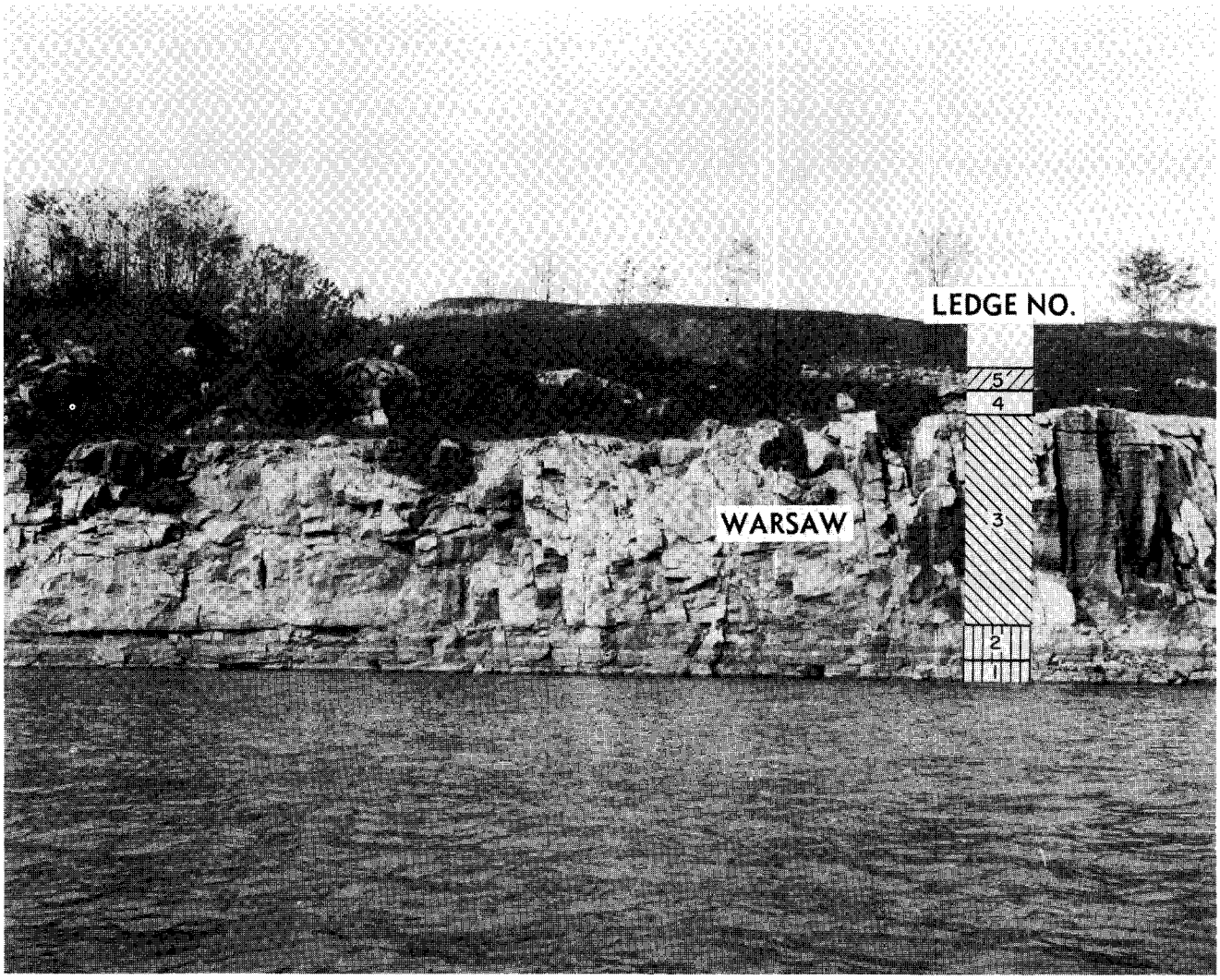
Calcium carbonate content of individual samples is as great as 98.0 percent. Average chemical analyses of the strata are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
43-51	96.3	1.27	1.18	0.13	0.04	.037	.017
9-39	97.1	0.95	1.08	0.11	0.09	.013	.021
0-9	96.7	1.08	1.67	0.09	0.17	.014	.018

Average chemical analysis of the total section sampled is:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
0-39 & 43-51	96.9	1.03	1.21	0.11	0.09	.017	.020

Figure 5 shows the position of the high-calcium limestone within the Warsaw and the general type of lithology encountered in the lower part of the formation by TVA cores taken at the quarry site. These cores recovered bioclastic limestone with a chalklike matrix to a depth of 26 feet below the level of the lowest sample in Table 5.



High-calcium limestone. 8 feet thick. $CaCO_3$ average 96.3%

High-calcium limestone. 30 feet thick. $CaCO_3$ average 97.1%

High-calcium limestone. 9 feet thick. $CaCO_3$ average 96.7%

Figure 10. Photograph of Tennessee Valley Authority Star quarry showing ledge designations and high-calcium limestone strata.

TABLE 5. CHEMICAL ANALYSES OF TENNESSEE VALLEY AUTHORITY STAR QUARRY

County: Lyon **Operator:** Abandoned
Property Owner: Tennessee Valley Authority (Star Quarry)
Location: $7\frac{1}{2}$ miles southeast of Kentucky Dam on east shore of Kentucky Lake, at Mile 30
Carter Coordinate Location: 21-F-16 (Birmingham Point quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
			NO SAMPLES				
96.2	1.14	1.15	0.06	0.00	98.6	.045	.019
95.9	1.45	1.12	0.14	0.00	98.6	.042	.017
96.4	1.18	1.48	0.14	0.07	99.3	.048	.013
96.4	1.12	1.12	0.13	0.15	99.0	.023	.012
96.4	1.27	1.27	0.15	0.08	99.2	.032	.015
96.4	1.37	1.07	0.18	0.03	99.1	.038	.019
96.6	1.48	1.09	0.15	0.00	99.3	.020	.019
96.5	1.17	1.18	0.12	0.00	99.0	.047	.019
			NO SAMPLES				
97.1	1.35	0.81	0.10	0.00	99.4	.065	.019
97.1	1.41	0.80	0.08	0.07	99.5	.067	.020
97.5	0.93	0.63	0.08	0.11	99.3	.015	.018
97.3	0.88	1.09	0.15	0.13	99.6	.022	.023
97.5	0.98	0.76	0.07	0.06	99.4	.018	.016
96.9	1.21	1.14	0.13	0.12	99.5	.025	.022
97.2	0.87	0.80	0.15	0.01	99.0	.007	.021
97.2	1.32	0.56	0.13	0.13	99.3	.007	.020
97.8	1.18	0.58	0.10	0.20	99.9	.000	.024
97.5	1.06	0.70	0.22	0.25	99.7	.016	.025
97.8	1.00	0.58	0.12	0.03	99.5	.000	.019
97.4	0.93	0.54	0.09	0.11	99.1	.015	.020
97.8	1.11	0.64	0.13	0.18	99.9	.000	.023
97.8	1.00	0.55	0.04	0.00	99.4	.000	.018
97.8	1.06	0.51	0.12	0.06	99.6	.011	.017
98.0	0.97	0.79	0.08	0.00	99.8	.004	.019
98.0	1.05	0.89	0.08	0.00	100.0	.000	.024
94.3	0.76	0.89	0.09	0.26	96.3	.006	.016
96.9	0.91	1.67	0.16	0.32	100.0	.008	.026
97.2	0.79	1.40	0.13	0.24	99.8	.005	.021
96.7	0.73	1.40	0.09	0.05	99.0	.010	.018
96.6	0.61	1.58	0.10	0.02	98.9	.014	.025
97.0	0.65	1.28	0.11	0.03	99.1	.000	.018
96.2	0.66	1.28	0.08	0.03	98.3	.012	.015
96.6	0.79	1.72	0.08	0.03	99.2	.008	.020
96.9	0.91	1.57	0.11	0.06	99.6	.006	.021
96.5	0.98	1.74	0.14	0.02	99.4	.010	.018
96.4	0.53	2.21	0.08	0.05	99.3	.004	.021
97.1	0.71	1.91	0.15	0.06	100.0	.006	.023
97.2	1.21	1.37	0.05	0.06	99.9	.021	.045

Sampled by: Eugene M. Luttrell
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: October 9, 1951

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
			TOP OF QUARRY	
		8-15	Residual soil and chert. Probably overlying some weathered limestone.	
		4-10	Limestone, light- to medium-gray, coarse-grained, crinoidal. Irregularly exposed.	
50-51				
49-50				
48-49			Limestone, light-gray, coarse-grained, crystalline and bioclastic, with some white to very light-gray chalklike matrix; jointed and fractured.	
47-48	5	8		
46-47				
45-46				
44-45				
43-44				
39-43	4	4	Zone covered by rock debris. Good samples not available.	
38-39				WARSAW LIMESTONE
37-38				
36-37				
35-36				
34-35				
33-34				
32-33				
31-32				
30-31				
29-30				
28-29				
27-28			Limestone, light-gray, coarse-grained, crystalline and bioclastic, in a white to very light-gray chalklike matrix; little or no chert present; weathers gray to dark gray. Somewhat shattered with some vertical fractures filled with calcite. Solution and weathering evident along some joints.	
26-27				
25-26				
24-25	3	30		
23-24				
22-23				
21-22				
20-21				
19-20				
18-19				
17-18				
16-17				
15-16				
14-15				
13-14				
12-13				
11-12				
10-11				
9-10				

TABLE 5—*Continued*

County: Lyon **Operator:** Abandoned
Property Owner: Tennessee Valley Authority (Star Quarry)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
96.5	1.09	1.39	0.07	0.00	99.1	.038	.021
97.4	0.76	1.21	0.08	0.00	99.5	.013	.017
97.2	0.76	1.14	0.07	0.00	99.2	.004	.017
97.0	1.13	1.43	0.08	0.26	99.9	.013	.017
96.8	1.36	1.56	0.06	0.25	100.0	.018	.018
97.1	1.25	1.22	0.08	0.20	99.9	.006	.016
96.2	1.21	2.30	0.08	0.24	100.0	.000	.018
95.9	1.04	2.54	0.17	0.17	99.8	.016	.021
96.2	1.14	2.25	0.14	0.39	100.0	.018	.020

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
8-9 7-8 6-7 5-6 4-5 3-4	2	6	Limestone, light-gray, medium- to coarse-grained, crystalline and bioclastic, in a white to very light-gray chalklike matrix; some mottled, whitish chert present; small chert concentration at top.	WARSAW LIMESTONE
2-3 1-2 0-1	1	3	Limestone, light-gray to white, coarse-grained, crystalline and bioclastic, in a white to very light-gray chalklike matrix.	
			Elevation of water level on date sampled, 355 feet	

Reed Crushed Stone Company Quarry

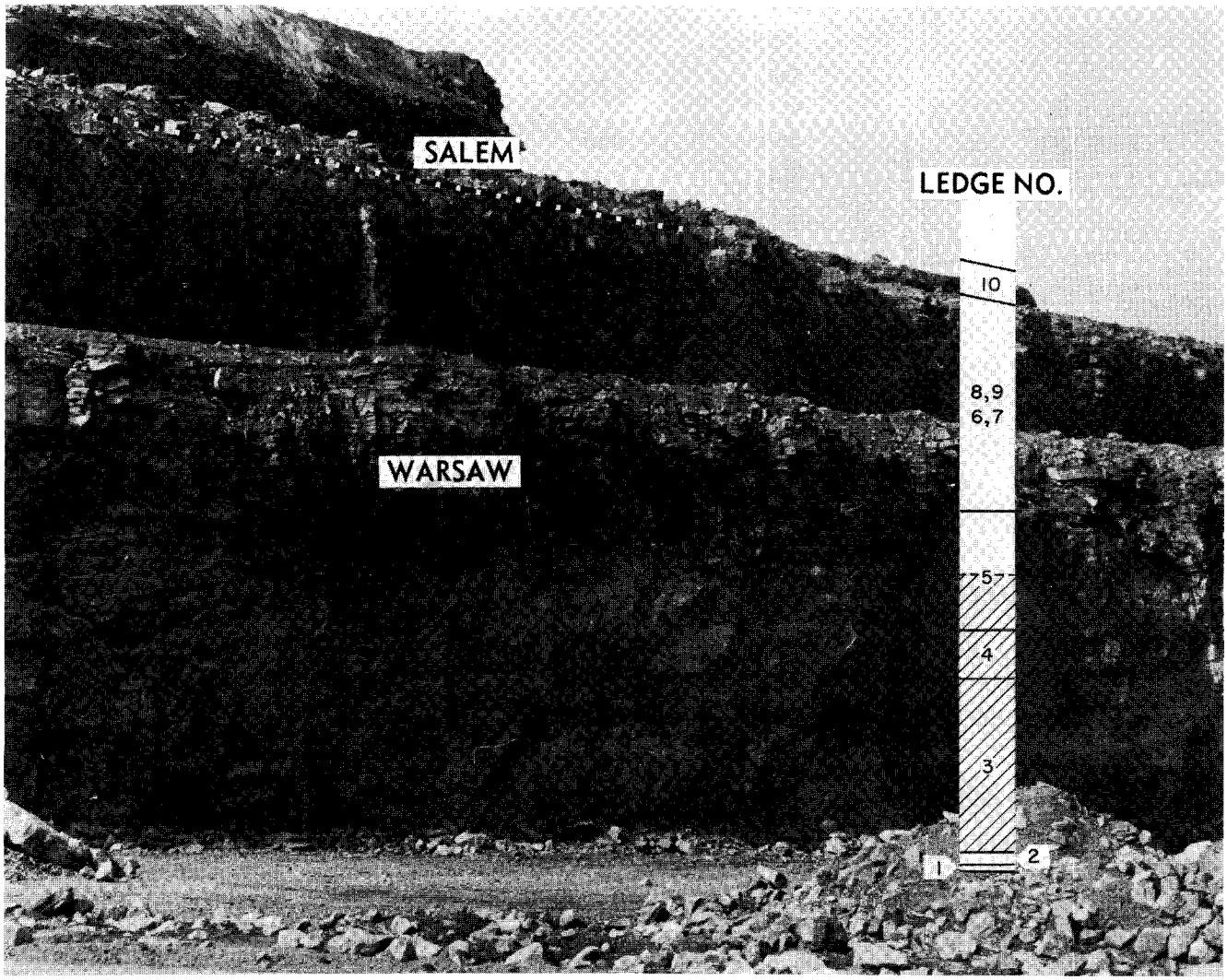
This quarry is an active open-face operation producing crushed limestone for concrete aggregate, roadstone, riprap, railroad ballast, and agricultural limestone. It ranks as one of the 20 largest stone quarries in the United States (Rock Products, October 1968, p. 70). The stone is quarried primarily from the Warsaw and Salem Limestones (Fig. 11), and the basal part of the St. Louis Limestone is exposed in the top of the quarry. Foot-by-foot analyses of the quarry face and analyses of composite samples from a test hole drilled in the quarry floor are reported in Table 6.

Calcium carbonate content of individual samples is as great as 97.95 percent. Average chemical analyses of the two purest zones are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
3-44 (Quarry face)	96.57	1.65	0.67	0.02	0.77	.074	.030
13½-63½ (Test hole)	95.92	0.99	1.18	0.02	0.52	.065	.020

The high sulfur content is believed to be attributable to the amount of residual organic material in the bioclastic limestone. Traces of bitumen were observed in the samples from the quarry face and the test hole. The amount and position of darker fine-grained limestone, chert, and shale partings were observed to vary laterally within individual ledges in the quarry. The high-calcium zones at this site are found in the lower and the upper parts of the formation (Figs. 5 and 6).

The site is located between the valleys of the Tennessee and Cumberland Rivers, and a barge-loading facility is operated by the company on the eastern shore of Kentucky Lake, between Miles 22 and 23. The quarry is served by a siding of the Illinois Central Railroad, and is adjacent to U. S. Highway 62-641 and Ky. Highways 453 and 917. The proposed route of Interstate Highway 24 passes north of the quarry.



High-calcium limestone. 41 feet thick. $CaCO_3$ average 96.57%

Figure 11. Photograph of Reed Crushed Stone Company quarry showing ledge designations and high-calcium limestone strata.

WRC

TABLE 6. CHEMICAL ANALYSES OF REED CRUSHED STONE COMPANY QUARRY AND TEST HOLE

County: Livingston **Operator:** Reed Crushed Stone Company
Property Owner: Reed Crushed Stone Company
Location: 2 miles northeast of Kentucky Dam on U.S. Highways 62-641
Carter Coordinate Location: 20-G-15, 16-G-16 (Calvert City and Grand Rivers quadrangl)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
72.7	6.4	15.28	0.17	3.20	97.8	NOT ANALYZED	
70.4	9.3	14.46	0.15	3.36	97.7		
75.1	6.4	14.52	0.16	1.59	97.8		
69.5	5.9	18.13	0.16	3.96	97.7		
65.9	8.5	18.62	0.15	4.01	97.2		
64.0	8.8	19.78	0.15	4.35	97.1		
72.3	7.2	15.92	0.13	3.17	98.7		
73.2	5.4	16.36	0.13	3.22	98.3		
72.3	5.5	17.90	0.16	3.22	99.1		
72.4	5.0	18.49	0.13	2.86	98.9		
69.4	5.2	20.48	0.23	3.30	98.6		
69.9	5.5	19.29	0.18	3.50	98.4		
69.9	5.5	18.33	0.18	3.98	97.9		
73.6	4.8	15.90	0.16	3.39	97.9		
91.6	2.1	4.59	0.08	1.35	99.7		
87.9	2.00	9.26	0.18	0.25	99.6		
92.2	1.78	5.40	0.13	0.29	99.8		
94.0	1.90	3.14	0.08	0.38	99.5		
94.0	1.85	3.53	0.08	0.35	99.8		
96.5	1.83	1.19	0.08	0.22	99.9		
96.0	1.97	1.51	0.03	0.37	99.9		
93.4	2.5	3.28	0.08	0.41	99.7		
92.1	2.6	4.57	0.08	0.61	100.0		
85.8	2.8	7.53	0.18	1.54	97.9		
85.9	3.0	7.77	0.18	1.74	98.6		
90.7	2.7	4.66	0.08	0.62	98.8		
92.6	2.8	3.42	0.13	0.48	99.4		
91.1	2.5	4.75	0.03	0.24	99.6		
94.5	1.97	2.50	0.08	0.16	99.2		
84.4	1.86	12.00	0.08	0.81	99.2		
83.3	2.9	10.84	0.11	1.22	98.4		
82.9	3.1	11.52	0.11	1.30	98.9		
85.1	3.4	9.09	0.08	1.40	99.1		
85.2	2.8	9.86	0.08	0.90	98.8		
91.5	2.5	5.16	0.06	0.58	99.8		
92.0	3.0	4.51	0.08	0.43	100.0		
88.4	2.6	8.10	0.11	0.73	99.9		
83.4	3.4	11.50	0.08	0.88	99.3		
78.1	6.2	12.50	0.18	1.96	98.9		
82.0	5.7	8.46	0.08	1.12	98.4		
94.6	2.2	1.94	0.03	0.46	99.2		
93.7	2.1	2.79	0.07	0.46	99.1		

Sampled by: Preston McGrain, Garland R. Dever, Jr., and Edmund Nosow
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: 1954 and May 18, 1967

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY Approximately 90 to 100 feet of Salem and St. Louis limestones exposed above Ledge 10.	
113-114 112-113 111-112 110-111 109-110 108-109 107-108 106-107 105-106 104-105 103-104 102-103 101-102 100-101	10	14	Limestone, medium- to dark-gray, microgranular to fine-grained, argillaceous, in part shaly; contains a small amount of chert; a few local dark-gray shale partings and thin beds.	SALEM LIMESTONE
99-100 98-99 97-98 96-97 95-96 94-95 93-94 92-93 91-92 90-91 89-90 88-89 87-88 86-87 85-86 84-85 83-84 82-83 81-82 80-81 79-80 78-79 77-78 76-77 75-76 74-75 73-74 72-73	9 8	7 22	Limestone, light- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, stylolitic. Limestone, medium- to dark-gray, microgranular to fine-grained; with some lenses and beds of limestone, light- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline; contains dark-bluish-gray chert; local dark-gray shale partings and thin beds.	WARSAW LIMESTONE

TABLE 6—*Continued*

County: Livingston **Operator:** Reed Crushed Stone Company
Property Owner: Reed Crushed Stone Company

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
91.0	2.7	4.52	0.06	0.76	99.0	NOT ANALYZED	
87.4	3.6	5.97	0.08	0.90	98.0		
93.6	1.84	3.24	0.10	0.55	99.3		
95.1	1.85	1.63	0.10	0.00	98.7		
83.5	5.2	8.02	0.09	1.23	98.1	NOT ANALYZED	
86.0	4.9	7.02	0.08	1.22	99.2		
92.9	3.1	3.28	0.08	0.40	99.8		
95.9	1.84	1.88	0.04	0.22	99.9		
96.1	0.80	2.22	0.07	0.35	99.5		
66.5	2.9	26.45	0.47	1.76	98.1		
72.4	3.7	20.12	0.27	1.97	98.5		
90.1	1.22	7.35	0.09	0.06	98.8		
91.0	1.21	6.50	0.08	0.32	99.1	NOT ANALYZED	
91.1	1.86	6.27	0.12	0.02	99.4		
67.02	13.55	15.05	0.35	3.52	99.49		
74.42	13.14	9.51	0.05	2.38	99.50		
93.55	4.31	1.24	0.02	0.86	99.98	.056	.016
93.27	3.93	1.41	0.02	1.27	99.90	.120	.023
94.81	2.56	1.36	0.02	1.06	99.81	.064	.018
94.81	2.59	1.28	0.02	0.91	99.61	.070	.026
95.09	2.56	1.29	0.02	0.65	99.61	.056	.018
95.23	2.45	1.42	0.02	0.88	100.--	.062	.022
95.37	2.66	0.96	0.02	0.42	99.43	.072	.021
95.16	2.81	0.83	0.02	0.56	99.38	.096	.019
92.09	4.93	1.62	0.02	0.78	99.44	.108	.031
92.30	4.48	1.33	0.02	0.66	98.79	.110	.027
93.41	3.69	1.55	0.02	0.55	99.22	.096	.028
96.69	1.72	0.29	0.02	0.39	99.11	.040	.016
96.97	1.84	0.45	0.02	0.42	99.70	.056	.019
97.04	1.66	0.42	0.02	0.42	99.56	.092	.021
96.97	1.15	0.18	0.02	0.71	99.03	.086	.017
96.90	1.36	0.80	0.02	0.84	99.92	.062	.020
96.62	1.51	0.56	0.02	0.76	99.47	.060	.022
97.04	1.44	0.31	0.02	0.66	99.47	.054	.018
97.18	1.36	0.62	0.02	0.86	100.04	.054	.017
96.34	1.80	0.94	0.02	0.86	99.96	.068	.021
96.07	1.78	0.90	0.02	0.98	99.75	.080	.045
96.34	1.60	0.94	0.02	0.88	99.78	.062	.015
94.81	2.48	0.84	0.02	0.94	99.09	.076	.041
94.53	2.59	0.09	0.02	0.89	98.12	.082	.079
95.09	1.84	0.46	0.02	0.89	98.30	.122	.055
95.23	0.32	0.79	0.02	1.01	97.37	.104	.065
94.81	2.48	1.03	0.02	0.78	99.12	.086	.079
96.62	1.47	0.46	0.02	0.85	99.42	.064	.050

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
71 -72				
69½-71 68 -69½ 67 -68 66 -67 65 -66 64 -65 63 -64 62 -63	7	9	Limestone, light- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline; with some limestone, medium- to dark-gray, micro-granular to very fine-grained; contains a small amount of chert; a few local dark-gray shale partings.	
61 -62 60 -61 59 -60 58 -59 57 -58 56 -57 55 -56	6	7	Limestone, medium- to dark-gray, microgranular to fine-grained, argillaceous, in part dolomitic; with some limestone, light- to medium-gray, fine- to coarse-grained, bioclastic and crystalline; contains some dark-bluish-gray chert and calcite-filled vugs.	
54- 55 53 -54 52 -53 51 -52 50 -51 49 -50 48 -49 47 -48 46 -47 45 -46 44 -45 43 -44 42 -43 41 -42 40 -41 39 -40 38 -39 37 -38 36 -37 35 -36	5	20	Limestone, light- and light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a white to light-gray chalklike matrix; upper part of ledge is darker colored and contains less coarser grained fragments; stylolitic; a few local dark-gray shale partings.	WARSAW LIMESTONE
34 -35 33 -34 32 -33 31 -32 30 -31 29 -30 28 -29 27 -28	4	8	Limestone, olive- to medium-gray, very fine- and fine- to medium-grained, crystalline and bioclastic; thin shale parting at 34 feet.	

TABLE 6—*Continued*

County: Livingston **Operator:** Reed Crushed Stone Company
Property Owner: Reed Crushed Stone Company

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
97.11	1.15	0.31	0.02	0.53	99.12	.042	.054
96.97	1.60	0.72	0.02	0.90	100.21	.048	.059
96.68	1.66	0.05	0.02	1.15	99.56	.068	.025
97.32	1.68	0.60	0.02	1.04	100.66	.060	.022
97.53	1.33	0.61	0.02	0.88	100.37	.048	.023
97.24	1.38	0.58	0.02	0.78	100.--	.050	.018
96.40	1.51	0.24	0.02	1.15	99.32	.124	.026
96.54	1.65	0.87	0.02	0.88	99.96	.062	.024
96.54	1.62	1.10	0.02	0.80	100.08	.068	.027
96.40	1.71	1.09	0.05	0.61	99.86	.106	.036
97.39	1.24	0.65	0.02	0.51	99.81	.046	.017
97.25	1.50	0.72	0.02	0.51	100.--	.050	.019
97.11	2.02	0.50	0.02	0.58	100.23	.096	.036
96.97	1.98	0.68	0.02	0.48	100.13	.062	.021
97.53	1.45	0.52	0.02	0.43	99.95	.042	.015
96.40	2.00	1.02	0.02	0.56	100.--	.112	.026
96.68	1.51	0.99	0.02	0.64	99.84	.146	.024
96.97	1.25	0.45	0.05	0.83	99.55	.102	.019
97.81	1.15	0.42	0.02	0.66	100.06	.072	.017
97.95	1.38	0.30	0.02	0.94	100.59	.066	.019
94.57	2.18	1.70	0.05	1.31	99.81	.206	.037
96.68	1.94	1.04	0.02	0.80	100.48	.042	.020
96.19	2.04	1.06	0.02	0.80	100.11	.044	.013
95.84	2.55	1.36	0.02	0.80	100.57	.050	.023
			NO SAMPLES				
70.05	3.21	23.83	0.07	2.41	99.57	NOT ANALYZED	

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
26-27 25-26 24-25 23-24 22-23 21-22 20-21 19-20 18-19 17-18 16-17 15-16 14-15 13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5	3	24	Limestone, light-olive- to medium- to light-gray, fine- to very coarse-grained, bioclastic and crystalline, in a white to light-gray chalklike matrix; trace of glauconite and bitumen; trace of pyrite from 21 to 22 feet; thin, vertical calcite veinlets; stylolitic; a few local dark-gray shale partings.	WARSAW LIMESTONE
5721 3-4				
1-3	2	2	Covered zone at base of face.	
5720 0-1	1	1	Limestone, dark-gray, microgranular to fine-grained, argillaceous; contains some dark-bluish-gray chert. (Sample from quarry floor at base of face.)	

BOTTOM OF QUARRY (May 18, 1967)

NOTE: Samples and ledge measurements are from the face at the west end of the quarry. Data for the interval from 57 to 114 feet are based on analyses of samples taken by Edmund Nosow in 1954.

TABLE 6—*Continued*

County: Livingston **Operator:** Reed Crushed Stone Company
Property Owner: Reed Crushed Stone Company

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
SAMPLES NOT ANALYZED							
95.37	1.27	1.59	0.02 (Composite sample)	0.56	98.81	.078	.018
96.48	0.71	0.78	0.02 (Composite sample)	0.48	98.47	.052	.022
SAMPLES NOT ANALYZED							
SAMPLES NOT ANALYZED							
SAMPLES NOT ANALYZED							

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
NOTE: The following data are based on sample chips recovered from a test hole drilled in the floor near the south end of the quarry. Representative composite samples for the intervals $13\frac{1}{2}$ to $38\frac{1}{2}$ feet and $38\frac{1}{2}$ to $63\frac{1}{2}$ feet were analyzed. There is an unsampled interval of approximately ten feet between the bottom of the quarry face, as described previously, and the top of the test hole, based on differences in elevation and calculated dip.				
			TOP OF TEST HOLE	
0 - $13\frac{1}{2}$	1A	$13\frac{1}{2}$	Limestone, light-brownish- to light- to medium-gray, fine- to coarse-grained, bioclastic and crystalline, in part in a white to light-gray chalklike and microcrystalline matrix; and limestone, dark- to brownish-gray, microgranular to fine-grained, argillaceous, silty; trace of chert and bitumen.	
5774A $13\frac{1}{2}$- $38\frac{1}{2}$	2A	25	Limestone, light-brownish- to light- to medium-gray, fine- to coarse-grained, bioclastic and crystalline in a white to medium-light-gray chalklike and microcrystalline matrix; trace of bitumen.	
5774B $38\frac{1}{2}$- $63\frac{1}{2}$	3A	25	Limestone, light-brownish- to light- to medium-light-gray, fine- to coarse-grained, bioclastic and crystalline, in a white to light-gray chalklike and microcrystalline matrix; trace of bitumen; slight trace of pyrite.	WARSAW LIMESTONE
$63\frac{1}{2}$- $73\frac{1}{2}$	4A	10	Limestone, medium- to dark-gray, microgranular to very fine-grained, argillaceous, crystalline; and limestone, light-brownish- to medium-gray, fine- to coarse-grained, crystalline and bioclastic, in part in a white to medium-light-gray chalklike and microcrystalline matrix; dark-brownish-gray shale; brownish- and bluish-gray chert common.	
$73\frac{1}{2}$- $83\frac{1}{2}$	5A	10	Limestone, light-brownish- to dark-brownish-gray, microgranular to very fine-grained, crystalline, in part argillaceous; with some limestone, light-brownish- to medium-light-gray, fine- to coarse-grained, crystalline and bioclastic, in a medium-light-gray to white microcrystalline and chalklike matrix; dark-brownish-gray shale; brownish- and bluish-gray chert common. (Transition zone.)	
$83\frac{1}{2}$-$128\frac{1}{2}$	6A	45	Limestone, brownish- to dark-brownish-gray, microgranular to very fine-grained, crystalline, in part argillaceous; dark-brownish-gray shale; brownish- and bluish-gray chert common.	FORT PAYNE FORMATION
			BOTTOM OF TEST HOLE	

B. F. Goodrich Chemical Company Core No. 3

This core hole, drilled to determine the feasibility of excavating an underground liquid-storage cavern in the Fort Payne Formation, is located at the company's plant on the south bank of the Tennessee River at Mile 18 near Calvert City.

Situated in a fault block (Amos and Finch, 1968), the core hole encountered a deposit of high-calcium limestone in the Warsaw formation at a potentially minable depth. The lower 140 feet of the Warsaw Limestone was recovered, and a 72½-foot section containing two zones of pure bioclastic limestone was sampled for this study. Foot-by-foot analyses are reported in Table 7.

Calcium carbonate content of individual samples is as great as 97.59 percent. Average chemical analyses of the purest zones are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
120-154	96.83	1.09	0.90	0.04	0.41	.071	.035
160-184	95.84	1.33	1.65	0.03	0.31	.053	.024

The high sulfur content is believed to be attributable to the amount of residual organic material in the bioclastic limestone. However, no traces of bitumen were observed in the core, such as were found in samples from the nearby Reed quarry and test hole (Table 6). The average magnesium carbonate content of the interval from 116 to 186½ feet is 1.24 percent.

High-calcium zones in this core occur in the lower part of the Warsaw formation (Fig. 5).

A rail spur connects the Goodrich plant site with the Illinois Central Railroad. In addition, the area is served by Ky. Highways 95, 282, and 1523. U. S. Highway 62 and the proposed route of Interstate Highway 24 are located immediately south of Calvert City. Benton, the seat of Marshall County, is 13 miles south of Calvert City.

WBF

TABLE 7. CHEMICAL ANALYSES OF B. F. GOODRICH CHEMICAL COMPANY CORE

County: Marshall **Operator:** B. F. Goodrich Chemical Company
Property Owner: B. F. Goodrich Chemical Company (Core No. 3) Elevation: 325 feet
Location: At the company's plant on the Tennessee River, northeast of Calvert City
Carter Coordinate Location: 450' FSL and 2550' FWL, sec. 6-G-15 (Calvert City quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
70.73	1.42	21.76	0.35	3.33	97.59	.340	.042
74.24	1.57	18.85	0.30	2.84	97.80	.242	.039
90.65	1.56	4.11	0.02	1.01	97.35	.048	.019
93.66	1.41	2.49	0.02	0.98	98.54	.064	.022
95.08	1.35	1.19	0.02	1.07	98.71	.076	.024
95.42	1.45	1.17	0.02	1.23	99.29	.086	.040
96.59	1.03	1.40	0.02	0.40	99.44	.056	.021
96.92	0.94	0.57	0.05	0.36	98.84	.078	.029
97.59	0.98	0.54	0.05	0.23	99.39	.066	.022
97.01	1.06	1.18	0.05	0.30	99.60	.068	.027
96.96	0.85	0.95	0.05	0.34	99.15	.068	.031
96.79	1.03	0.74	0.05	0.30	98.91	.064	.027
96.92	1.03	0.72	0.05	0.35	99.07	.074	.031
96.88	1.15	1.15	0.02	0.29	99.49	.062	.025
96.67	0.92	0.75	0.02	0.57	98.93	.084	.030
96.68	0.91	0.82	0.02	0.42	98.85	.072	.030
96.84	1.01	0.89	0.02	0.39	99.15	.078	.036
97.01	0.95	0.77	0.02	0.42	99.17	.054	.030
96.92	1.01	1.01	0.05	0.27	99.26	.066	.034
96.59	0.95	1.05	0.05	0.27	98.91	.070	.030
96.92	0.92	0.90	0.02	0.24	99.--	.060	.030
97.10	1.09	1.05	0.05	0.41	99.70	.066	.028
97.10	1.24	1.12	0.02	0.40	99.88	.054	.025
96.88	1.22	0.44	0.05	0.28	98.87	.060	.027
96.62	1.19	0.63	0.05	0.45	98.94	.092	.035
97.21	1.19	0.48	0.05	0.49	99.42	.070	.030
97.14	1.15	1.02	0.05	0.45	99.81	.072	.041
97.28	1.13	1.02	0.06	0.36	99.85	.064	.059
97.01	1.27	1.11	0.04	0.43	99.86	.100	.047
97.15	1.18	0.76	0.05	0.26	99.40	.070	.063
96.75	1.18	1.09	0.05	0.30	99.37	.076	.064
96.88	1.18	0.84	0.05	0.24	99.19	.074	.056
96.88	1.30	0.81	0.05	0.37	98.60	.076	.044
96.95	1.22	0.70	0.05	0.38	99.30	.078	.047
96.75	1.07	0.80	0.05	0.15	98.82	.064	.027
96.95	1.12	0.86	0.02	0.30	99.25	.076	.031
97.01	1.07	1.23	0.05	0.29	99.65	.082	.027
96.75	1.03	1.06	0.05	0.89	99.78	.074	.031
94.95	1.21	1.16	0.05	1.06	98.43	.072	.032
94.86	1.21	0.21	0.04	0.83	97.15	.066	.027
95.29	1.34	0.10	0.04	0.85	97.62	.050	.026

Sampled by: Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 22, 1967

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF SAMPLED INTERVAL IN CORE	
116-117 117-118	1	2	Limestone, dark-brownish-gray, microcrystalline to very finely crystalline; laminae of dark-gray silty shale; dark-bluish-gray chert.	
118-119 119-120 120-121	2	3	Limestone, light-olive- to medium-dark-gray, microgranular to very coarse-grained, bioclastic and crystalline.	
121-122 122-123 123-124 124-125 125-126 126-127 127-128 128-129 129-130 130-131	3	10	Limestone, light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light-brownish- to light-gray microcrystalline matrix.	WARSAW LIMESTONE
131-132 132-133 133-134 134-135 135-136 136-137 137-138 138-139 139-140 140-141 141-142 142-143 143-144 144-145 145-146 146-147 147-148 148-149 149-150 150-151 151-152 152-153 153-154	4	23	Limestone, light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light- to light-brownish-gray chalklike and microcrystalline matrix; less matrix material in the interval from 145 to 154 feet; stylolites.	
154-155 155-156 156-157	5	3	Limestone, light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a brownish-gray microcrystalline matrix.	

TABLE 7—*Continued*

County: Marshall **Operator:** B. F. Goodrich Chemical Company
Property Owner: B. F. Goodrich Chemical Company (Core No. 3)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
89.46	1.63	6.81	0.13	1.33	99.36	.074	.031
94.61	1.21	1.12	0.02	0.95	97.91	.018	.022
94.18	1.36	0.68	0.04	0.95	97.21	.062	.024
95.83	1.27	1.11	0.02	0.23	98.46	.054	.015
95.11	1.54	1.74	0.02	0.30	98.71	.082	.028
95.77	1.51	1.48	0.02	0.31	99.08	.024	.021
95.90	1.39	1.17	0.03	0.13	98.62	.036	.021
95.96	1.19	0.66	0.03	0.30	98.14	.028	.022
95.77	1.63	0.75	0.03	0.48	98.66	.060	.030
96.23	1.53	0.78	0.03	0.39	98.96	.042	.022
95.77	1.45	0.66	0.03	0.36	98.27	.044	.020
95.57	1.21	2.15	0.02	0.21	99.16	.030	.020
96.88	1.12	1.27	0.05	0.28	99.60	.034	.022
96.10	1.16	1.17	0.02	0.50	98.95	.092	.035
96.23	1.34	1.55	0.02	0.34	99.48	.052	.024
94.39	1.53	2.99	0.02	0.40	99.33	.050	.027
95.96	1.41	1.58	0.05	0.37	99.37	.048	.029
95.96	1.39	1.63	0.02	0.49	99.49	.064	.032
96.36	1.22	1.37	0.02	0.35	99.32	.052	.023
96.42	1.33	1.58	0.06	0.28	99.67	.044	.023
96.29	1.31	1.86	0.05	0.26	99.77	.052	.024
95.24	1.31	2.60	0.05	0.27	99.47	.056	.026
95.83	1.24	2.14	0.05	0.27	99.53	.058	.026
95.18	1.21	3.04	0.05	0.27	99.75	.064	.022
95.31	1.22	2.59	0.05	0.21	99.38	.086	.017
96.36	1.21	2.12	0.05	0.23	99.97	.060	.030
95.70	1.31	1.64	0.03	0.22	98.90	.064	.018
93.93	1.63	2.95	0.03	0.34	98.88	.034	.014
94.39	1.78	2.49	0.02	0.26	98.94	.036	.027
52.77	4.19	38.85	0.55	1.89	99.25	.180	.038
46.61	3.36	47.13	0.52	1.54	99.16	.086	.022
SAMPLES NOT ANALYZED							

SAMPLES NOT ANALYZED

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
157 -158 158 -159 159 -160 160 -161 161 -162	6	5	Limestone, brownish-gray, microcrystalline to coarsely crystalline, dense; vertical calcite vein in interval from 158 to 162 feet; traces of purple fluorite in limestone from 157 to 158 feet, and in calcite vein.	
162 -163 163 -164 164 -165 165 -166 166 -167 167 -168 168 -169 169 -170 170 -171 171 -172 172 -173 173 -174 174 -175 175 -176 176 -177 177 -178 178 -179 179 -180 180 -181 181 -182 182 -183 183 -184 184 -185 185 -186½	7	24½	Limestone, light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a brownish- to light-gray microcrystalline and chalklike matrix.	WARSAW LIMESTONE
186½-187½ 187½-188½ 188½-190½	8	4	Limestone, dark-brownish-gray, microcrystalline to very finely crystalline, argillaceous, siliceous; laminae of dark-gray shale; dark-bluish- to brownish-gray chert.	
190½-200	9	9½	Limestone, light-olive- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light-brownish- to light-gray microcrystalline and chalklike matrix.	
			TOP OF FORT PAYNE FORMATION IN CORE	

Shell Oil Company No. 1 Stanley Herrin Core

The Herrin core hole was drilled during Shell Oil Company's preliminary geological investigation of the Tolu dome, a broad anticlinal structure. The investigation resulted in the drilling of an 8,821-foot wildcat well, the No. 1 M. D. Davis, in the center of the structure in northern Crittenden County (McCann, 1956). The Herrin core was taken approximately 1.3 miles southeast of the site of the Davis well.

The entire Warsaw formation, 584 feet thick, was recovered in the core. Zones of bioclastic limestone with a microcrystalline and chalklike matrix occurred in the intervals from 456 to 480, 487 to 529, and 682 to 748 feet. A complete section of the core was not available to the writers. The samples studied consisted of chips that had been taken from the core at relatively even-spaced intervals and at the approximate positions of changes in lithology. A small sample was taken for analysis from each available core chip in the intervals from 442 to 536 and 682 to 748 feet. The chip from 529 feet was too small to be sampled. The analyses of these samples are reported in Table 8.

Calcium carbonate content of individual samples is as great as 98.18 percent. Average chemical analyses of the purest zones are:

Intervals (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)	S(%)	P(%)
442-480	95.59	1.61	1.11	0.02	0.90	.145	.025
487-529	96.92	0.77	0.81	0.00	0.76	.056	.023
713-748	97.49	0.67	1.53	0.00	0.07	.030	.017

The high sulfur content in the upper zones is believed to be attributable to the amount of residual organic material in the bioclastic limestone. The low percentage of iron in the samples indicates that pyrite, which is present in visible trace amounts, is not the principal source of the sulfur. The average magnesium carbonate content of the interval from 682 to 748 feet is 0.58 percent. Figures 5 and 6 show the position of the high-calcium zones within the Warsaw formation. The analysis of the sample from 536 feet suggests that zones of high-calcium limestone may also be present in the interval from 536 to 632 feet.

As noted in a previous section on the Tolu dome area, bioclastic limestone with a chalklike matrix has also been found in a core on the north side of the dome, suggesting that deposits of high-calcium limestone may be present in the center of the structure at shallower, potentially minable depths (Fig. 7).

The location of the Herrin core hole is about two miles south of the Ohio River and about two miles southeast of Tolu on Ky. Highway 387. The site of the M. D. Davis well, in the center of the dome, is approximately 4,000 feet south of the river between Miles 885 and 886.

WISD

TABLE 8. CHEMICAL ANALYSES OF SHELL OIL COMPANY NO. 1 STANLEY HERRIN CORE

County: Crittenden **Operator:** Shell Oil Company
Property Owner: Stanley Herrin (Core No. 1) Elevation: 352 feet
Location: 2 miles southeast of Tolu on Ky. Highway 387 (Cave In Rock quadrangle)
Carter Coordinate Location: 1500' FSL and 2200' FWL, sec. 23-L-16

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
SAMPLES NOT ANALYZED							
96.10	1.66	0.92	0.04	0.56	99.28	.148	.023
95.18	1.83	0.72	0.05	1.39	99.17	.480	.052
96.56	1.54	1.04	0.05	0.35	99.54	.098	.018
95.57	1.90	0.87	0.00	1.11	99.44	.096	.017
94.59	1.78	1.92	0.00	1.03	99.32	.126	.032
95.97	1.07	0.94	0.00	0.79	98.77	.042	.015
89.41	5.97	1.51	0.00	1.43	98.32	.204	.037
96.82	0.82	0.66	0.00	0.90	99.20	.034	.018
97.08	0.76	0.33	0.00	0.87	99.04	.036	.024
96.49	0.85	0.51	0.00	1.02	98.87	.062	.023
97.08	0.68	0.49	0.00	0.89	99.14	.064	.019
95.98	0.77	1.92	0.00	0.58	99.25	.102	.024
96.80	0.60	1.69	0.00	0.54	99.63	.036	.030
98.18	0.91	0.11	0.00	0.53	99.73	.060	.026
SAMPLE NOT ANALYZED							

Sampled by: Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 23, 1967

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
			TOP OF WARSAW LIMESTONE IN CORE	
206-430	1	224	Limestone, light- to dark-brownish-gray, microgranular to very coarse-grained, bioclastic and crystalline, in part argillaceous; with interbeds of limestone, dark-brownish-gray, microgranular to very fine-grained, argillaceous to siliceous; some bluish-gray chert; traces of pyrite.	
430-456 *445 *448 *453	2	26	Limestone, medium- to light-brownish-gray, microgranular to very coarse-grained, bioclastic and crystalline; in part argillaceous from 430 to 442 feet; traces of pyrite at 437 and 442 feet.	
456-480 *456 *462 *468	3	24	Limestone, light-brownish- to medium-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light- to medium-gray, microcrystalline to chalklike matrix; trace of pyrite at 462 feet.	WARSAW LIMESTONE
480-487 *480	4	7	Limestone, dark- to dark-brownish-gray, microgranular to coarse-grained, crystalline and bioclastic, slightly argillaceous; trace of pyrite.	
487-529 *487 *492 *499 *504 *510 *516 *524	5	42	Limestone, brownish- to light-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light- to medium-light-gray, microcrystalline to chalklike matrix; traces of pyrite at 504 and 524 feet.	
529-536	6	7	Limestone, medium-light- to light-brownish-gray, microgranular; in part very fine- to medium-grained, crystalline and bioclastic; trace of pyrite.	

* Only available samples for analysis.

TABLE 8—*Continued*

County: Crittenden **Operator:** Shell Oil Company
Property Owner: Stanley Herrin (Core No. 1)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
98.11	0.68	0.22	0.00	0.66	99.67	.054	.033
SAMPLES NOT ANALYZED							
95.01	0.60	3.99	0.00	0.36	99.96	.036	.033
94.74	0.60	4.08	0.00	0.58	100.--	.062	.022
93.64	0.57	4.71	0.05	0.64	99.61	.066	.033
91.71	0.32	6.48	0.00	0.60	99.11	.030	.044
97.15	0.71	2.04	0.00	0.10	100.--	.032	.013
97.49	0.54	1.54	0.00	0.08	99.65	.032	.017
97.84	0.76	1.02	0.00	0.04	99.66	.026	.022
SAMPLES NOT ANALYZED							

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
536-632 **536	7	96	Limestone, medium- to light-brownish-gray, microgranular to coarse-grained, predominantly very fine-grained, crystalline and bioclastic; bluish-gray chert at 603 and 622 feet; traces of pyrite at 550, 557, 585, and 618 feet.	
632-682	8	50	Limestone, medium-light- to light-brownish-gray, microgranular to coarse-grained, crystalline and bioclastic; chert at 667 feet; traces of pyrite at 652, 669, and 682 feet.	WARSAW LIMESTONE
682-748 *682 *695 *702 *710 *713 *723 *745	9	66	Limestone, light-brownish- to medium-light-gray, fine- to very coarse-grained, bioclastic and crystalline, in a light-gray to white, microcrystalline to chalklike matrix; a small amount of bluish-gray chert; trace of pyrite at 713 feet.	
748-790	10	42	Limestone, brownish- to dark-brownish-gray, microgranular to fine-grained, crystalline and bioclastic, slightly argillaceous; gray chert; traces of pyrite at 757 and 782 feet.	

TOP OF FORT PAYNE FORMATION IN CORE

* Only available samples for analysis.
** Only top sample from ledge analyzed.

Salem Limestone

The Salem is mainly composed of bioclastic and microgranular limestones containing abundant fossil fragments, with some interbedded oolitic limestone. Very thin interbeds and laminae of dark-gray argillaceous limestone are common, and dolomitic beds occur locally. The lower part of the formation is predominantly dark-gray, very fine-grained, argillaceous limestone, in part shaly, with interbeds of fine- to coarse-grained bioclastic limestone. Chert is present locally in the form of nodules and stringers.

Foot-by-foot chemical analyses of quarry sections have included the basal part of the Salem at two locations: a 14-foot interval at the Reed quarry in Livingston County (Table 6), and a 2-foot interval at the Canton quarry in Trigg County (Table 3).

St. Louis Limestone

The St. Louis Limestone throughout most of the region covered in this report consists of an upper member and a lower member. Strata included in the lower part of the Ste. Genevieve Limestone on the new geologic quadrangle maps in Christian and southeastern Trigg Counties were assigned to the St. Louis Limestone and designated as the upper member on the maps covering the remainder of Trigg County and throughout Caldwell, Crittenden, Livingston, and Lyon Counties. Ulrich and Klemic (1966) present a correlation diagram showing the relationship between the Ste. Genevieve Limestone and the St. Louis Limestone as mapped in the two areas. The general relationship between the upper member and the Ste. Genevieve is also shown in Figure 12 .

The lower member is composed of microgranular to very fine-grained limestone containing varying amounts of coarser grains, very fine-grained dolomitic limestone, some dolomite and bioclastic limestone, and a few beds of oolitic limestone. The limestone is in part argillaceous, and thin interbeds of shaly limestone are common. Chert is generally sparse but is locally abundant, particularly in the upper part. A zone of abundant ball and nodular chert is commonly present just below the contact with the overlying upper member, and in Christian and southeastern Trigg Counties it lies just below the contact with the equivalent basal part of the Ste. Genevieve Limestone. Throughout most of the region, gypsum occurs in the member in thin layers, vugs, nodules, and geodes.

The upper member is generally lighter in color than the lower member, and the limestones are predominantly microgranular to very fine grained, with scattered coarser grains and fossil fragments. There is a variable amount of oolitic limestone, and some bioclastic, dolomitic, and shaly beds. Chert occurs throughout the member and is locally abundant, in zones up to 40 feet thick. Gypsum is present locally in thin layers, vugs, and nodules, but is less common than in the lower member.

Two samples of limestone from the upper member have been analyzed. The samples were taken from an abandoned building-stone excavation in a bluff on the Ohio River in northwestern Crittenden County about 4¼ miles northeast of Carrsville and 2,500 feet southeast of Barnett Lake. The samples are from the basal part of the upper member of the St. Louis as mapped by Amos (1965). The exposure is in the basal part of the Fredonia Member of the Ste. Genevieve as mapped by Weller and Sutton (1951).

The limestone of Sample 1, from the lower part of the 12-foot exposure, is medium gray, very fine grained to microgranular, dolomitic, and dense. Sample 2, from the upper part, is medium gray, fine to medium grained, oolitic, and dense, with scattered crystalline calcite. The analyses are tabulated below.

Sample no.	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	Total (%)
2	94.72	0.64	2.41	0.05	1.51	99.33
1	76.40	15.18	6.16	0.10	1.92	99.76

Ste. Genevieve Limestone

The Ste. Genevieve Limestone has been analyzed on a foot-by-foot basis at 12 locations in the area of study (Fig. 1). A total of 15 deposits of high-calcium limestone, ranging in thickness from 10 to 36 feet, have been found at 9 of the locations. Three of the deposits are from 30 to 36 feet thick; 7 are from 20 to 28 feet thick; 5 are from 10 to 14 feet thick. The general chemical characteristics of the high-calcium stone in this formation are summarized below. The range in values was obtained by averaging the foot-by-foot analyses of each deposit of pure limestone.

	30-36 feet	*20-28 feet*	*10-14 feet*
$CaCO_3$ (%)	96.09 -98.2	95.47 -96.74	95.6 -97.9
$MgCO_3$ (%)	0.72 - 1.78	1.23 - 2.56	0.76 - 3.04
SiO_2 (%)	0.69 - 0.82	0.24 - 1.25	0.35 - 1.48
Fe_2O_3 (%)	0.04 - 0.17	0.03 - 0.24	0.03 - 0.18
Al_2O_3 (%)	0 08 - 0.44	0.13 - 0.73	0.10 - 0.90
S (%)	0.001- 0.051	0.019- 0.061	0.018- 0.055
P (%)	0.008- 0.012	0.004- 0.021	0.008- 0.012

The chemical analyses, lithologic descriptions, and geographic information for the 12 locations are presented in Tables 9-20 and their accompanying texts. Analyses of two representative samples from two other locations are reported in the section on the Ste. Genevieve in Crittenden and Livingston Counties.

The Fredonia Limestone, Rosiclare Sandstone, and Levias Limestone, the three traditional members of the Ste. Genevieve, are useful stratigraphic guides and are recognizable in much of the northern and central part of the region. The Rosiclare interval is not as easily identified in the southern part of the region, where it consists of shale with interbedded limestone; zones of similar lithology are present at other stratigraphic positions within the formation.

The high-calcium zones in the Ste. Genevieve formation occur predominantly in oolitic limestone. The lithology of this stone ranges from an almost pure oolite to an oolitic limestone containing varying amounts of calcarenite and bioclastic material.

Some of the high-calcium zones extend into the limestones above and below the oolitic ledges. These pure limestones have various lithologies: bioclastic and calcarenitic, vaughanitic, microgranular, and crystalline. However, only minor high-calcium zones (less than 10 feet thick) have been found in these nonoolitic limestones where they are not immediately overlying or underlying an oolitic ledge.

The occurrence of operable deposits of high-calcium limestone in the Ste. Genevieve is therefore primarily related to the distribution of the oolitic limestone in the formation. Figure 12 shows the positions within the Ste. Genevieve of the oolitic limestones and the high-calcium zones found in the quarries and cores described in this report. Included in the figure are generalized sections adapted from the stratigraphic columns of several of the new geologic quadrangle maps from this region. These sections show the general occurrence of oolitic limestone within the formation as found over the relatively large area encompassed by a quadrangle.

The figure also shows that to date (1968) all of the high-calcium zones have been found in essentially the same part of the formation. The position of these zones outlines an interval within the Fredonia Member that can be considered the most favorable for further exploration. Across the region there are local variations in the interval that can be recognized from the available data. For example, the highest occurring zone of high-calcium limestone in western Livingston County has been found lower in the Fredonia Member than the highest zone in Caldwell and Crittenden Counties.

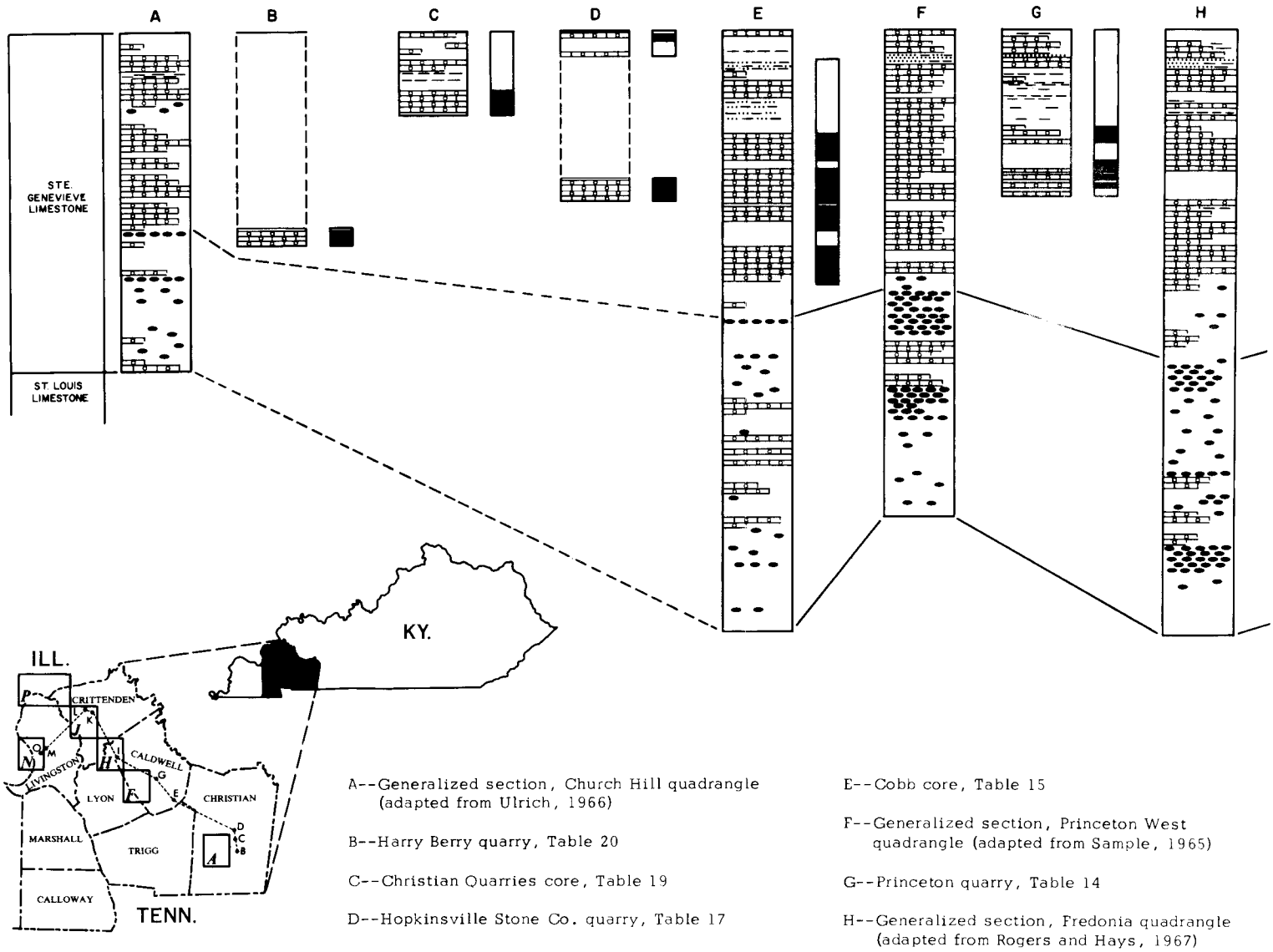
The principal areas of occurrence of the Ste. Genevieve Limestone in the region are controlled by the region's position on the flank of the Eastern Interior basin and by the complex faulting in the western Kentucky fluorspar district. Along the southwest edge of the Kentucky portion of the basin, a wide belt of Ste. Genevieve outcrop extends from western Caldwell County through southern Christian County. To the north and west this belt is broken and offset by faulting, and discontinuous areas of outcrop occur at a number of locations in Crittenden and Livingston Counties. The locations of the areas of outcrop and the occurrence of high-calcium limestone in the region are summarized in three sections that follow. For detailed information on the geologic and geographic aspects of these areas, the reader is referred to the new geologic quadrangle maps and topographic maps (Fig. 2) and the *Geologic Map of the Western Kentucky Fluorspar District* (Weller and Sutton, 1951). Part of the strata included in the lower part of the Ste. Genevieve Limestone (Fredonia Member) by Weller and Sutton (1951) has been assigned to the upper member of the St. Louis Limestone on some of the new geologic quadrangle maps (*see* discussion in the previous section on the St. Louis Limestone).

Crittenden and Livingston Counties

The greater part of the western Kentucky fluorspar district is in Crittenden and Livingston Counties, and the location of surface and near-surface occurrences of the Ste. Genevieve Limestone has been controlled by the complex faulting in the district. The general trend of the main faults in the two counties is northeast-southwest. It should be noted that prospective deposits of pure limestone in the fluorspar district that are located within or immediately adjacent to fault zones may have been locally altered by mineralization. An example of such alteration is discussed in the text accompanying the analysis of Ste. Genevieve limestone recovered from an exploratory core hole in Crittenden County (Table 9).

The Ste. Genevieve Limestone is found at the surface in the following six areas.

1. Two locations along the Commodore fault system southwest of Fords Ferry: in the vicinity of Dunn Spring Church, and south of Underdown Cemetery (Cave in Rock and Repton quadrangles).



A--Generalized section, Church Hill quadrangle (adapted from Ulrich, 1966)

B--Harry Berry quarry, Table 20

C--Christian Quarries core, Table 19

D--Hopkinsville Stone Co. quarry, Table 17

E--Cobb core, Table 15

F--Generalized section, Princeton West quadrangle (adapted from Sample, 1965)

G--Princeton quarry, Table 14

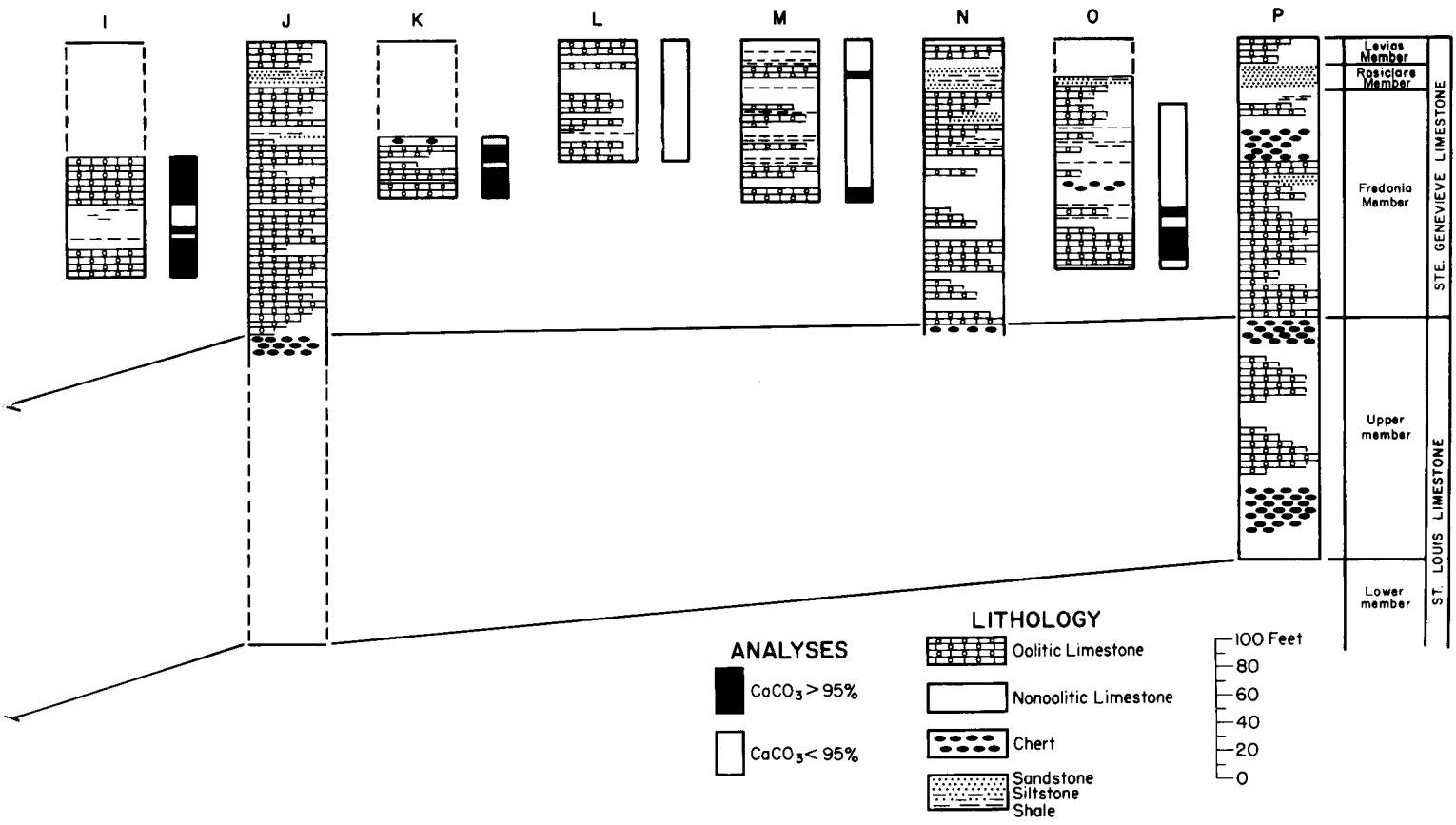
H--Generalized section, Fredonia quadrangle (adapted from Rogers and Hays, 1967)

Figure 12. Distribution of high-calcium zones and oolitic limestone

2. A relatively large area along the Crittenden-Livingston County line, from south of Lola northward to the Ohio River (Lola, Rosiclare, and Salem quadrangles). At the northeastern border of this area, two samples were taken from an abandoned building-stone excavation in a bluff approximately 2,500 feet southeast of Barnett Lake. The excavation is in the basal part of the Fredonia Member as mapped by Weller and Sutton (1951), and in the basal part of the upper member of the St. Louis Limestone as mapped by Amos (1965). Analyses of these two samples are reported in the preceding section on the St. Louis Limestone.

3. Northern Livingston County west of Carrsville. The upper part of the Fredonia Member is at the surface in a bluff on the Ohio River opposite Shetlerville, Ill. (Shetlerville quadrangle). A quarry at Shetlerville, formerly operated by the P. R. Brown Stone Company, contains a 38½-foot interval in the Fredonia Member that averages more than 98 percent calcium carbonate (Lamar, 1959, Table 5). The equivalent interval occurs at a minable depth at this location in Kentucky, and should be found both on the surface and at minable depths in the area along the Crittenden-Livingston County line outlined previously.

4. A long and relatively narrow, fault-bounded belt extending from northeast of Crittenden Spring



I--Fredonia Valley Quarries quarry, Table 13

J--Generalized section, Salem quadrangle (adapted from Trace, 1962b)

K--Crittenden Spring quarry, Table 10

L--Exploratory core, Table 9

M--Barrett quarry, Table 12

N--Generalized section, Smithland quadrangle (adapted from Amos, 1967)

O--Three Rivers Rock Co. quarry, Table 11

P--Generalized section, Shetlerville and Rosiclare quadrangles (adapted from Amos, 1965)

in the Ste. Genevieve Limestone. Datum is top of Ste. Genevieve.

to southwest of Salem. There are two similar but shorter outcrop belts to the southeast. One extends from the vicinity of Shelbys Store southwestward toward the Cumberland River, and the other from the vicinity of View southwestward toward the Crittenden-Livingston County line. (Burna, Cave in Rock, Dycusburg, Fredonia, Lola, Marion, Repton, and Salem quadrangles.) Two zones of high-calcium limestone, 22 and 13 feet thick, have been found in an inactive quarry near Crittenden Spring (Table 10).

5. Several fault blocks located on the south side of the Cumberland River: in the drainage of Sugar Creek and Hickory Creek, on the north side of Dunn Creek, and at the north end of Vick Hill (Burna quadrangle). Samples of the Ste. Genevieve Limestone were taken for analysis from two locations within the fault block in the Sugar Creek drainage. Sample 1 is from a roadcut on Ky. Highway 70, located approximately 3,000 feet east of Sugar Creek, and Sample 2 is from an exposure beside the Leeper Cemetery. The latter exposure is about 70 feet higher in elevation than the roadcut. The limestone at both locations is very light to light gray, very fine to coarse grained, bioclastic. Replacement of many of the coarser grains by crystalline calcite gives the rock a speckled appearance. Analyses of the two samples follow.

Sample no.	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	R_2O_3 (%)	Total (%)
2	97.18	0.59	0.10	0.10	0.84		98.81
1	96.08	1.51	1.43			0.38	99.41

6. North side of the Cumberland River, northward and eastward from Silver Mine to the vicinity of Bissell Creek (Smithland and Burna quadrangles). Foot-by-foot analyses of two quarries located in this area show a 24-foot zone of high-calcium limestone in the Three Rivers Stone Company quarry (Table 11) and a 10-foot zone averaging 97.9 percent calcium carbonate in the inactive Barrett quarry (Table 12). The highest occurring zone of high-calcium limestone at these two sites is at a lower position within the Fredonia Member of the Ste. Genevieve than the highest zone found in the Crittenden Spring quarry and at three locations in Caldwell County (Fig. 12).

Caldwell and Lyon Counties

The Ste. Genevieve outcrops in a wide belt across western Caldwell County and part of eastern Lyon County. Bounded on the north by the Tabb fault system in central Caldwell County, the belt of outcrop extends in a general southeasterly direction across the two counties and continues into Trigg and Christian Counties. Its continuity is broken and offset locally by several east-west-trending faults. To the east and northeast, the Ste. Genevieve dips beneath the Renault Limestone except where the outcrop is locally bounded by faulting.

There are 2 zones of high-calcium limestone, 30 and 36 feet thick, in the Fredonia Valley quarry in western Caldwell County (Table 13), and 4 zones, 22, 24, 28, and 31 feet thick, in the Cobb core that was recovered in the southern part of the county (Table 15). Several relatively thin zones of pure limestone have been found in the Cedar Bluff Stone Company quarry, located southeast of Princeton (Table 14). The unexposed section of the Ste. Genevieve beneath the floor of this quarry is equivalent to the interval containing the lower high-calcium zones in the Cobb core and the Fredonia Valley quarry (Fig. 12), and may contain operable thicknesses of pure limestone.

Christian and Trigg Counties

The wide belt of Ste. Genevieve outcrop continues southeastward from Caldwell County into eastern Trigg County and across the southern half of Christian County. In northeastern Trigg County it is locally offset by faulting. The belt is bounded along its northeastern and northern border by the Renault Limestone, and on the west and south by the St. Louis Limestone. The Ste. Genevieve has also been found in a down-faulted block north of Canton, on the east shore of Lake Barkley between Miles 60 and 61 (Fox and Seeland, 1964).

As noted previously, strata included in the lower part of the Ste. Genevieve Limestone on the new geologic maps covering Christian and southeastern Trigg Counties are mapped as the upper member of the St. Louis Limestone in the area north and west of the Caledonia and Johnson Hollow quadrangles.

In Christian County there is a 21-foot zone of high-calcium limestone in the Christian Quarries quarry (Table 19), a 19-foot zone exposed in the bottom of the Hopkinsville Stone Company quarry (Table 17), and a 14-foot zone exposed in the bottom of the Harry Berry quarry (Table 20). These three zones occur at different positions within the formation, as shown in Figure 12. Within the Ste. Genevieve in the region of this report, the 21-foot zone in the Christian Quarries quarry is the highest occurrence of a relatively thick zone of high-calcium limestone. The two other zones are within the same general interval as the high-calcium zones found at other locations in the region. Thin zones of pure stone have been found in the upper part of the formation at the Hopkinsville Stone Company quarry (Table 17) and the abandoned Cook quarry (Table 18), and in Trigg County at the Cerulean quarry (Table 16). Ulrich and Klemic (1966) report the occurrence of chert-free, oolitic limestone in units 20 to 30 feet thick along Sinking Fork in the vicinity of Julien, in western Christian County.

Exploratory Core from the Fluorspar District

Samples described here are from a company core taken near the Commodore fault system in the vicinity of Sheridan. The interval from the lower part of the Renault Limestone through the Ste. Genevieve Limestone was sampled for analysis. Because of displacement by faulting, only the upper 93 feet of the Ste. Genevieve was present in the core. Foot-by-foot analyses are reported in Table 9.

With the exception of the intervals of vein calcite, the maximum thickness shown for any zone of high-calcium limestone in the core is 2 feet. There is a relatively pure zone of oolitic limestone in the interval from 824 to 839 feet which is at the same stratigraphic position within the Ste. Genevieve formation as the zone of oolitic and bioclastic high-calcium limestone at the Crittenden Spring quarry (*see* Fig. 12 and Table 10). The quarry is located less than two miles east of the test hole. The average chemical analyses of these zones are tabulated below for comparison.

	Samples (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)
Core	824-839	93.07	0.81	4.43	0.06	0.40
Quarry	27-40	96.97	0.99	0.57	0.04	0.90

These analyses show an increase in the silica content in the oolitic limestone in the core relative to the zone at the quarry, with a corresponding decrease in the carbonate content. The chemical data, presence of secondary quartz and calcite in the oolitic zones in the core, and faulting indicate that this interval—which may have been a primary high-calcium zone—has been altered by secondary mineralization. Hardin (1955, p. 24) estimated that 5 to 20 percent silica had been added to most limestones within 10 feet of the veins in the Babb fault system, Crittenden and Livingston Counties. A large quantity of quartz in the silicified wall rock was reported at the Big Four fault system, Crittenden County (Hardin and Trace, 1959, p. 715), and crystalline quartz was found in fissures in wall rocks of veins at the Levias-Keystone and Dike-Eaton areas, also in Crittenden County (Trace, 1962a, p. E-15).

Throughout the western Kentucky fluorspar district, which includes parts of Caldwell, Crittenden, and Livingston Counties, the deposits of fluorite and associated minerals (sphalerite, galena, calcite, quartz, marcasite, pyrite, and barite) are principally localized along faults, with some deposits occurring by bedding-replacement. The oolitic zones within the Ste. Genevieve and Renault formations have been found to be readily mineralized by replacement.

Studies to date indicate that the principal source of high-calcium stone in the fluorspar district will be oolitic zones in the Ste. Genevieve Limestone. Consequently, prospective deposits of purer limestone located within or immediately adjacent to a fault zone may be locally mineralized. Tables 10, 11, and 12 report analyses of the Ste. Genevieve from three quarries within the mineralized district. These quarries, which are not immediately adjacent to fault zones, have ledges of high-calcium oolitic limestone.

Limestones used in the manufacture of portland cement generally must have a magnesium carbonate content of less than 3 percent. The mineralized oolitic zone in the core from 824 to 839 feet meets this specification, and suggests that the high-calcium limestones which have been locally mineralized through the introduction of silica would be usable as a cement raw material.

WEX

TABLE 9. CHEMICAL ANALYSES OF PART OF AN EXPLORATORY CORE

County: Crittenden **Operator:** Private Company
Property Owner:
Location: Along the Commodore fault system, northeast of Sheridan
Carter Coordinate Location: 20-K-16 (Salem quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
94.45	1.69	1.21	0.15	1.21	98.71	NOT ANALYZED	
95.17	2.07	1.53	0.07	0.80	99.64		
96.10	1.81	1.58	0.10	0.42	100.--		
90.94	6.43	1.38	0.15	0.49	99.39		
85.47	11.52	1.34	0.25	0.58	99.16		
90.48	6.76	1.60	0.15	0.41	99.40		
93.02	3.66	2.43	0.10	0.34	99.55		
94.17	3.28	1.62	0.10	0.45	99.62		
86.01	5.56	5.09	0.15	2.38	99.19		
38.35	15.21	25.78	1.30	12.50	93.14		
77.52	5.22	11.48	0.57	2.58	97.37		
95.19	1.16	1.90	0.16	0.93	99.34		
92.81	0.86	4.14	0.17	0.40	98.38		
89.55	0.60	6.40	0.13	0.50	97.18		
89.40	0.60	7.46	0.15	0.66	98.27		
86.72	0.56	9.28	0.16	0.51	97.23		
83.16	0.54	13.67	0.22	0.52	98.11		
86.39	0.68	12.03	0.17	0.58	99.85		
84.79	0.88	11.66	0.17	0.65	98.15		
86.86	0.83	10.05	0.15	0.50	98.39		
89.84	0.85	7.46	0.15	0.50	98.80		
91.62	0.82	5.24	0.17	0.47	98.32		
98.75	0.71	0.03	0.15	0.28	99.92		
98.25	0.50	0.34	0.15	0.23	99.47		
98.45	0.39	0.07	0.15	0.29	99.35		
98.87	0.59	0.23	0.05	0.06	99.80		
98.64	0.54	0.39	0.05	0.04	99.66		
94.36	0.88	3.38	0.07	0.19	98.88		
93.73	1.07	3.87	0.10	0.68	99.45		
93.02	0.94	3.81	0.07	1.61	99.38		
94.40	0.91	3.10	0.07	1.20	99.68		
94.86	0.86	2.--	0.07	1.12	98.84		
96.87	0.53	1.60	0.05	0.95	99.95		
98.25	0.62	0.18	0.05	0.24	99.34		
98.25	0.60	0.09	0.13	0.20	99.27		
97.48	0.68	0.18	0.13	0.22	98.69		
46.51	25.79	17.60	0.57	5.26	95.73		
59.60	25.87	8.46	0.57	3.02	97.52		
97.79	1.21	0.53	0.07	0.64	98.24		
96.87	0.83	0.54	0.10	0.59	98.93		
93.63	1.42	2.39	0.10	1.01	98.55		

Sampled by: Preston McGrain
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: September 28, 1966

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF SAMPLED INTERVAL IN CORE	
736-737 737-738 738-739 739-740 740-741 741-742 742-743 743-744 744-745	1	9	Limestone, gray, crystalline, dense, argillaceous at base; calcite veinlet at 740 feet; scattered small stylolites.	RENAULT LIMESTONE
745-746	2	1	Shale, gray, calcareous.	
				?
746-747 747-748 748-749 749-750 750-751 751-752 752-753 753-754 754-755 755-756 756-757 757-758	3	12	Limestone, light-gray, oolitic, sparsely crystalline.	STE. GENEVIEVE LIMESTONE
758-759 759-760 760-761 761-762 762-763	4	5	Predominantly white calcite.	
763-764 764-765 765-766 766-767	5	4	Limestone, light-gray, oolitic, sparsely crystalline.	
767-768 768-769 769-770 770-771 771-772	6	5	Predominantly white calcite.	
772-773 773-774 774-775 775-776 776-777				

TABLE 9—*Continued*

County: Crittenden **Operator:** Private Company
Property Owner:

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
94.56	0.71	3.17	0.05	0.72	99.21	NOT ANALYZED	
78.69	1.81	16.20	0.15	1.25	98.10		
81.47	5.70	6.61	0.20	3.13	97.11		
88.40	3.36	4.21	0.12	1.80	97.89		
83.31	5.58	5.32	0.22	2.71	97.14		
93.02	0.85	2.87	0.10	0.66	97.50		
93.79	0.86	2.62	0.05	0.66	97.98		
66.53	23.71	5.25	0.30	2.08	97.87		
70.84	20.63	5.56	0.30	1.95	99.28		
75.61	15.80	5.42	0.25	1.96	99.04		
76.54	17.05	3.66	0.22	1.61	99.08		
87.31	5.19	5.03	0.12	1.37	99.02		
94.28	1.83	2.78	0.05	1.01	99.90		
88.55	1.--	6.94	0.05	2.66	99.20		
92.86	1.56	3.81	0.07	0.93	99.23		
87.93	1.24	6.81	0.10	1.25	98.43		
90.40	0.95	5.02	0.05	1.54	97.96		
91.17	1.06	4.91	0.05	1.68	98.87		
95.78	0.67	2.10	0.05	1.06	99.66		
95.94	0.74	1.95	0.05	0.55	99.18		
93.01	0.62	4.31	0.05	0.62	98.56		
87.16	0.98	9.83	0.08	0.78	98.75		
95.79	0.53	1.59	0.10	0.52	98.43		
93.86	0.59	1.30	0.10	0.43	96.18		
85.47	1.35	9.51	0.10	1.46	97.89		
75.31	4.19	15.19	0.17	2.38	97.24		
96.55	0.24	1.30	0.10	0.32	98.51		
89.71	0.62	1.65	0.08	1.09	93.15		
95.17	1.25	1.97	0.10	0.36	98.85		
97.17	0.88	0.80	0.08	0.26	99.19		
89.17	2.12	6.37	0.10	1.09	98.85		
86.39	1.68	7.74	0.08	1.50	97.39		
89.94	2.52	3.42	0.10	1.25	97.23		
95.48	0.83	1.48	0.10	0.62	98.51		
92.55	0.82	3.95	0.05	0.99	97.52		
89.87	0.67	6.72	0.10	0.49	97.85		
92.55	0.91	3.68	0.10	0.70	97.94		
95.79	1.18	1.12	0.12	0.87	99.08		
91.33	0.93	2.22	0.12	1.01	95.60		
92.25	2.27	2.39	0.12	1.02	98.05		
94.42	1.83	1.01	0.05	1.07	98.38		
94.42	1.95	2.43	0.10	0.91	99.81		
78.49	14.79	3.36	0.20	1.36	98.20		
73.32	16.95	5.06	0.28	2.07	97.68		
71.95	17.70	6.86	0.35	2.09	98.95		
78.18	13.50	4.92	0.30	1.65	98.55		
89.01	2.96	5.17	0.10	1.41	98.65		

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION Lithology	Formation
777-778				
778-779				
779-780				
780-781				
781-782				
782-783				
783-784				
784-785				
785-786				
786-787				
787-788				
788-789				
789-790			Limestone, light-gray, crystalline and oolitic; some dolomite and dolomitic limestone; scattered calcite veinlets; some secondary quartz. (The top of the Rosiclare Sandstone Member may be represented by the higher silica content at 772 feet. The base cannot be determined precisely.)	
790-791				
791-792	7	40		
792-793				
793-794				
794-795				
795-796				
796-797				
797-798				
798-799				
799-800				
800-801				
801-802				
802-803				
803-804				
804-805				
805-806				
806-807				
807-808				
808-809				
809-810				
810-811				
811-812				
812-813				
813-814				
814-815				
815-816				
816-817				
817-818				
818-819				
819-820				
820-821				
821-822				
822-823				
823-824				

STE. GENEVIEVE LIMESTONE

TABLE 9—*Continued*

County: Crittenden **Operator:** Private Company
Property Owner:

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
94.20	1.21	2.42	0.10	0.36	98.29	NOT ANALYZED	
94.57	0.85	2.97	0.08	0.28	98.75		
93.59	0.97	3.62	0.05	0.53	98.76		
93.21	0.76	4.30	0.08	0.41	98.76		
93.20	0.79	4.80	0.05	0.44	99.28		
93.96	0.79	4.17	0.05	0.53	99.50		
94.57	0.54	2.53	0.05	0.44	98.13		
93.96	0.76	3.67	0.05	0.31	98.85		
94.88	0.80	2.60	0.05	0.40	98.73		
94.27	0.79	3.49	0.05	0.33	98.93		
92.75	0.77	4.84	0.08	0.38	98.81		
91.23	0.83	6.56	0.10	0.40	99.12		
85.31	0.71	11.39	0.05	0.42	97.88		
93.51	0.77	4.33	0.05	0.52	99.18		
92.90	0.77	4.86	0.05	0.31	98.89		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
824-825 825-826 826-827 827-828 828-829 829-830 830-831 831-832 832-833 833-834 834-835 835-836 836-837 837-838 838-839	8	27	Limestone, light-gray, oolitic; crystalline in middle part; in part dolomitic; some secondary quartz; scattered stylolites; thin shale parting at 817 feet.	STE. GENEVIEVE LIMESTONE
839			At 839 feet, the lower part of the Fredonia Member is cut out by a fault.	

BOTTOM OF SAMPLED INTERVAL

Alexander Stone Company's Crittenden Spring Quarry

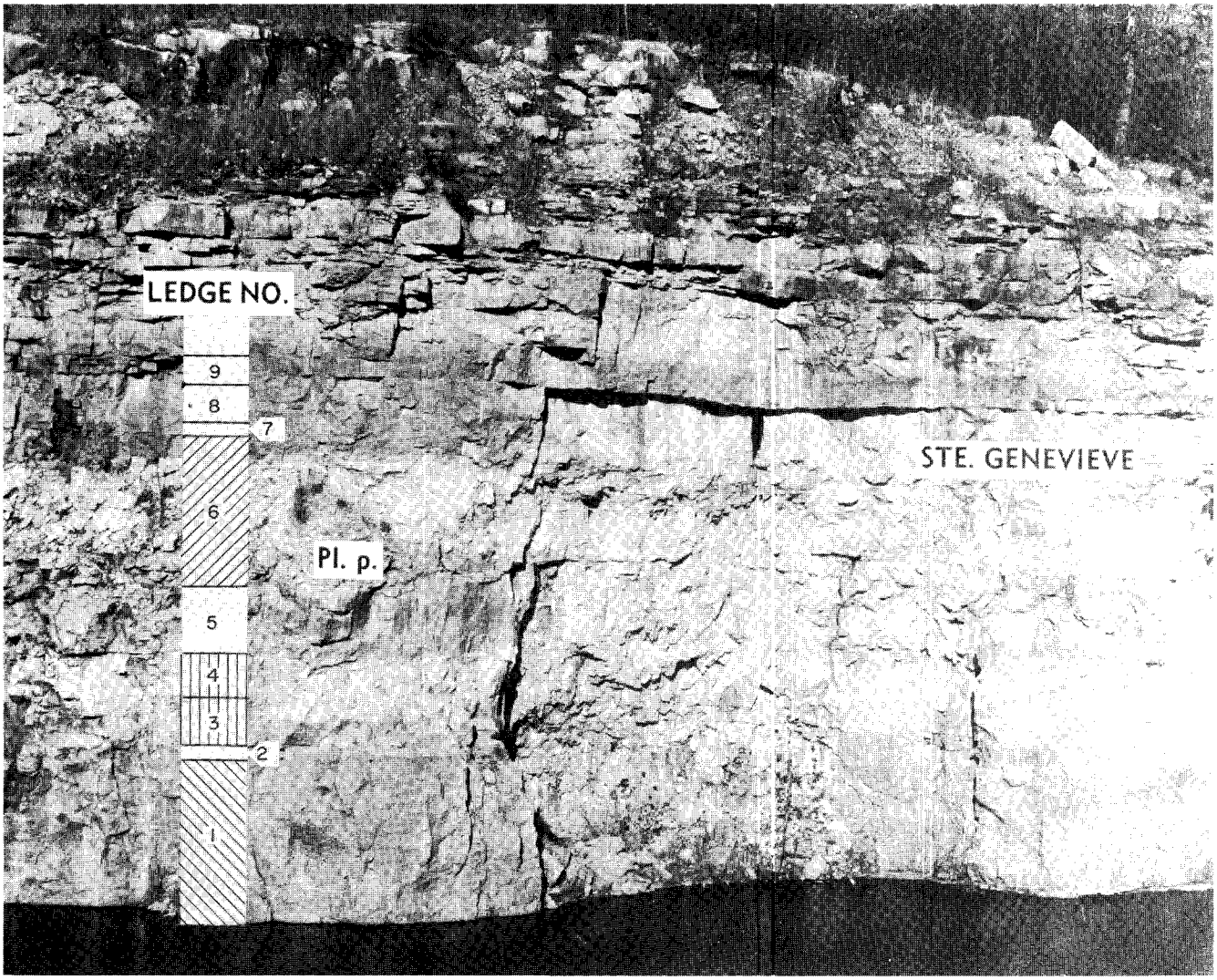
This open-face quarry, now inactive, was formerly operated by the Crittenden Limestone Company and produced crushed limestone for concrete aggregate, roadstone, and agricultural limestone. The stone was quarried from the Fredonia Member of the Ste. Genevieve Limestone. The lower part of the quarry was filled with water at the time of sampling; the portion of the face exposed above water is shown in Figure 13. Foot-by-foot chemical analyses of the exposed face are reported in Table 10. Stokley (1949, p. 42) reported partial chemical analyses by the Kentucky Department of Highways for stone from this quarry.

Calcium carbonate content of individual samples is as great as 98.66 percent. Average chemical analyses of the purest zones are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
27-40	96.97	0.99	0.57	0.04	0.90	.018	.008
13-22	97.35	1.16	0.49	0.06	0.67	.015	.013
0-12	95.67	2.05	0.87	0.05	0.48	.029	.028
0-22	95.47	2.53	0.75	0.06	0.60	.028	.021

The average total carbonate content for the interval from 0 to 40 feet is 97.96 percent. The position of the quarry's high-calcium zones in the Ste. Genevieve Limestone is shown in Figure 12.

The quarry is adjacent to Ky. Highway 1668, which leads toward the Ohio River 7½ (airline) miles northwest of the site. Marion, the seat of Crittenden County, is located 5½ miles to the southeast and is served by the Illinois Central Railroad.



High-calcium limestone. 13 feet thick. $CaCO_3$ average 96.97%

High-calcium limestone. 9 feet thick. $CaCO_3$ average 97.35%

High-calcium limestone. 12 feet thick. $CaCO_3$ average 95.67%

Abbreviation: Pl. p.—*Platycrinites penicillus*

Figure 13. Photograph of Alexander Stone Company's Crittenden Spring quarry showing ledge designations and high-calcium limestone strata.

WJGS

TABLE 10. CHEMICAL ANALYSES OF ALEXANDER STONE COMPANY'S CRITTENDEN SPRING QUARRY

County: Crittenden **Operator:** Inactive
Property Owner: Alexander Stone Company, Inc.
Location: 2 miles west of Marion on U.S. Hwy. 60, then $2\frac{1}{2}$ miles northwest on Ky. Hwy. 1668
Carter Coordinate Location: 17-K-17 (Salem quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
93.80	2.01	2.42	0.05	1.13	99.41	.032	.012
90.91	2.49	5.04	0.07	1.05	99.56	.028	.011
62.37	16.03	17.03	0.20	2.89	98.52	.040	.016
62.01	16.41	17.09	0.25	3.27	99.03	.042	.016
75.12	14.91	7.58	0.10	2.28	99.99	.032	.017
76.53	12.83	8.08	0.10	2.34	99.88	.020	.019
98.52	0.54	0.12	0.05	0.65	99.88	.010	.005
98.09	0.47	0.64	0.03	0.83	100.06	.016	.004
97.95	0.62	0.90	0.03	0.71	100.21	.012	.005
97.95	0.68	0.43	0.03	0.58	99.67	.016	.006
97.53	1.04	0.72	0.05	0.53	99.87	.016	.006
96.40	1.30	1.07	0.03	0.68	99.48	.016	.010
96.54	1.09	0.35	0.03	0.87	98.88	.016	.008
96.54	0.60	0.29	0.03	0.70	98.16	.016	.008
97.04	1.01	0.51	0.03	0.88	99.47	.018	.007
93.73	2.72	0.57	0.03	1.40	98.45	.030	.010
95.91	1.13	0.99	0.05	1.36	99.44	.030	.008
97.11	0.92	0.33	0.03	1.36	99.75	.020	.016
97.39	0.82	0.50	0.05	1.21	99.97	.020	.011
88.23	8.89	1.04	0.05	1.36	99.57	.010	.006
91.19	6.50	0.72	0.03	0.80	99.24	.010	.010
86.11	11.61	1.16	0.08	1.02	99.98	.004	.009
89.43	8.71	0.65	0.13	0.84	99.76	.010	.010
94.36	3.66	0.60	0.10	0.77	99.49	.010	.009
98.66	0.70	0.24	0.03	0.33	99.96	.010	.006
98.50	0.54	0.34	0.05	0.57	100.00	.008	.011
97.95	0.79	0.50	0.07	0.57	99.88	.010	.007
97.53	1.50	0.48	0.07	0.61	100.19	.012	.009
97.67	1.06	0.43	0.08	0.58	99.82	.012	.006
97.18	0.57	0.56	0.05	0.84	99.20	.020	.014
94.78	2.80	0.41	0.10	1.07	99.16	.012	.014
96.68	1.42	0.59	0.05	0.72	99.46	.032	.033
97.25	1.06	0.89	0.05	0.75	100.--	.020	.016
76.11	20.67	1.58	0.13	1.45	99.94	.130	.013

Sampled by: Preston McGrain and Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: March 16, 1967

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY Approximately 30 to 35 feet of Ste. Genevieve Limestone is exposed above Ledge 9. The uppermost ledges are oolitic and bioclastic.	
45-46 44-45	9	2	Limestone, dark-gray, finely crystalline, with some tabular chert.	
43-44 42-43 41-42	8	3	Limestone, medium-gray, fine-grained, dolomitic, with some tabular chert.	
40-41	7	1	Limestone, dark-gray, coarsely crystalline, dolomitic.	
39-40 38-39 37-38 36-37 35-36 34-35 33-34 32-33 31-32 30-31 29-30 28-29 27-28	6	13	Limestone, medium- to brownish-gray, dense, massive, with a few stylolites; weathers light gray. Lower part is predominantly a heterogeneous interlensing of microgranular and fine- to medium-grained bioclastic limestones; upper part is predominantly fine- to medium-grained oolitic limestone.	STE. GENEVIEVE LIMESTONE
26-27 25-26 24-25 23-24 22-23	5	5	Limestone, gray, predominantly microgranular, with fewer oolites and bioclastic fragments than in Ledge 3; dense, massive.	
21-22 20-21 19-20 18-19	4	4	Limestone, white to light-gray, fine- to coarse-grained, oolitic, dense, massive.	
17-18 16-17 15-16 14-15 13-14	3	5	Limestone, light-gray, fine- to coarse-grained, oolitic to bioclastic, in a microgranular matrix; dense, massive.	
12-13	2	1	Limestone, medium- to dark-gray, very fine- to fine-grained, dolomitic.	

TABLE 10—*Continued*

County: Crittenden **Operator:** Inactive
Property Owner: Alexander Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
96.54	2.03	0.54	0.05	0.81	99.97	.028	.021
96.97	1.16	0.70	0.05	0.93	99.81	.030	.049
96.27	1.41	0.55	0.05	0.29	98.57	.022	.027
95.90	1.81	0.52	0.05	0.19	98.47	.034	.026
96.05	1.54	0.51	0.05	0.31	98.46	.038	.029
95.53	2.48	0.51	0.05	0.24	98.81	.046	.020
95.90	1.77	1.21	0.05	0.47	99.40	.024	.023
95.53	2.09	1.19	0.05	0.29	99.15	.032	.029
96.71	1.01	0.93	0.03	0.39	99.07	.024	.032
95.16	2.00	1.47	0.05	0.43	99.11	.036	.029
94.72	2.95	1.24	0.05	0.71	99.67	.016	.031
92.81	4.43	1.12	0.05	0.74	99.15	.026	.026

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5 3-4 2-3 1-2 0-1	1	12	Limestone, medium- to light-gray, fine- to medium-grained, oolitic to crystalline, dense, massive.	STE. GENEVIEVE LIMESTONE
			Elevation of water level in quarry on date sampled, approximately 460 feet	

Three Rivers Rock Company Quarry

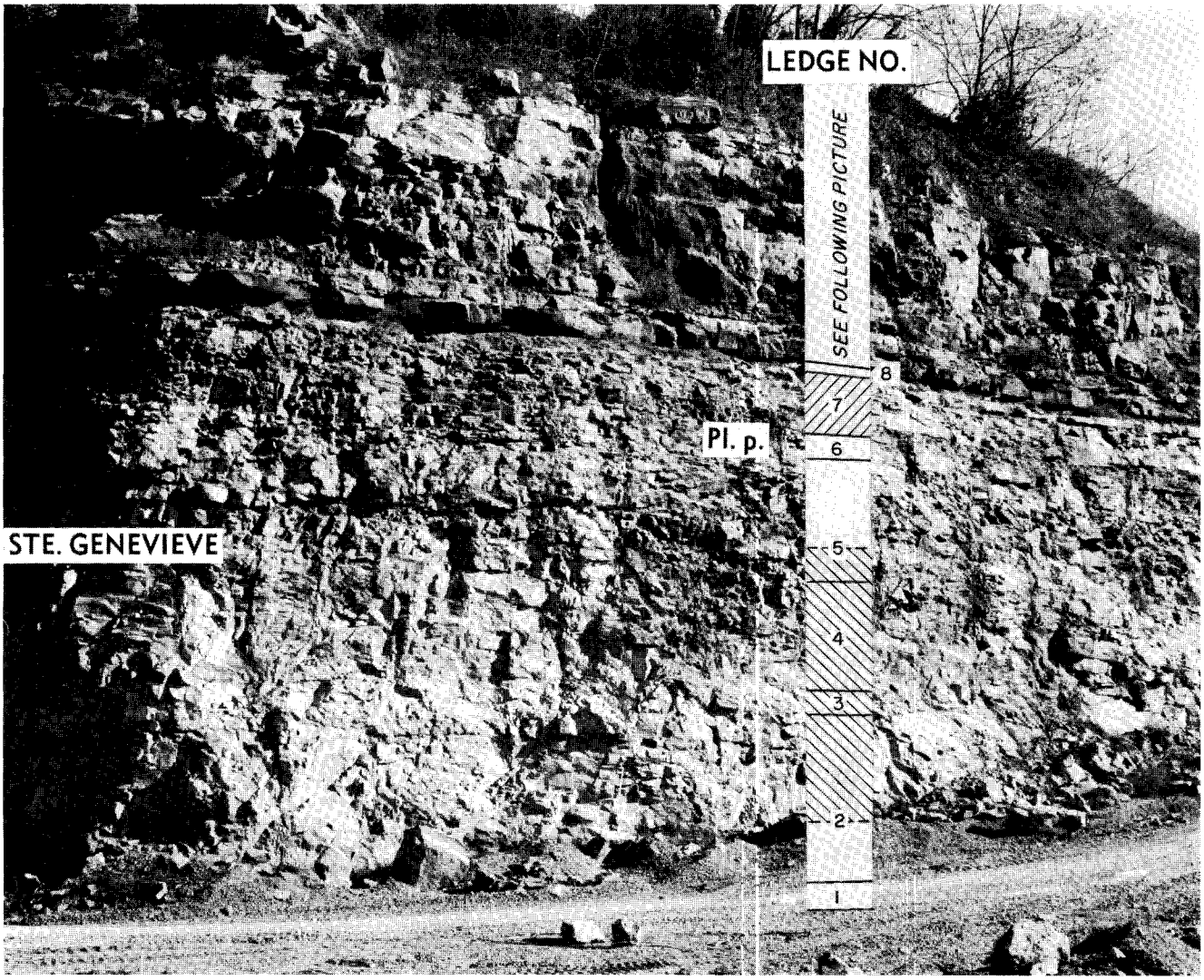
This quarry is an active open-face operation producing crushed limestone for concrete aggregate, roadstone, riprap, and agricultural limestone. The stone is quarried from the Fredonia Member of the Ste. Genevieve Limestone (Figs. 14 and 15). Foot-by-foot analyses of the quarry face are reported in Table 11.

Calcium carbonate content of individual samples is as great as 99.14 percent. Average chemical analyses of the purest zones are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
97-109	94.29	2.25	1.11	0.13	1.15	.048	.021
41-47	96.04	1.58	1.18	0.04	0.57	Not analyzed	
7-31	95.97	1.23	1.06	0.04	0.73	.055	.017

The thickness of individual ledges in the interval from 0 to 47 feet was found to vary laterally in the exposures at the south end of the quarry. The position of the quarry's high-calcium zones in the Ste. Genevieve Limestone is shown in Figure 12.

The quarry is on the north side of the Cumberland River between Miles 7 and 8 and has barge-loading facilities. The site is 1¼ miles southeast of U. S. Highway 60 and 6¼ miles northeast of Smithland, the seat of Livingston County. Smithland is located at the confluence of the Cumberland and Ohio Rivers and is served by Ky. Highways 93 and 70, in addition to U. S. Highway 60.



High-calcium limestone. 6 feet thick. $CaCO_3$ average 96.04%

High-calcium limestone. 24 feet thick. $CaCO_3$ average 95.97%

Abbreviation: Pl. p.—*Platycrinites penicillus*

Figure 14. Photograph of the south end of Three Rivers Rock Company quarry showing ledge designations and high-calcium limestone strata.

Abbreviation: Pl. p.—*Platycrinites penicillus*

Figure 15. Photograph of the north end of Three Rivers Rock Company quarry showing ledge designations.

WTR

TABLE 11. CHEMICAL ANALYSES OF THREE RIVERS ROCK COMPANY QUARRY

County: Livingston **Operator:** Three Rivers Rock Company
Property Owner: Charles R. Jones
Location: 5 miles NE of Smithland on U.S. 60, then 1 1/4 miles SE on secondary road
Carter Coordinate Location: 17-I-14 (Smithland quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
			NO SAMPLES				
95.60	2.25	0.29	0.10	1.11	99.35		
90.93	4.02	2.54	0.12	1.88	99.49		
87.45	6.76	3.10	0.12	2.06	99.49		
89.48	4.35	3.12	0.15	1.69	98.64		
88.81	6.24	2.56	0.12	1.83	99.56		
90.33	4.94	2.82	0.12	1.62	99.83		
92.20	2.87	2.62	0.07	1.48	99.24		
93.90	3.31	1.34	0.05	1.12	99.72		
95.09	2.25	0.85	0.02	1.03	99.24	NOT ANALYZED	
94.24	2.42	1.74	0.05	1.27	99.72		
94.41	2.19	1.28	0.05	1.15	99.08		
92.63	3.33	1.84	0.05	1.41	99.26		
94.83	2.31	1.28	0.05	1.21	99.68		
87.28	7.42	3.00	0.07	1.63	99.40		
86.26	7.42	4.06	0.10	1.46	99.30		
85.41	5.47	6.50	0.15	1.63	99.16		
88.04	4.90	5.26	0.17	1.09	99.46		
95.60	1.41	1.14	0.10	1.26	99.51		
95.68	1.68	0.96	0.10	0.84	99.26	.020	.023
94.92	1.77	0.79	0.15	1.04	98.67	.030	.022
95.60	1.87	0.70	0.17	0.88	99.22	.028	.024
94.83	2.01	1.24	0.17	1.25	99.50	.032	.023
94.58	3.04	0.74	0.17	1.34	99.87	.084	.025
95.43	2.27	0.54	0.15	0.99	99.38	.030	.019
93.73	2.21	1.28	0.12	1.14	98.48	.038	.017
92.71	1.92	1.39	0.12	1.48	97.62	.038	.024
94.15	1.89	1.00	0.10	1.19	98.33	.124	.019
94.66	1.91	1.22	0.12	1.16	99.07	.050	.019
94.24	2.68	1.35	0.12	1.10	99.49	.050	.017
91.01	3.72	2.15	0.12	1.37	98.37	.052	.022
82.86	10.05	4.07	0.15	2.23	99.36	NOT ANALYZED	
66.39	20.96	7.69	0.22	3.76	99.02		
93.13	2.13	1.40	0.07	0.87	97.60		
94.33	1.75	1.44	0.07	0.71	98.30		
94.42	1.84	1.24	0.10	0.88	98.48	NOT ANALYZED	
96.21	1.32	0.80	0.05	0.75	99.13		
92.88	2.53	2.46	0.07	1.30	99.24		
93.56	2.39	1.18	0.07	1.15	98.35		

Sampled by: Preston McGrain and Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 3, 1967

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
			Stripping. Very fine-grained sandstone and variegated shale. (Rosiclare Sandstone Member.)	
127-141 126-127 125-126 124-125 123-124 122-123 121-122 120-121 119-120 118-119 117-118 116-117 115-116 114-115 113-114 112-113 111-112 110-111 109-110	19	32	Limestone, light- to medium-gray, microgranular to very fine-grained; in part fine- to coarse-grained, oolitic and calcarenitic; crossbedded; stylolites; thin green shale at base. (Note: Upper 14 feet was not sampled because of weathered condition of exposures.)	STE. GENEVIEVE LIMESTONE
108-109 107-108 106-107 105-106 104-105 103-104 102-103 101-102 100-101 99-100 98-99 97-98	18	12	Limestone, medium-gray, microgranular to very fine-grained; in part fine- to coarse-grained, calcarenitic and oolitic; fossil fragments; trace of pyrite from 100 to 101 feet; stylolites; thin shale at base.	
96-97 95-96	17	2	Limestone, light- to medium-gray, fine- to coarse-grained, calcarenitic; in part very fine- to fine-grained, argillaceous; dolomitic; shaly.	
94-95 93-94 92-93 91-92 90-91 89-90	16	6	Limestone, medium- to brownish-gray, fine- to coarse-grained, calcarenitic; in part microgranular, in part oolitic.	

TABLE 11—*Continued*

County: Livingston **Operator:** Three Rivers Rock Company
Property Owner: Charles R. Jones

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
89.45	4.25	2.99	0.12	1.73	98.54	NOT ANALYZED	
89.88	4.81	1.92	0.12	1.32	98.05		
83.03	9.72	3.58	0.17	2.13	98.63		
90.99	3.93	2.14	0.10	1.58	98.74		
91.68	2.65	2.24	0.10	1.88	98.55		
92.11	3.81	1.71	0.10	1.37	99.10		
59.58	20.41	11.57	0.22	5.48	97.26		
74.13	15.51	6.22	0.15	2.22	98.23		
NO SAMPLES							
92.28	1.56	3.55	0.07	1.02	98.48		
94.67	1.91	2.12	0.07	0.60	99.37		
93.73	2.09	2.75	0.07	0.52	99.16		
78.41	11.57	6.92	0.15	1.82	98.87		
69.51	16.60	9.19	0.15	2.72	98.17		
70.88	14.39	10.18	0.15	2.29	97.89		
71.38	15.26	8.20	0.15	2.44	97.44		
70.71	17.69	6.87	0.15	2.64	98.06		
77.38	13.26	6.88	0.10	2.38	100.--		
75.76	8.69	12.82	0.07	1.77	99.11		
71.56	17.36	7.55	0.10	2.09	98.66		
76.95	11.93	7.04	0.07	2.07	98.06		
72.76	12.58	8.91	0.10	2.27	96.62		
76.53	10.54	8.94	0.12	2.14	98.27		
84.14	4.16	9.62	0.05	1.37	99.34		
80.72	7.53	8.27	0.07	1.94	98.53		
91.51	2.78	3.38	0.07	1.13	98.87		
89.79	2.93	4.67	0.05	1.43	98.87		
79.27	8.48	8.37	0.12	2.01	98.25		
70.96	12.38	11.61	0.17	2.85	97.97		
90.74	2.83	2.89	0.07	1.14	97.67		
85.34	4.72	6.17	0.07	2.17	98.47		
90.05	2.52	5.80	0.07	0.99	99.53		
60.95	25.01	9.85	0.32	2.19	98.32		
53.07	22.66	16.58	0.32	4.54	97.17		
NO SAMPLES							

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
88-89 87-88 86-87 85-86 84-85 83-84	15	6	Limestone, medium- to brownish-gray, fine- to coarse-grained, calcarenitic, in part micro-granular.	STE. GENEVIEVE LIMESTONE
82-83	14	1	Limestone, light-gray, very fine-grained, with granular appearance; interbedded and interlaminated with limestone, brownish-gray, very fine- to coarse-grained, calcarenitic; dolomitic; shaly; thin shale at base.	
81-82	13	1	Limestone, brownish-gray, very fine-grained, with granular appearance; in part fine- to coarse-grained, calcarenitic; dolomitic.	
74-81	12	7	Inaccessible.	
73-74 72-73 71-72	11	3	Limestone, dark-brownish-gray, medium-grained, oolitic; in part microgranular to coarse-grained, crystalline.	
70-71 69-70 68-69 67-68 66-67 65-66 64-65 63-64 62-63 61-62 60-61 59-60 58-59	10	13	Limestone, predominantly brownish-gray, very fine-grained, with granular appearance; interbedded and interlaminated with limestone, medium- to dark-gray, very fine- to coarse-grained, calcarenitic; dolomitic; dense; thin zones of dark-bluish-gray chert.	
57-58 56-57 55-56 54-55 53-54 52-53 51-52 50-51 49-50	9	9	Limestone, brownish-gray, very fine-grained, with granular appearance; interbedded and interlaminated limestone, medium- to dark-gray, very fine- to coarse-grained, calcarenitic; dense; crossbedded; predominantly microgranular to very fine-grained and dolomitic in lower 2 feet.	
47-49	8	2	Shale.	

TABLE 11—*Continued*

County: Livingston **Operator:** Three Rivers Rock Company
Property Owner: Charles R. Jones

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
96.13	1.74	1.08	0.05	0.61	99.61		
97.50	1.39	0.20	0.05	0.35	99.49		
95.53	1.54	1.65	0.05	0.43	99.20	NOT ANALYZED	
95.53	1.53	1.68	0.05	0.61	99.40		
96.39	1.72	0.72	0.05	0.65	99.53		
95.19	1.57	1.74	0.02	0.76	99.28		
84.74	2.15	6.79	0.05	2.88	96.61	NOT ANALYZED	
89.71	2.10	4.55	0.05	2.38	98.79		
93.13	2.51	2.80	0.05	1.17	99.66		
90.79	3.01	3.28	0.05	1.78	98.91		
90.91	2.72	3.41	0.05	1.78	98.87		
92.28	2.95	2.82	0.07	1.55	99.67	NOT ANALYZED	
93.48	1.83	2.80	0.05	1.81	99.97		
86.11	6.59	3.52	0.10	2.12	98.44		
89.71	4.08	4.41	0.07	1.67	99.94		
87.74	6.17	3.11	0.07	1.89	98.98		
96.39	1.81	0.70	0.05	0.83	99.78	.038	.010
95.87	1.63	1.46	0.07	0.89	99.92	.056	.013
96.56	1.71	0.67	0.05	0.90	99.89	.094	.013
93.82	1.69	1.91	0.05	2.19	99.66	.102	.018
95.36	1.04	1.01	0.05	0.59	98.05	.034	.021
96.47	1.12	0.80	0.05	0.81	99.25	.096	.021
96.04	1.18	1.35	0.05	0.59	99.21	.034	.019
95.87	1.51	1.90	0.02	0.61	99.91	.038	.022
96.30	1.10	1.54	0.02	0.50	99.46	.030	.028
95.10	1.42	1.62	0.02	0.72	98.88	.056	.040
96.56	1.30	0.97	0.02	0.82	99.67	.112	.016
93.27	1.65	1.62	0.02	0.99	97.55	.134	.029
94.11	1.16	1.93	0.02	0.92	98.14	.062	.016
97.46	0.88	0.20	0.02	0.65	99.21	.034	.010
96.34	1.16	1.14	0.02	0.53	99.19	.022	.011
94.39	1.86	1.23	0.08	0.59	98.15	.018	.009
96.00	1.50	0.81	0.05	0.57	98.93	.024	.015
94.81	1.35	1.79	0.05	1.06	99.06	.040	.013
96.07	0.74	0.55	0.05	0.37	97.78	.032	.013
99.14	0.65	0.04	0.05	0.41	100.29	.086	.019
96.90	0.74	0.39	0.05	0.58	98.66	.078	.017
97.74	0.88	0.31	0.02	0.52	99.47	.060	.013
95.65	0.79	1.19	0.05	0.46	98.14	.034	.017
97.04	0.64	0.39	0.02	0.54	98.63	.012	.016
94.18	1.41	2.49	0.02	0.60	98.70		
92.02	1.56	4.33	0.05	0.67	98.63	NOT ANALYZED	
91.88	1.63	4.47	0.07	0.54	98.59		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
46-47 45-46 44-45 43-44 42-43 71 41-42	7	6	Limestone, light- to medium-gray, very fine- to very coarse-grained, crystalline to oolitic.	
40-41 69 39-40	6	2	Limestone, light- to medium-gray, very fine- to coarse-grained, crystalline; fossil fragments; interbedded with thin shales.	
38-39 37-38 36-37 35-36 34-35 33-34 32-33 31-32 30-31 29-30 58 28-29	5	11	Limestone, medium- to dark-gray, very fine- to coarse-grained, crystalline; in part oolitic from 28 to 32 feet; a few fossil fragments.	STE. GENEVIEVE LIMESTONE
27-28 26-27 25-26 24-25 23-24 22-23 21-22 20-21 19-20 48 18-19	4	10	Limestone, white to medium-gray, medium- to coarse-grained, oolitic; some fossil fragments; some coarsely crystalline calcite; upper $\frac{1}{2}$ foot very fine- to fine-grained, argillaceous; stylolites.	
17-18 46 16-17	3	2	Limestone, light-gray, medium-grained, oolitic; in part microgranular, with whole brachiopods.	
15-16 14-15 13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5	2	14	Limestone, white to medium-gray, medium- to coarse-grained, oolitic; some fossil fragments; some coarsely crystalline calcite; generally dense; massive; stylolites.	

TABLE 11—*Continued*

County: Livingston **Operator:** Three Rivers Rock Company
Property Owner: Charles R. Jones

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
94.11	1.25	3.13	0.07	1.02	99.58	NOT ANALYZED	
93.62	1.56	2.01	0.05	1.10	98.34		
76.10	9.89	7.26	0.10	2.33	95.68		
88.94	2.27	3.36	0.07	0.67	95.31		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
3-4				STE. GENEVIEVE LIMESTONE
2-3				
1-2	1	2	Limestone, medium- to dark-gray, fine- to coarse-grained, crystalline, argillaceous; some fossil fragments and oolites; in part dolomitic.	
0-1				

BOTTOM OF QUARRY (August 3, 1967)

NOTE: Ledges 1 through 8 were measured and sampled in the south end of the quarry. (See Figure 14.)
Ledges 9 through 19 were measured and sampled in the north end of the quarry. (See Figure 15.)

Barrett Quarry

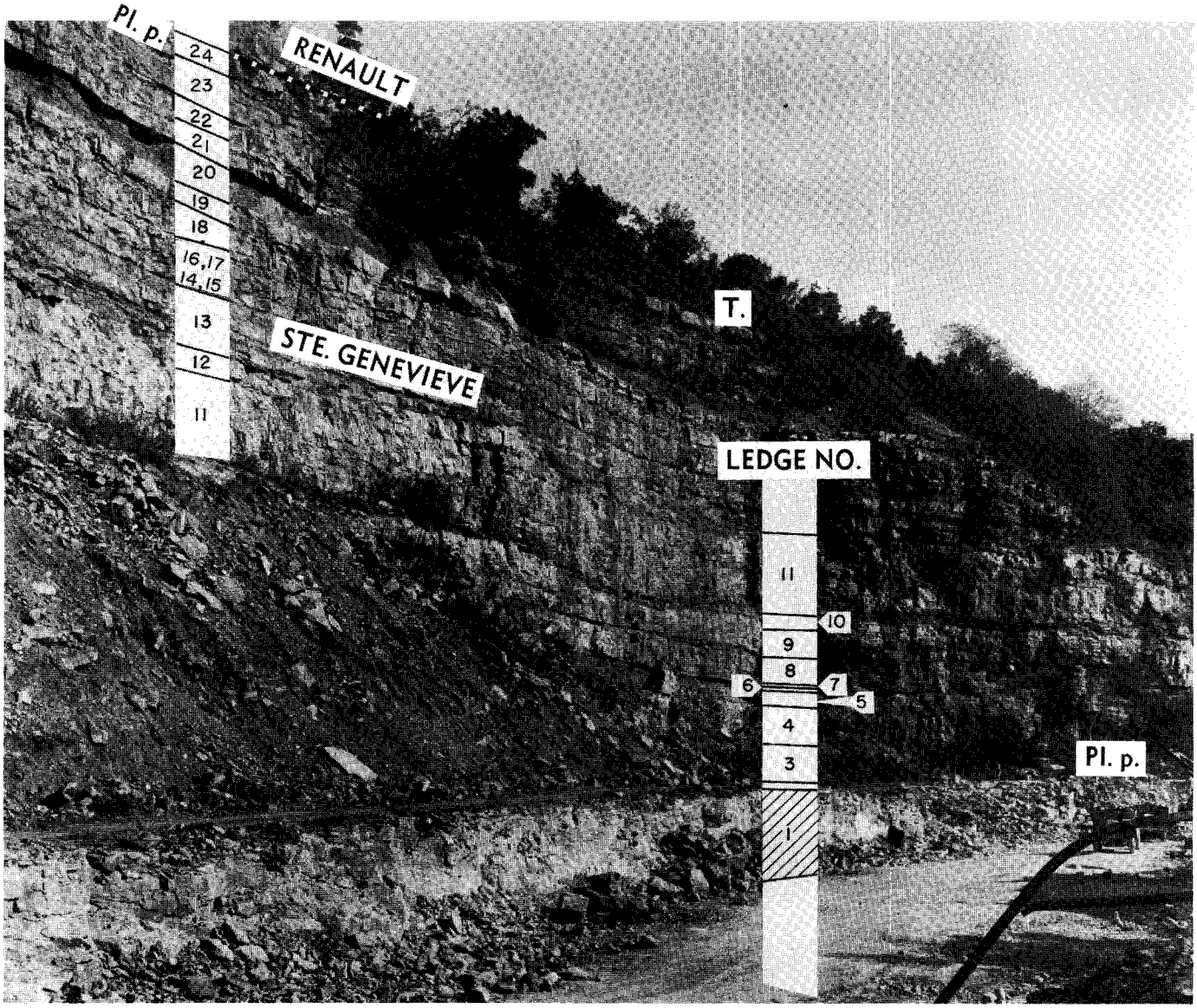
This inactive open-face quarry was operated, at the time of sampling in 1951, by the Ward and Montgomery Stone Company, and at later times by the Franklin Limestone Company and the West Tennessee Limestone Company. Crushed limestone was produced for concrete aggregate, roadstone, riprap, and agricultural limestone. The stone was quarried from the Ste. Genevieve Limestone and the lower part of the Renault Limestone (Fig. 16). Foot-by-foot analyses of the Ste. Genevieve section are reported in Table 12. The analysis of this quarry was previously reported by Stokley and Walker (1953, p. 32-35), but the values for phosphorus and sulfur content of the high-calcium zone in the lower part of the face are presented here for the first time.

Calcium carbonate content of individual samples is as great as 98.1 percent. Average chemical analysis of the purest zone is:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
0-10	97.9	0.76	0.35	0.09	0.10	.022	.012

Figure 12 shows the relationship of the pure limestone in this quarry with the position of the high-calcium zones in the Ste. Genevieve Limestone at other locations in the region.

The quarry is on the north bank of the Cumberland River between Miles 8 and 9. The site is 1½ miles southeast of U. S. Highway 60 and 6½ miles northeast of Smithland.



High-calcium limestone. 10 feet thick. $CaCO_3$ average 97.9%

Abbreviations: Pl. p.—*Platycrinites penicillus*
T.—*Talarocrinus*

Figure 16. Photograph of Barrett quarry showing ledge designations and high-calcium limestone stratum.

TABLE 12. CHEMICAL ANALYSES OF BARRETT QUARRY

County: Livingston **Operator:** Inactive
Property Owner: Barrett
Location: 5 miles NE of Smithland on U.S. Hwy. 60, then 1½ miles SE on secondary road
Carter Coordinate Location: 13-I-14 (Burna quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
88.4	3.2	5.80	0.43	2.02	99.9	NOT ANALYZED	
91.1	1.67	4.42	0.23	1.08	98.5		
79.1	16.5	3.00	0.43	0.33	99.4		
68.9	24.8	2.54	0.51	0.55	97.3		
75.8	20.8	1.60	0.28	0.35	98.8		
93.5	3.3	1.93	0.18	0.46	99.4		
95.4	1.74	0.72	0.18	0.39	98.4		
69.4	21.1	5.60	0.58	1.94	98.6		
56.5	30.3	9.18	0.98	2.05	99.0		
73.4	17.3	6.64	0.68	1.79	99.8		
38.2	16.4	40.42	1.23	3.40	99.7		
58.7	10.0	29.03	1.22	1.18	99.9		
55.7	13.1	27.27	0.97	1.91	99.0		
24.2	19.3	44.37	2.74	7.06	97.7		
44.0	21.1	28.79	0.91	5.05	99.8		
25.8	11.2	50.80	1.90	7.78	97.5		
14.1	5.1	66.77	1.50	11.86	99.3		
93.3	1.36	4.21	0.21	0.39	99.5		
93.9	1.16	3.64	0.18	0.50	99.4		
93.9	1.46	3.44	0.23	0.47	99.5		
94.4	1.98	1.68	0.23	0.40	98.7		
90.6	4.9	2.60	0.35	0.66	99.1		
95.5	1.84	1.40	0.23	0.28	99.3		
95.5	1.54	1.30	0.23	0.38	99.0		
95.6	1.45	1.84	0.23	0.57	99.7		
95.5	1.67	1.53	0.22	0.40	99.3		
95.4	1.36	1.89	0.21	0.35	99.2		
86.0	5.9	5.53	0.38	1.41	99.2		
88.8	5.7	3.51	0.25	0.66	98.9		
89.7	5.7	3.80	0.20	0.54	99.9		
91.1	4.1	3.75	0.18	0.52	99.7		
55.2	21.6	15.11	1.10	5.28	98.3		

Sampled by: Eugene M. Luttrell, Harry W. Settle, and Preston McGrain
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: October 17, 1951

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY Approximately 45 feet of Renault limestone, with some interbedded shale, is exposed above Ledge 24.	
124-125 123-124	24	2	Limestone, gray, coarsely crystalline, fossiliferous.	
122-123 121-122 120-121 119-120 118-119 117-118 116-117 115-116	23	8	Limestone, gray, vaughanitic, with buff dolomitic streaks; 3-inch shale at 115 feet.	
114-115 113-114 112-113	22	3	Limestone, gray, finely crystalline to vaughanitic, dolomitic.	STE. GENEVIEVE LIMESTONE
111-112 110-111 109-110	21	3	Shale, gray, calcareous; and limestone, gray, very fine-grained, argillaceous, dolomitic.	
105-109	20	4	Shale, green, calcareous; thins toward west side of quarry.	
104-105 103-104 102-103 101-102 100-101 99-100 98-99 97-98 96-97 95-96	19	10	Limestone, gray, medium-grained, oolitic, hard.	
94-95 93-94 92-93 91-92	18	4	Limestone, light-gray, very finely to medium-crystalline.	
90-91	17	1	Limestone, greenish-gray, very argillaceous, dolomitic.	

TABLE 12—*Continued*

County: Livingston **Operator:** Inactive
Property Owner: Barrett

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
68.9	15.2	10.05	0.81	3.03	98.0	NOT ANALYZED	
83.5	9.8	3.45	0.41	1.16	98.3		
76.0	4.0	16.27	0.64	1.82	98.7		
47.0	7.2	39.75	1.08	2.69	97.7		
50.9	7.7	37.91	0.90	2.14	99.6		
77.5	7.6	12.44	0.47	1.88	99.9		
46.2	14.8	31.25	1.43	2.57	96.3		
57.5	13.3	24.26	1.05	2.85	99.0		
81.0	3.8	13.12	0.44	1.38	99.7		
			NO SAMPLES				
97.1	1.34	0.84	0.20	0.04	99.5		
94.8	1.67	1.97	0.28	0.18	98.9		
90.2	2.3	5.89	0.33	0.49	99.2		
96.0	0.95	2.05	0.23	0.14	99.4		
95.8	0.73	2.41	0.23	0.65	99.8		
96.2	1.21	1.24	0.18	0.50	99.3		
96.2	1.19	1.00	0.16	0.58	99.1		
94.4	2.3	1.41	0.19	0.63	99.9		
94.4	2.1	1.62	0.18	0.85	99.2		
97.1	1.54	0.53	0.14	0.26	99.6		
97.1	1.55	0.66	0.16	0.20	99.7		
92.8	3.7	2.21	0.27	0.44	99.4		
95.9	2.3	1.24	0.21	0.37	100.0		
92.0	3.7	2.64	0.20	0.80	99.3		
85.4	8.0	4.43	0.30	1.55	99.7		
81.5	8.5	6.08	0.34	1.92	98.3		
79.6	9.5	7.38	0.32	2.33	99.1		
85.6	6.5	5.07	0.28	1.67	99.0		
88.5	5.7	4.13	0.27	1.10	99.7		
95.3	2.0	1.55	0.13	0.52	99.5		
94.6	2.4	2.02	0.18	0.68	99.9		
93.4	3.3	2.48	0.18	0.50	99.9		
93.4	3.3	2.54	0.18	0.43	99.9		
94.5	2.2	2.70	0.19	0.23	99.8		
72.5	14.8	9.83	0.68	1.78	99.6		
83.3	4.5	7.93	0.53	2.40	98.7		
71.3	11.9	10.91	0.78	3.18	98.1		
91.2	2.4	3.57	0.28	1.18	98.6		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
89-90 88-89	16	2	Limestone, light-gray, very finely to medium-crystalline, dolomitic; 1- to 2-inch shale at 88 feet.	
87-88	15	1	Limestone, medium-gray, medium-crystalline, fossiliferous.	
86-87 85-86 84-85 83-84 82-83 81-82	14	6	Limestone, light- to medium-gray, finely to medium-crystalline, dolomitic.	
75-81	13	6	Covered zone; includes at least 3 feet of greenish-gray argillaceous limestone.	
74-75 73-74 72-73 71-72 70-71	12	5	Limestone, light-gray to white, medium-grained, oolitic and crystalline, in part fossiliferous; dense; 1-inch shale at 70 feet.	
69-70 68-69 67-68 66-67 65-66 64-65 63-64 62-63 61-62 60-61 59-60 58-59 57-58 56-57 55-56 54-55 53-54 52-53 51-52 50-51	11	20	Limestone, gray, finely to coarsely crystalline, slightly fossiliferous; some oolites in upper part; shale at 50 feet, which varies from 0 to 1½ feet in thickness.	STE. GENEVIEVE LIMESTONE
49-50 48-49 47-48	10	3	Limestone, gray, finely to medium-crystalline, in part oolitic and fossiliferous, with interbedded green calcareous shale; scattered pyrite cubes in upper part; 1- to 2-inch shale at 47 feet.	

TABLE 12—*Continued*

County: Livingston **Operator:** Inactive
Property Owner: Barrett

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
93.4	2.0	2.60	0.19	0.81	99.0		
91.2	2.7	3.42	0.26	1.09	98.7		
95.1	2.3	1.98	0.17	0.39	99.9		
94.2	2.0	2.23	0.21	0.74	99.4	NOT ANALYZED	
85.5	4.8	6.40	0.33	1.67	98.7		
91.7	3.2	3.18	0.19	1.12	99.4		
94.0	2.4	2.32	0.18	0.78	99.7		
79.4	12.9	5.13	0.53	1.53	99.5		
83.0	9.5	4.76	0.41	1.41	99.1		
61.1	29.4	6.73	0.88	1.22	99.3	NOT ANALYZED	
71.5	18.6	7.53	0.53	1.42	99.6		
81.3	11.1	5.22	0.38	1.27	99.3		
70.7	19.8	6.97	0.53	1.67	99.7		
37.4	29.2	21.96	1.81	7.04	97.4	NOT ANALYZED	
NO SAMPLE							
90.0	2.7	5.11	0.19	0.81	98.8		
78.7	12.5	5.93	0.36	1.51	99.0	NOT ANALYZED	
86.6	4.9	6.05	0.22	1.22	99.0		
84.9	7.5	5.39	0.30	1.00	99.1		
93.4	4.9	0.87	0.50	0.10	99.8		
94.8	3.2	1.31	0.36	0.07	99.7		
95.8	2.3	1.12	0.12	0.06	99.4		
94.5	3.1	1.81	0.13	0.20	99.7		
93.9	3.1	2.21	0.27	0.27	99.8	NOT ANALYZED	
94.9	1.96	2.04	0.27	0.04	99.2		
95.1	1.84	2.31	0.25	0.09	99.6		
95.5	1.40	2.36	0.21	0.06	99.5		
96.5	1.39	1.45	0.15	0.04	99.5		
76.9	12.9	6.98	0.34	1.51	98.6		
80.7	7.7	7.24	0.29	2.15	98.1		
78.5	6.[illegible]	10.68	0.34	1.90	98.3		
78.9	5.4	11.86	0.29	1.91	98.4	NOT ANALYZED	
57.5	11.4	22.93	0.65	4.78	97.3		
65.0	8.3	21.69	0.48	2.68	98.2		
61.8	11.5	17.14	0.70	5.43	96.6		
NO SAMPLES							
97.8	0.98	0.30	0.11	0.00	99.2	.026	.013
97.8	1.28	0.07	0.15	0.00	99.3	.018	.010
97.9	0.75	0.31	0.08	0.41	99.5	.014	.008
98.1	0.48	0.29	0.08	0.27	99.2	.016	.01[illegible]

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
46-47 45-46 44-45 43-44 42-43 41-42 40-41	9	7	Limestone, gray, medium-grained, oolitic and crystalline, fossiliferous, dense.	STE. GENEVIEVE LIMESTONE
39-40 38-39 37-38 36-37 35-36 34-35	8	6	Limestone, gray, fine-grained, crystalline, dolomitic.	
33-34	7	1	Limestone, bluish-gray to gray, argillaceous, dolomitic.	
32-33	6	1	Shale, greenish-gray, calcareous; thickens to 2 feet locally.	
31-32 30-31 29-30 28-29	5	4	Limestone, bluish-gray, finely to coarsely crystalline, in part fossiliferous; dense; 3- to 5-inch shale at 28 feet.	
27-28 26-27 25-26 24-25 23-24 22-23 21-22 20-21 19-20	4	9	Limestone, light-gray, medium-grained, oolitic and crystalline, dense; a few stylolites; indistinct bedding.	
18-19 17-18 16-17 15-16 14-15 13-14 12-13	3	7	Limestone, medium-gray, fine-grained, with irregular lenses of gray, argillaceous limestone; in part dolomitic.	
10-12	2	2	Covered zone; bench.	
9-10 8-9 7-8 6-7				

TABLE 12—*Continued*

County: Livingston
Property Owner: Barrett

Operator: Inactive

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
98.1	0.56	0.39	0.09	0.08	99.2	.022	.020
98.1	0.47	0.39	0.11	0.00	99.1	.012	.014
98.1	0.96	0.33	0.06	0.00	99.5	.008	.006
97.5	0.91	0.48	0.07	0.10	99.1	.032	.016
97.9	0.70	0.57	0.09	0.10	99.4	.032	.012
98.0	0.48	0.36	0.03	0.05	98.9	.038	.014

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
5-6 4-5 3-4 2-3 1-2 0-1	1	10	Limestone, white, medium-grained, oolitic and crystalline, dense; stylolites common; no conspicuous bedding.	STE. GENEVIEVE LIMESTONE

BOTTOM OF QUARRY (October 17, 1951)

Fredonia Valley Quarries Quarry

This quarry is an active open-face operation producing crushed limestone for concrete aggregate, roadstone, agricultural limestone, and metallurgical purposes. The stone is quarried from the Fredonia Member of the Ste. Genevieve Limestone (Fig. 17). Foot-by-foot analyses of this quarry are reported in Table 13. The analysis of the quarry was previously reported by Stokley and McFarlan (1952, p. 28-31), but the values for phosphorus and sulfur content of the high-calcium zones are presented here for the first time. Stokley (1949, p. 42) reported partial chemical analyses by the Kentucky Department of Highways for stone from this quarry.

Calcium carbonate content of individual samples is as great as 98.9 percent. Average chemical analyses of the purest zones are:

Samples (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)	S(%)	P(%)
56-92	98.2	0.72	0.82	0.10	0.09	.001	.008
0-30	97.2	1.78	0.72	0.17	0.08	.023	.010

The position of the quarry's high-calcium zones within the Ste. Genevieve Limestone is shown in Figure 12.

Stokley and McFarlan (1952, p. 9-12) pointed out that the Ste. Genevieve in the area east and northeast of the quarry should be considered in prospecting for similar zones of high-calcium limestone. As shown in their report, and on the Fredonia geologic quadrangle map (Rogers and Hays, 1967), the Ste. Genevieve Limestone dips eastward beneath an escarpment capped by the Bethel Sandstone, and offers a potentially large reserve of stone at a minable depth if the chemical characteristics are similar to the limestone in the quarry.

The quarry is 2½ miles south of Fredonia on U. S. Highway 641, and has a rail siding connecting with the Illinois Central Railroad. Princeton, the seat of Caldwell County, is 13¼ miles southeast of Fredonia by way of Ky. Highway 91.

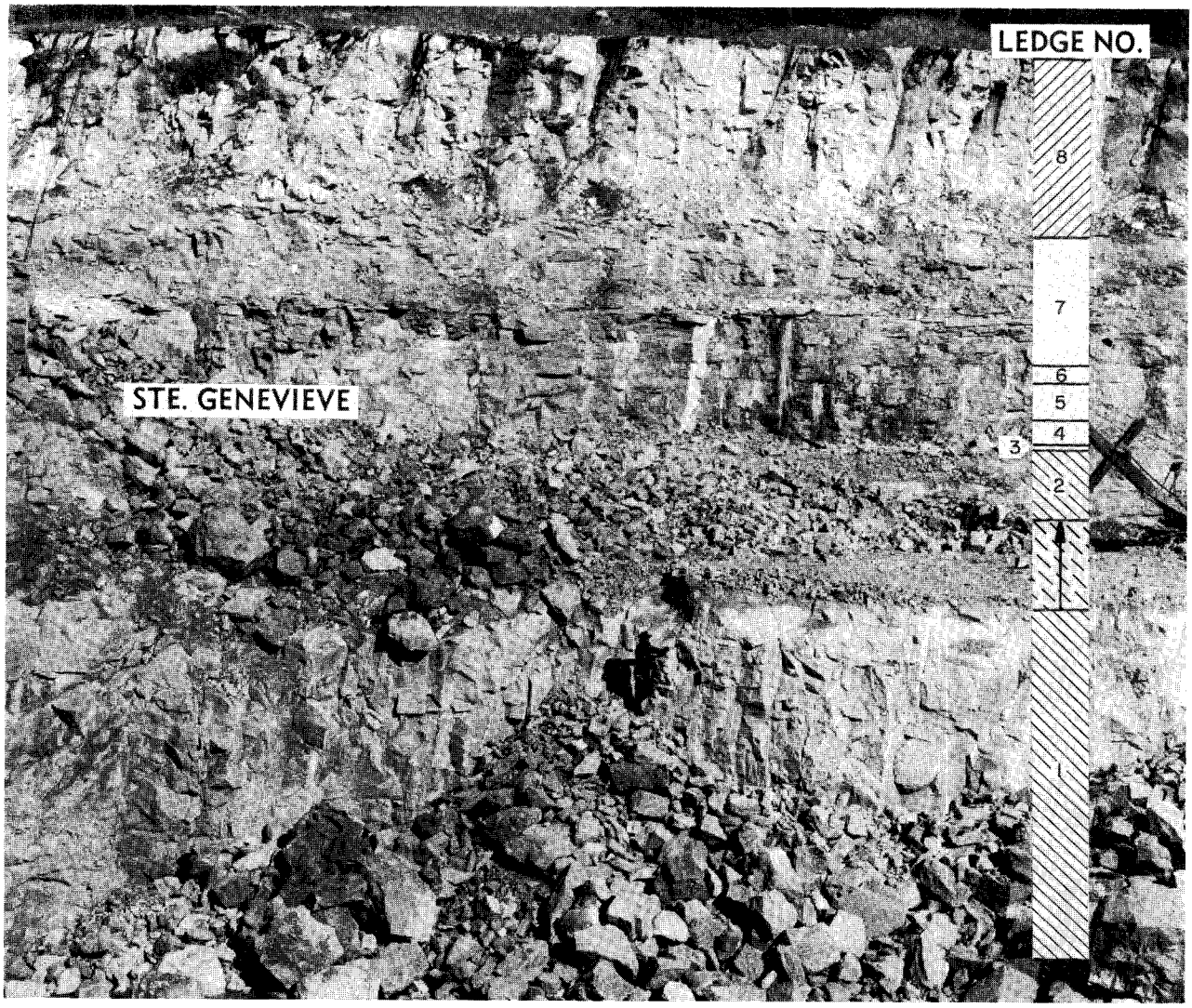


Figure 17. Photograph of Fredonia Valley Quarries quarry showing ledge designations and high-calcium limestone strata.

WFV

TABLE 13. CHEMICAL ANALYSES OF FREDONIA VALLEY QUARRIES QUARRY

County: Caldwell **Operator:** Fredonia Valley Quarries, Inc.
Property Owner: Baker and Baker
Location: $2\frac{1}{2}$ miles south of Fredonia on U.S. Highway 641
Carter Coordinate Location: 23-I-18 (Fredonia quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
98.6	0.38	0.60	0.18	0.00	99.8	.000	.007
98.5	0.86	0.45	0.14	0.00	100.0	.000	.007
98.5	0.75	0.57	0.16	0.00	100.0	.000	.009
98.2	0.61	0.60	0.23	0.00	99.6	.000	.007
98.2	0.68	0.58	0.19	0.00	99.7	.000	.008
98.5	0.46	0.60	0.18	0.00	99.7	.000	.008
98.1	0.81	0.72	0.23	0.00	99.9	.000	.007
98.1	0.61	0.69	0.23	0.00	99.6	.000	.010
98.1	0.65	0.66	0.18	0.00	99.6	.000	.009
98.2	0.45	0.68	0.18	0.00	99.5	.000	.008
98.5	0.68	0.54	0.13	0.00	99.9	.000	.008
98.7	0.53	0.55	0.15	0.00	99.9	.000	.005
98.9	0.60	0.30	0.15	0.04	100.0	.000	.007
97.9	0.86	0.96	0.12	0.17	100.0	.000	.007
98.5	0.79	0.58	0.05	0.00	99.9	.000	.006
98.5	0.62	0.75	0.05	0.00	99.9	.000	.005
98.9	0.58	0.72	0.03	0.00	100.2	.000	.008
97.8	0.94	0.82	0.04	0.00	99.6	.000	.011
98.3	0.97	0.68	0.04	0.00	100.0	.000	.011
98.6	0.58	0.66	0.06	0.08	100.0	.000	.011
98.9	0.62	0.49	0.04	0.00	100.0	.000	.011
98.2	0.39	0.64	0.04	0.00	99.3	.001	.008
98.5	0.62	0.73	0.06	0.00	99.9	.000	.004
98.4	0.62	0.90	0.05	0.00	100.0	.000	.003
98.5	0.60	0.86	0.06	0.00	100.0	.000	.004
97.5	0.53	1.76	0.06	0.00	99.9	.000	.005
97.5	0.58	1.82	0.06	0.00	100.0	.000	.007
98.1	0.54	1.30	0.05	0.00	100.0	.001	.009
98.1	0.92	0.95	0.05	0.03	100.0	.000	.012
98.3	0.91	0.73	0.05	0.05	100.0	.000	.011
98.1	0.89	0.78	0.05	0.19	100.0	.000	.009
98.3	0.80	0.81	0.05	0.07	100.0	.000	.009
98.5	0.94	0.44	0.06	0.03	100.0	.006	.011
98.5	0.94	0.32	0.06	0.06	99.9	.006	.011
96.8	1.12	1.83	0.07	0.07	99.9	.000	.011
95.3	1.36	2.48	0.07	0.22	99.4	.012	.014
74.8	19.0	4.50	0.58	1.09	100.0		
72.8	16.6	7.56	0.50	1.91	99.4		
80.3	9.0	6.93	0.49	1.58	98.3		
71.4	14.0	8.95	0.75	2.54	97.6	NOT ANALYZED	
76.6	11.3	7.82	0.62	2.23	98.6		
73.9	12.4	9.26	0.68	2.20	98.4		
77.1	11.5	8.00	0.68	1.96	99.2		
79.6	9.4	8.67	0.64	2.20	100.5		

Sampled by: Harry W. Settle
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: August 3, 1949, and January 1951

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
			Soil and limestone.	
91-92				
90-91				
89-90				
88-89				
87-88				
86-87				
85-86				
84-85				
83-84				
82-83				
81-82				
80-81				STE. GENEVIEVE LIMESTONE
79-80				
78-79				
77-78				
76-77				
75-76				
74-75	8	36	Limestone, white, medium-grained, oolitic,	
73-74			soft, massive; weathers buff.	
72-73				
71-72				
70-71				
69-70				
68-69				
67-68				
66-67				
65-66				
64-65				
63-64				
62-63				
61-62				
60-61				
59-60	WFV3			
58-59				
57-58				
56-57	WFV2			
55-56				
54-55				
53-54				
52-53				
51-52			Limestone, gray to dark-gray, medium- to coarse-	
50-51	7	14	grained, crystalline, fossiliferous, dolomitic;	
49-50			weathers bluish gray. Contains some thin inter-	
48-49			bedded shale seams and shaly limestone.	

TABLE 13—*Continued*

County: Caldwell **Operator:** Fredonia Valley Quarries, Inc.
Property Owner: Baker and Baker

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
85.7	6.5	5.94	0.43	1.37	99.9		
79.6	9.0	8.23	0.58	1.71	99.1		
89.3	5.0	4.47	0.38	0.82	100.0	NOT ANALYZED	
79.3	11.3	6.83	0.50	1.59	99.5		
80.7	9.5	6.23	0.65	1.37	98.5		
67.3	16.1	10.11	1.08	2.72	97.3		
90.7	4.6	2.89	0.36	0.81	99.4		
94.3	2.7	2.25	0.32	0.20	99.8	NOT ANALYZED	
91.4	2.9	2.67	0.63	0.18	97.8		
94.2	3.2	2.23	0.30	0.16	100.1		
95.3	2.3	1.68	0.38	0.00	99.7		
95.0	1.97	2.65	0.32	0.00	99.9	NOT ANALYZED	
94.6	2.2	2.41	0.20	0.00	99.4		
97.1	1.51	1.06	0.20	0.00	99.9		
66.4	32.2	0.89	0.42	0.06	100.0		
74.3	24.3	1.19	0.27	0.30	100.4	NOT ANALYZED	
75.7	21.5	2.08	0.22	0.25	99.7		
NO SAMPLE							
97.1	1.48	1.34	0.20	0.01	100.1	.030	.010
95.7	2.3	1.32	0.23	0.00	99.6	.044	.009
92.0	5.7	2.06	0.23	0.08	100.1	.032	.011
97.8	1.36	0.70	0.13	0.18	100.2	.034	.012
98.9	0.42	0.89	0.15	0.00	100.3	.048	.013
97.8	1.01	0.88	0.13	0.13	100.0	.036	.015
97.8	1.33	0.83	0.14	0.95	101.0	.042	.016
97.8	1.21	0.86	0.10	0.04	100.0	.042	.013
97.8	1.39	0.68	0.17	0.00	100.0	.044	.011
93.2	5.4	0.70	0.33	0.00	99.6	.008	.008
97.2	1.92	0.70	0.17	0.00	100.0	.020	.010
97.9	1.24	0.52	0.13	0.17	100.0	.008	.007
96.8	2.14	0.50	0.20	0.50	100.1	.016	.008
97.1	2.42	0.44	0.15	0.24	100.3	.008	.007
97.5	2.26	0.29	0.17	0.00	100.2	.016	.010
97.5	1.31	0.01	0.18	0.00	99.0	.016	.009
98.4	1.04	0.41	0.13	0.00	100.0	.012	.010
96.3	1.74	0.26	0.15	0.00	98.5	.010	.010
98.9	0.74	0.03	0.18	0.00	99.8	.002	.011
98.2	0.95	0.21	0.13	0.00	99.5	.014	.011
96.4	3.30	0.40	0.25	0.00	100.3	.014	.010
98.2	1.50	0.53	0.16	0.00	100.4	.016	.009
98.5	0.83	0.56	0.14	0.00	100.0	.016	.009
97.4	1.12	0.91	0.16	0.00	99.6	.016	.011
98.7	0.47	0.69	0.19	0.00	100.0	.022	.011
96.8	1.81	0.51	0.13	0.00	99.3	.018	.011

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
47-48				
46-47				
45-46				
44-45				
43-44				
42-43				
41-42				
40-41	6	3	Limestone, brownish-gray, fine- to medium-grained, crystalline; weathers gray.	
39-40				
38-39				
37-38				
36-37	5	5	Limestone, brownish-gray, medium- to coarse-grained; weathers gray.	
35-36				
34-35				
33-34				
32-33	4	3	Limestone, dove-gray, fine-grained, dense, dolomitic, flecked with calcite crystals.	
31-32				
30-31	3	½-1	Shale.	
29-30				
28-29				
27-28				
26-27	2	8	Limestone, dark-gray, medium- to coarse-grained, crystalline, fossiliferous, thick-bedded; weathers bluish gray.	
25-26				
24-25				
23-24				
22-23				
21-22				
20-21				
19-20				
18-19				
17-18				
16-17				
15-16				
14-15				
13-14				
12-13				
11-12	1	22	Limestone, light-gray to white, medium-grained, oolitic, soft, massive; weathers buff. Upper 3-4 feet darker, coarser, fossiliferous.	
10-11				
9-10				
8-9				
7-8				
6-7				
5-6				
4-5				

STE. GENEVIEVE LIMESTONE

TABLE 13—*Continued*

County: Caldwell **Operator:** Fredonia Valley Quarries, Inc.
Property Owner: Baker and Baker

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
95.3	4.3	0.42	0.15	0.03	100.2	.020	.010
98.2	0.23	0.78	0.18	0.00	99.4	.018	.009
96.3	1.93	1.53	0.14	0.00	99.9	.040	.010
97.5	0.68	1.73	0.14	0.00	100.0	.036	.010

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
3-4 2-3 1-2 0-1				STE. GENEVIEVE LIMESTONE

BOTTOM OF QUARRY (January 1951)

Cedar Bluff Stone Company's Princeton Quarry

This is an active operation producing crushed limestone for concrete aggregate, roadstone, riprap, and agricultural limestone. At the main site, stone is produced from the Fredonia Member of the Ste. Genevieve Limestone by drift-mining (Fig. 18). A smaller open-face quarry, located approximately 600 feet north of the main site, is operated on an "on-call" basis, and recent production has been principally from the upper part of the Fredonia Member (Fig. 19). The Rosiclare Sandstone and Levias Limestone Members of the Ste. Genevieve and part of the Renault Limestone are exposed in the quarry face at both sites.

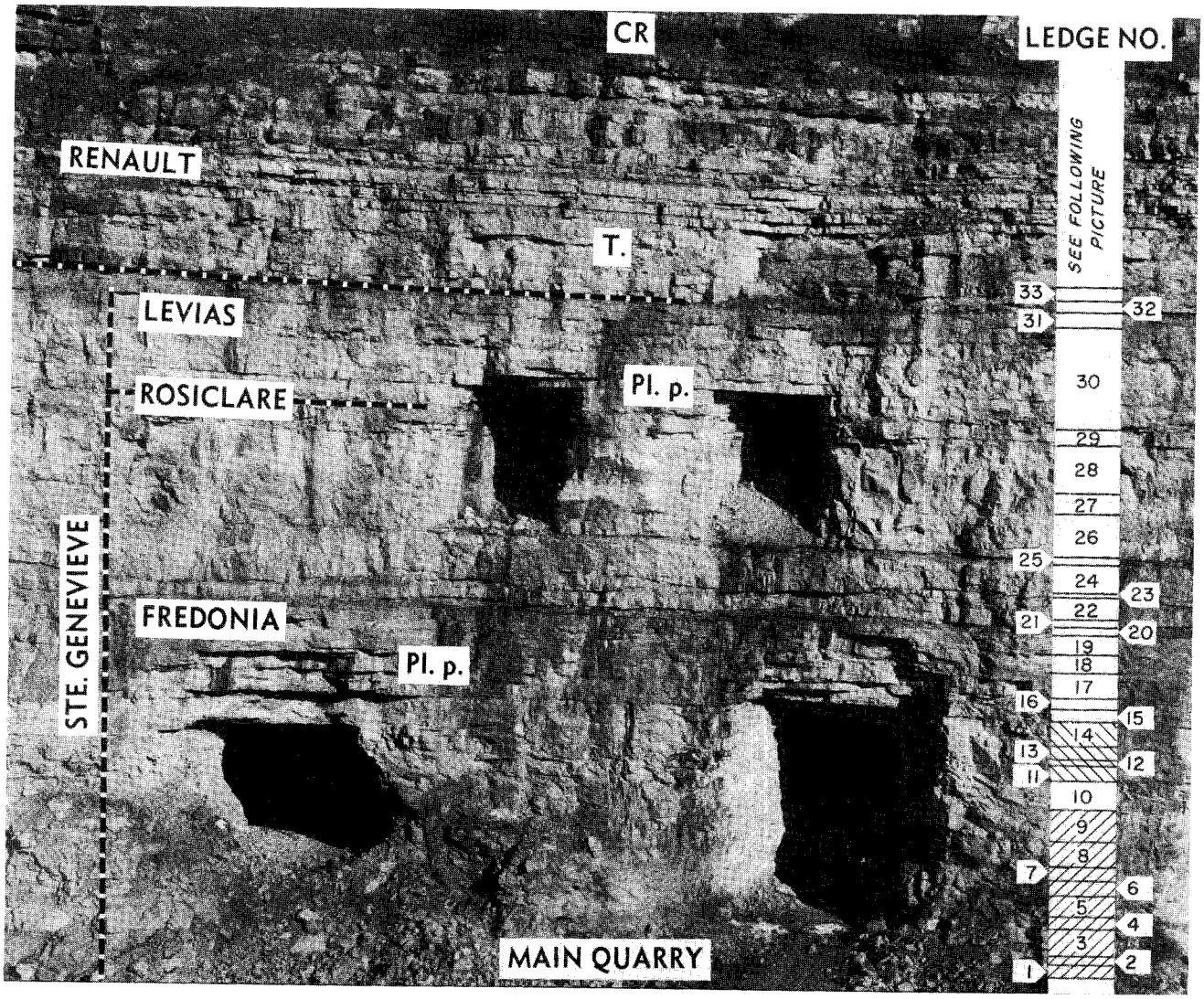
Foot-by-foot analyses are reported in Table 14 for the exposed section of the Ste. Genevieve and the lower part of the Renault. The analyses for the interval from 0 to 60 feet are presented as previously reported by Stokley and McFarlan (1952, p. 32-35), with the addition in this report of values for phosphorus and sulfur content. The data for the interval from 60 to 163 feet are the result of later sampling by Survey geologists. Stokley (1949, p. 41) reported partial chemical analyses by the Kentucky Department of Highways for stone from this quarry.

Calcium carbonate content of individual samples from the Ste. Genevieve is as great as 99.5 percent. The zones of high-calcium limestone are thin, but the total carbonate content averaged 98.3 percent for the interval from 0 to 39 feet. Average chemical analyses of the purest zones in the Ste. Genevieve are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
47-60	96.1	1.64	1.48	0.18	0.19	.055	.010
21-31	95.6	3.04	0.97	0.18	0.22	.038	.012
13-19	98.6	0.72	0.20	0.11	0.08	.133	.007
5-11	98.1	0.96	0.56	0.12	0.22	.036	.009
0-39	——98.3——		0.96	0.20	0.26	.056	.012

During their sampling of the quarry, Stokley and Nosow found that the character and thickness of the beds and ledges varied laterally between the main quarry and the north quarry, and also within each quarry. However, the variations were not great, and they considered the samples to be representative of the quarry section. Figure 12 shows the relationship of the section of Ste. Genevieve Limestone exposed in this quarry with the position of the high-calcium zones in the formation at other locations in the region.

The quarry is 2¾ miles southeast of Princeton, adjacent to Ky. Highways 91 and 128, and has a rail siding connecting with the Illinois Central Railroad. Princeton, the seat of Caldwell County, is served by U. S. Highway 62, the Western Kentucky Parkway, and a network of state highways.



High-calcium limestone. 13 feet thick. $CaCO_3$ average 96.1%

High-carbonate limestone. 39 feet thick. $CaCO_3 + MgCO_3$ average 98.3%

Abbreviations: Pl. p.—*Platycrinites penicillus*
T.—*Talarocrinus*
CR—Large crinoid stem (unidentified)

Figure 18. Photograph of the main quarry at Cedar Bluff Stone Company's Princeton plant showing ledge designations and high-calcium and high-carbonate limestone strata.

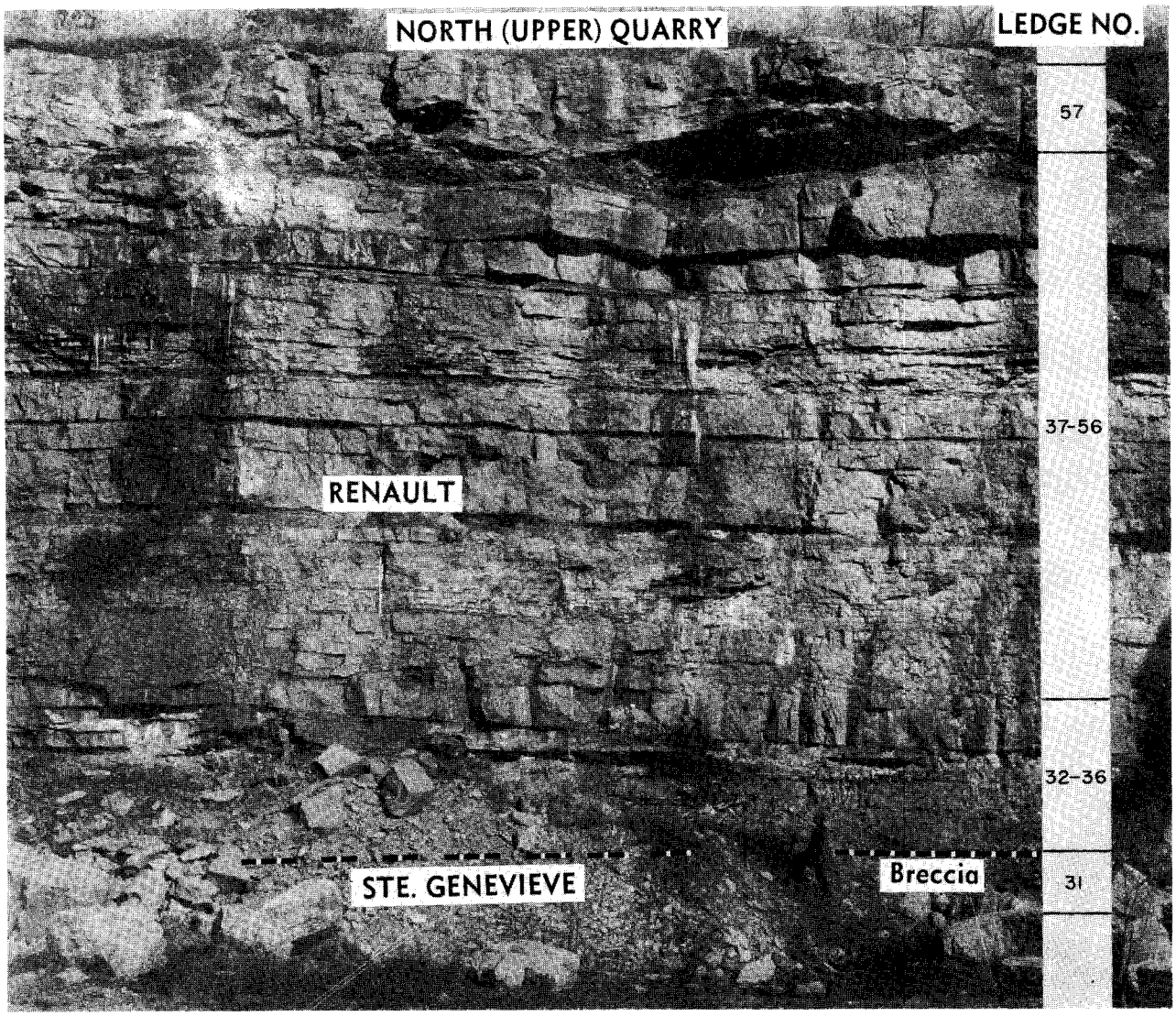


Figure 19. Photograph of the north (upper) quarry at Cedar Bluff Stone Company's Princeton plant showing ledge designations.

WKP

Table 14. Chemical Analyses of Cedar Bluff Stone Company's Princeton Quarry

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.
Location: 2 3/4 miles southeast of Princeton on Ky. Highway 91
Carter Coordinate Location: 21-H-20 (Princeton East quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
NO SAMPLES							
NO SAMPLES							

Sampled by: John A. Stokley, Edmund Nosow, E. Boyne Wood, and Harry W. Settle
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: 1949 and August 27, 1952

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF MEASURED SECTION	
	61		Bethel Sandstone and soil.	
229 -232½	60	3½	Limestone, light-gray, fine- to medium-grained, fragmental, fossiliferous; three indistinct beds.	
228½-229	59	½	Clay shale, greenish.	
226½-228½	58	2	Limestone, dark-gray, fine-grained, dense (vaughanitic), with hackly fracture; one bed.	
218½-226½	57	5-8	Limestone, gray, fine- to medium-grained, in part earthy, in beds 6 inches to 2 feet thick; somewhat crossbedded and variable in thickness. (Top ledge of quarry.)	
214½-218½	56	4-7	Shale, gray; 2 feet of fine-grained, earthy limestone at top; ledge is 7 feet thick on sides of quarry and 4 feet thick in main face.	RENAULT LIMESTONE
211 -214½	55	3½	Limestone, light-gray, fine-grained, dense (vaughanitic), with abundant fossil fragments; abundant pyrite cubes up to 1 inch across; one bed.	
210½-211	54	½	Clay shale, greenish.	
207 -210½	53	3½	Limestone, light-brownish-gray, fine-grained, earthy; one bed; weathers light colored.	
206 -207	52	1	Clay shale, greenish, with thin limestone beds.	
202 -206	51	4	Limestone, brownish-gray, fine-grained, dense (vaughanitic), slightly fossiliferous; two beds, 2 feet thick, with a thin shale seam between; weathers light colored.	
198 -202	50	4	Limestone, brownish- to greenish-gray, fine-grained, earthy, in beds 2 inches to 1 foot thick; beds thicker at top.	
197½-198	49	½	Clay shale, greenish.	
194½-197½	48	3	Limestone, brownish-gray, fine-grained, dense (vaughanitic), in beds 6 to 9 inches thick.	
194 -194½	47	½	Clay shale, greenish.	

TABLE 14—*Continued*

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
NO SAMPLES							
82.5	13.5	3.14	0.28	0.32	97.7	NOT ANALYZED	
81.6	12.9	3.68	0.27	0.34	98.8		
81.3	12.7	5.14	0.37	0.49	100.0		
83.9	9.9	4.68	0.26	0.37	99.1		
85.5	9.1	4.77	0.28	0.37	100.0		
91.5	4.5	3.55	0.22	0.26	100.0		
84.9	5.0	6.64	0.48	1.60	98.6		
86.1	4.1	6.59	0.56	1.19	98.5		
76.0	4.3	4.08	0.35	1.11	95.8		
86.1	6.5	5.00	0.35	0.52	98.5		
84.0	7.6	6.07	0.45	0.77	98.9		
77.9	11.1	8.19	0.57	1.01	98.8		
89.5	4.6	4.35	0.28	0.19	98.9		
86.2	3.9	7.44	0.55	0.90	99.0		
62.6	4.2	29.69	0.86	1.35	98.7		
70.8	3.5	23.82	0.65	0.91	97.7		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
188 -194	46	6	Limestone, brownish-gray, fine-grained, dense (vaughanitic); lower 6 inches is earthy; two beds, 2 and 4 feet thick.	
186½-188	45	1½	Clay shale, greenish.	
184 -186½	44	2½	Limestone, gray, fine-grained, dense, in part fragmental and fossiliferous.	
176 -184	43	8	Limestone, gray, fine-grained, earthy, in beds 1 to 3 inches thick, with almost equally thick interbedded shales.	
171 -176	42	5	Limestone, brownish-gray, fine-grained, dense (vaughanitic), slightly fossiliferous; thick- to thin-bedded; crossbedded; bedding varies laterally.	
170 -171	41	1	Shale and shaly limestone; thickness varies laterally.	
169 -170	40	1	Limestone, brownish-gray, medium-grained.	
167 -169	39	2	Shale, black; 6 inches of dark, fine-grained limestone at base.	
165 -167	38	2	Limestone, dark-gray, fine-grained, dense, earthy and shaly; one bed.	
163 -165	37	2	Shale and thin-bedded limestone; 6 inches of earthy limestone at base.	
162 -163 161 -162 160 -161	36	3	Limestone, brownish-gray, fine-grained, dense, dolomitic, in part fragmental; conchoidal fracture; weathers light gray.	
159 -160 158 -159 156½-158	35	3½	Limestone, gray, fine- to medium-grained, crystalline to fragmental, fossiliferous; top 1 foot is finer grained; one bed; thin shale seam at top.	
155½-156½ 154 -155½	34	2½	Limestone, dove-gray, fine-grained, dense (vaughanitic), in beds 1 to 3 inches thick, with interbedded thin shale seams.	
153 -154 152 -153 151 -152 150 -151 149 -150 148 -149	33	6	Limestone, light-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals, slightly fossiliferous; 6-inch pyritic layer at top; beds 1 to 3 feet thick; shale seam at base.	
147 -148 146 -147	32	2	Limestone, fine- to medium-grained, oolitic and fragmental, fossiliferous, in part earthy; one bed. (Basal ledge of Renault Limestone.)	

RENAULT LIMESTONE

TABLE 14—*Continued*

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
85.5	3.3	7.86	0.56	1.17	98.4	NOT ANALYZED	
85.5	3.2	8.86	0.51	0.79	98.9		
82.9	3.1	9.94	0.57	1.34	97.9		
77.0	5.0	12.07	0.71	1.32	96.1		
80.9	5.9	8.94	0.53	1.42	97.7		
79.0	8.6	8.53	0.58	1.63	98.3		
94.0	2.6	2.81	0.18	0.17	99.8		
94.9	2.6	1.80	0.17	0.17	99.6		
96.0	2.2	1.20	0.13	0.04	99.6		
96.1	2.1	1.42	0.13	0.11	99.9		
94.6	3.3	1.52	0.18	0.14	99.7		
95.0	2.8	1.44	0.17	0.14	99.6		
92.6	4.3	2.41	0.23	0.09	99.6		
94.7	3.8	0.95	0.20	0.09	99.7		
92.6	5.6	0.89	0.26	0.26	99.6		
91.0	7.1	1.37	0.28	0.19	99.9		
94.0	4.6	0.55	0.20	0.25	99.6		
95.4	3.3	0.80	0.16	0.11	99.8		
96.5	2.4	0.81	0.16	0.05	99.9		
92.0	5.9	1.60	0.23	0.21	99.9		
92.5	5.7	1.22	0.23	0.20	99.9		
95.4	2.7	1.20	0.13	0.11	99.5		
63.1	30.1	4.62	0.78	0.76	99.4		
94.8	---	1.71	0.18	0.14	----		
94.9	---	1.54	0.18	0.29	----		
94.0	---	1.82	0.20	0.13	----		
89.4	---	3.07	0.25	0.29	----		
91.0	---	0.83	0.23	0.30	----		
97.3	1.21	0.61	0.20	0.08	99.4		
88.6	9.3	1.35	0.27	0.14	99.7		
96.5	1.95	0.84	0.10	0.12	99.5		
92.6	5.5	1.43	0.15	0.17	99.9		
96.4	2.0	0.63	0.11	0.11	99.3		
95.1	3.1	0.87	0.12	0.25	99.4		
78.0	17.0	3.14	0.35	0.70	99.2		
92.4	5.0	2.10	0.13	0.26	99.9		
83.9	12.6	2.21	0.25	0.26	99.2		
90.1	6.7	1.70	0.18	0.12	98.8		
91.5	6.3	1.58	0.17	0.08	99.6		
NO SAMPLE							

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
145-146 144-145 143-144 142-143 141-142 140-141	31	6	Limestone, gray, fine-grained, earthy; breccia zone, up to 4 feet thick, in upper part; beds 6 inches to 2 feet thick, with interbedded thin shale partings. (Top ledge of Ste. Genevieve Limestone.)	STE. GENEVIEVE LIMESTONE
139-140 138-139 137-138 136-137 135-136 134-135 133-134 132-133 131-132 130-131 129-130 128-129 127-128 126-127 125-126 124-125	30	16	Limestone, light-gray, medium-grained, oolitic to crystalline, fossiliferous; conchoidal fracture; massive.	
123-124	29	1	Dolomite, brownish-gray, fine-grained, almost vaughanitic; sandy in upper 2 to 3 inches. (Rosiclare Sandstone Member; member thickens to 3 feet locally in quarry.)	
122-123 121-122 120-121 119-120 118-119 117-118 116-117 115-116	28	8	Limestone, light-gray to white, fine- to medium-grained, oolitic, in beds 1 to 2 feet thick; indistinct bedding; weathers light colored.	
114-115 113-114 112-113	27	3	Limestone, light-gray, fine- to medium-grained, oolitic; one bed.	
111-112 110-111 109-110 108-109 107-108	26	5	Limestone, brownish-gray, fine-grained, crystalline to fragmental, in part fossiliferous, in part dolomitic; indistinct bedding.	
106-107	25	½-1	Clay shale; weathers greenish.	

TABLE 14—*Continued*

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
93.4	1.41	1.77	0.18	0.25	97.0	NOT ANALYZED	
94.1	1.06	2.30	0.22	0.24	97.9		
94.0	1.86	1.67	0.31	0.33	98.2		
94.8	1.73	1.36	0.23	0.30	98.4		
93.9	1.95	1.83	0.23	0.34	98.3		
94.1	1.82	2.46	0.25	0.51	99.1		
94.5	1.63	2.01	0.26	0.41	98.8		
			NO SAMPLES				
			NO SAMPLES				
			NO SAMPLES				
			NO SAMPLES				
88.9	3.0	5.50	0.43	1.15	99.1		
89.0	3.3	4.69	0.37	0.46	97.8		
91.5	2.4	4.35	0.26	0.16	98.7		
90.2	2.6	5.93	0.30	0.41	99.4		
85.9	4.5	7.39	0.38	0.50	98.7		
86.5	3.0	9.23	0.32	0.26	99.3		
79.3	7.8	8.77	0.55	1.95	98.4		
79.5	8.3	8.39	0.58	1.80	98.6		
68.1	11.0	16.83	0.80	2.32	99.1		
83.6	3.3	11.45	0.45	0.42	99.2		
88.1	3.1	7.16	0.35	0.41	99.1		
81.6	5.6	9.47	0.55	1.23	98.5		
81.3	5.9	9.57	0.55	1.64	99.0		
87.0	3.9	6.79	0.33	0.94	99.0		
88.6	2.6	6.97	0.25	0.69	99.1		
91.9	2.2	3.91	0.20	0.45	98.7		
87.4	2.9	7.19	0.30	1.69	99.5		
87.2	3.4	6.61	0.28	1.65	99.1		
89.2	2.9	5.95	0.23	0.68	99.0		
92.5	2.4	3.80	0.14	0.42	99.3		
93.5	2.0	3.58	0.13	0.34	99.6		
74.7	12.7	10.38	0.73	1.40	99.9		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
105 -106 104 -105 103 -104 102 -103 101 -102 100 -101 99 -100	24	7	Limestone, light-gray, fine- to medium-grained, crystalline to oolitic, fossiliferous (microfossils); indistinct bedding.	
96 -99	23	3	Clay shale; weathers greenish.	
91 -96	22	5	Limestone, brownish- to greenish-gray, fine- to medium-grained, crystalline to fragmental, slightly oolitic; earthy at base; beds 6 inches to 2 feet thick, with interbedded thin shale seams.	
89 -91	21	2	Limestone, greenish-gray, fine-grained, earthy; one bed.	
84 -89	20	5	Shale and thin shaly limestone; variable in thickness; weathers greenish.	
83 -84 82 -83 81 -82 80 -81 79 -80	19	5	Limestone, brownish-gray, fine-grained, crystalline, in part fossiliferous; beds 6 inches to 1 foot thick.	
78 -79 77 -78 76 -77 75 -76	18	4	Limestone, brownish-gray, fine-grained, dense (vaughanitic); slightly coarser grained at top; beds 6 inches to 2 feet thick; thin-bedded and shaly at top.	
74 -75 73 -74 72 -73 71 -72 70 -71 69 -70	17	6	Limestone, brownish-gray, fine-grained, crystalline, fossiliferous, in beds 3 inches to 3 feet thick; indistinct bedding.	
68 -69 67 -68 66 -67 65 -66 63½-65	16	5½	Limestone, brownish-gray, fine-grained, dense (vaughanitic), in beds 2 to 6 inches thick, with interbedded thin shale partings.	
61½-63½ 60 -61½	15	3½	Limestone, gray, fine-grained, fragmental to oolitic, fossiliferous, in part dolomitic, in beds 1½ and 2 feet thick.	

STE. GENEVIEVE LIMESTONE

WKP2
2211

TABLE 14—*Continued*

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
92.2	4.22	1.64	0.18	0.36	98.6	.042	.013
97.5	1.54	1.07	0.15	0.07	100.3	.048	.017
97.2	1.18	0.89	0.12	0.00	99.4	.026	.009
97.2	0.95	1.34	0.23	0.00	99.7	.056	.006
96.6	1.07	1.44	0.31	0.00	99.4	.124	.013
96.7	1.44	1.32	0.10	0.00	99.6	.050	.011
97.5	1.22	0.88	0.13	0.00	99.7	.044	.009
96.0	1.31	1.54	0.22	0.35	99.4	.050	.010
95.9	1.36	2.05	0.20	0.48	100.0	.052	.008
97.5	1.18	1.39	0.14	0.16	100.4	.028	.007
97.9	1.13	1.30	0.17	0.12	100.6	.104	.014
91.6	3.49	3.43	0.25	0.77	99.5	.074	.011
95.6	1.25	0.93	0.16	0.18	98.1	.026	.007
			NO SAMPLE				
			NO SAMPLE				
81.8	7.16	7.64	0.42	1.23	98.3	.106	.013
79.9	9.00	7.69	0.40	1.26	98.3	.116	.014
80.4	7.57	8.87	0.48	1.28	98.6	.138	.014
82.4	7.20	7.81	0.43	1.28	99.1	.140	.016
76.0	11.55	9.15	0.56	1.72	99.0	.118	.019
92.7	2.69	2.74	0.22	0.27	98.6	.094	.012
96.0	1.41	0.68	0.17	0.00	98.3	.038	.014
95.8	2.04	0.78	0.14	0.06	98.8	.018	.011
92.3	5.19	0.85	0.12	0.69	99.2	.030	.010
89.5	7.25	0.76	0.13	0.73	98.4	.036	.021
90.5	6.55	1.12	0.23	0.55	99.0	.028	.014
86.0	11.18	0.95	0.19	0.60	98.9	.058	.015
98.1	1.15	0.72	0.18	0.29	100.4	.016	.012
82.1	13.76	2.68	0.35	0.53	99.5	.108	.026
96.7	1.93	1.16	0.20	0.30	100.3	.048	.022
96.6	1.31	1.29	0.15	0.43	99.8	.046	.012
97.3	2.97	0.29	0.20	0.33	101.1	.042	.020
89.6	7.64	2.33	0.22	0.10	99.8	.050	.013
96.4	3.26	0.86	0.24	0.06	100.7	.032	.011
95.4	2.72	0.79	0.27	0.20	99.4	.030	.014
96.0	2.21	0.81	0.14	0.25	99.4	.028	.010
96.9	1.24	0.56	0.11	0.05	98.9	.036	.006
95.4	3.33	1.15	0.13	0.29	100.3	.038	.007
96.0	3.78	0.51	0.14	0.19	100.6	.036	.006
81.9	16.7	0.93	0.38	0.08	100.0	.040	.009
80.2	19.1	1.07	0.50	0.08	100.0	.032	.018

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
59-60 58-59 57-58 56-57 55-56 54-55 53-54	14	7	Limestone, light-gray, fine-grained, dense, crystalline; and limestone, light-gray to white, medium-grained, oolitic, soft; gray and oolitic in upper part; massive.	STE. GENEVIEVE LIMESTONE
52-53 51-52	13	2	Limestone, dove-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals.	
50-51 49-50	12	2	Limestone, light-gray, oolitic, soft.	
48-49 47-48 46-47	11	3	Limestone, white to gray, medium-grained, oolitic.	
45-46 44-45 43-44 42-43 41-42 40-41 39-40	10	7	Limestone, light-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals; darker colored toward top.	
38-39 37-38 36-37 35-36 34-35 33-34 32-33	9	7	Limestone, gray to light-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals; dark-gray at base.	
31-32 30-31 29-30 28-29 27-28 26-27 25-26 24-25	8	8	Limestone, gray, medium-grained, crystalline; fine-grained and dense at base; massive.	
23-24 22-23 21-22	7	3	Limestone, gray, medium-grained, oolitic, soft.	
20-21 19-20	6	2	Limestone, gray, fine-grained, dense (vaughanitic), with conchoidal fracture, dolomitic.	

TABLE 14—*Continued*

County: Caldwell **Operator:** Cedar Bluff Stone Company, Inc.
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
99.5	0.00	0.32	0.08	0.02	99.9	.032	.007
98.6	0.76	0.00	0.08	0.14	99.6	*	*
99.5	0.00	0.22	0.09	0.03	99.8	.100	.007
97.1	0.80	0.14	0.12	0.30	98.5	*	*
98.6	1.39	0.17	0.12	0.02	100.3	.176	.008
98.2	1.39	0.37	0.12	0.00	100.1	.224	.008
88.5	11.48	0.96	0.30	0.13	101.3	.038	.019
83.2	15.20	1.26	0.37	0.17	100.2	.044	.008
98.2	1.07	0.45	0.12	0.19	100.0	.098	.017
98.1	0.98	0.57	0.11	0.20	100.0	.098	.007
98.5	1.16	0.45	0.12	0.08	100.3	.108	.011
98.1	0.38	0.44	0.14	0.44	99.5	*	*
98.1	1.08	0.79	0.10	0.20	100.3	.042	.004
97.8	1.10	0.68	0.12	0.24	99.9	.040	.007
70.0	26.0	1.71	0.38	0.61	98.7	.098	.015
72.0	25.1	1.92	0.39	0.59	100.0	*	*
96.0	1.41	1.56	0.24	0.38	99.6	.010	.021
95.0	2.30	2.34	0.58	0.26	100.5	*	*
93.1	2.50	3.06	0.18	0.27	99.1	.018	.016

* No data. Sample depleted in original analysis.

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
18-19 17-18 16-17 15-16 14-15 13-14	5	6	Limestone, light-gray to white, medium-grained, oolitic, soft, massive.	STE. GENEVIEVE LIMESTONE
12-13 11-12	4	2	Limestone, light-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals, dolomitic.	
10-11 9-10 8-9 7-8 6-7 5-6	3	6	Limestone, light-gray to white, medium-grained, oolitic, soft; weathers white.	
4-5 3-4	2	2	Limestone, dark-gray, fine-grained, dense (vaughanitic), flecked with calcite crystals, dolomitic; stylolites.	
2-3 1-2 0-1		3	Limestone, light-gray to white, medium-grained oolitic, soft.	

WKP1

BOTTOM OF QUARRY (1949)

NOTE: Ledges 1-14 were measured and sampled in the middle of the main quarry. (See Figure 18.)

Ledges 15-28 were measured and sampled on the north end of the main quarry.

Measurements and samples for Ledges 29 and 30 were obtained from a test hole drilled in the floor of the north, or upper, quarry. (See Figure 19.)

Ledges 31-36 were measured and sampled in the north, or upper, quarry.

Ledges 37-61 were measured in the north, or upper, quarry; samples were not taken because operable thicknesses of purer limestone were not present.

Kentucky Geological Survey-U. S. Geological Survey Cobb Core

This core hole was drilled for stratigraphic information as part of the cooperative Kentucky Geological Survey-U. S. Geological Survey statewide areal geologic mapping program. The core provided data on the stratigraphic section from the upper part of the Renault Limestone through the upper part of the Warsaw Limestone. Several zones of oolitic limestone were encountered in the upper part of the Fredonia Member of the Ste. Genevieve Limestone. Samples were obtained for chemical analysis of the interval from the basal part of the Levias Member through the lowest occurring oolitic zone of apparent operable thickness in the Fredonia Member. Foot-by-foot analyses for this interval are reported in Table 15.

Calcium carbonate content of individual samples is as great as 98.53 percent. Average chemical analyses of the purest zones are:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
150-174	95.86	2.56	0.24	0.06	0.54	.025	.004
180-208	95.86	2.55	0.47	0.04	0.58	.041	.009
214-236	96.74	1.56	0.68	0.04	0.46	.061	.018
250-281	96.09	1.50	0.69	0.04	0.44	.051	.012

The average total carbonate content of the interval from 150 to 236 feet is 98.27 percent. The position of the core's high-calcium zones within the Ste. Genevieve Limestone is shown in Figure 12.

The drill site is 1¾ miles northeast of Cobb which is on a main line of the Illinois Central Railroad. The site is adjacent to Ky. Highway 672, which intersects Ky. Highway 91 to the northeast and Ky. Highways 126 and 128 at Cobb. Princeton is 9 (airline) miles northwest of the core hole.

WUC

TABLE 15. CHEMICAL ANALYSES OF KENTUCKY GEOLOGICAL SURVEY-U. S. GEOLOGICAL SURVEY COBB CORE

County: Caldwell **Operator:** Ky. Geol. Survey-U. S. Geol. Survey
Property Owner: Garland Wood Elevation: 505 feet
Location: 1 3/4 miles northeast of Cobb on Ky. Highway 672 (Princeton East quadrangle)
Carter Coordinate Location: 4600' FSL and 4450' FEL, sec. 21-G-21

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
86.15	4.17	5.99	0.10	1.60	98.01	NOT ANALYZED	
88.50	2.83	3.74	0.10	1.51	96.68		
84.40	2.01	8.54	0.17	2.11	97.23		
44.32	2.63	45.18	0.32	3.75	96.20		
81.54	1.32	13.08	0.25	1.41	97.60		
73.02	1.45	19.68	0.20	2.04	96.39		
44.34	1.53	49.57	0.40	3.29	99.13		
57.38	2.06	32.29	0.35	3.04	95.12		
58.19	1.81	31.46	0.35	4.74	96.55		
75.64	2.18	16.94	0.25	2.87	97.88		
92.34	1.77	1.47	0.10	1.37	97.05		
93.56	1.66	2.67	0.10	1.28	99.27		
93.37	1.45	1.15	0.10	1.60	97.67		
94.62	1.42	1.12	0.05	1.24	98.45		
77.10	6.49	8.39	0.20	4.46	96.64		
81.34	5.65	6.61	0.20	3.45	97.25		
75.47	8.54	8.52	0.15	3.26	95.94		
78.32	8.27	7.41	0.15	2.83	96.98		
90.63	3.63	2.28	0.10	0.84	97.48		
96.82	1.45	0.86	0.05	0.04	99.22		
94.54	1.66	0.40	0.08	0.39	97.07		
95.52	1.24	1.00	0.05	0.28	98.09		
94.95	2.83	0.14	0.10	0.28	98.30		
91.85	5.38	0.20	0.15	0.42	98.--		
93.32	2.18	0.47	0.15	0.74	96.86		
88.75	6.70	1.78	0.15	0.18	97.56		
90.06	5.59	1.13	0.10	0.39	97.27		
86.96	8.51	0.89	0.10	0.28	96.74		
95.19	2.81	0.37	0.10	0.09	98.56		
92.80	3.45	0.88	0.05	0.41	97.59		
94.38	2.16	1.05	0.05	0.45	98.09		
68.30	19.94	6.59	0.20	1.21	96.24		
82.07	10.66	3.48	0.10	1.92	98.23		
95.68	1.07	0.74	0.05	0.66	98.20		
37.57	23.39	24.31	0.40	9.20	94.87		
43.20	24.44	20.97	0.50	7.37	96.48		
93.64	1.62	1.24	0.05	1.50	98.05		
56.56	16.39	16.30	0.25	6.81	96.31		
57.70	13.83	17.49	0.25	7.21	96.48		
57.70	13.56	17.47	0.25	7.23	96.21		
68.54	11.23	11.74	0.20	4.87	96.58		
71.07	12.37	9.77	0.25	3.81	97.27		

Sampled by: Preston McGrain and Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: January 16, 1967

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF SAMPLED INTERVAL IN CORE	
84'8"-86'			Limestone, medium-gray, fine- to medium-grained, calcarenitic and crystalline, with some fine-grained oolites.	
86-87	1	3'4"		
87-88				
88-89				
89-90			Limestone, medium-gray, fine- to medium-grained, calcarenitic and crystalline, with some fine-grained oolites; interbedded with greenish-gray siltstone. Siltstone layers are not over 2 inches thick. (Rosiclare Member.)	
90-91				
91-92	2	7		
92-93				
93-94				
94-95				
95-96				
96-97	3	4	Limestone, medium-gray, fine- to medium-grained, calcarenitic and oolitic, in part crystalline.	STE. GENEVIEVE LIMESTONE
97-98				
98-99				
99-100				
100-101	4	4	Limestone, medium-gray, very fine-grained, dense, argillaceous, with scattered small calcite faces.	
101-102				
102-103				
103-104				
104-105				
105-106				
106-107				
107-108				
108-109				
109-110			Limestone, light-gray, fine- to coarse-grained, oolitic, in part calcarenitic, with scattered large calcite faces; in part very finely crystalline and dolomitic from 116 to 118 feet; a few stylolites.	
110-111	5	16		
111-112				
112-113				
113-114				
114-115				
115-116				
116-117				
117-118				
118-119				
119-120				
120-121				
121-122				
122-123				
123-124				
124-125				
125-126				
126-127				

TABLE 15—*Continued*

County: Caldwell
Property Owner: Garland Wood
Operator: Ky. Geol. Survey-U. S. Geol. Survey

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
70.33	12.75	9.44	0.25	3.85	96.62		
73.02	12.02	9.52	0.20	3.54	98.30		
67.24	9.89	14.99	0.20	5.65	97.97		
79.71	7.23	6.51	0.12	2.70	96.27		
76.94	8.33	10.10	0.15	3.60	99.12		
54.25	14.64	19.22	0.25	7.27	95.63		
47.43	17.18	23.12	0.25	8.89	96.87	NOT ANALYZED	
59.41	16.07	15.99	0.15	6.10	97.72		
88.75	3.37	4.49	0.08	1.75	98.44		
88.84	4.20	4.05	0.10	1.73	98.92		
86.39	5.43	5.26	0.15	1.88	99.11		
80.08	7.50	7.73	0.13	3.02	98.46		
78.62	6.70	8.11	0.15	3.87	97.45		
90.97	2.45	3.64	0.08	1.68	98.82		
69.48	18.72	7.17	0.15	3.01	98.53		
68.78	17.48	9.77	0.20	2.55	98.78		
63.58	22.11	9.58	0.20	2.76	98.23		
63.82	23.35	8.49	0.20	2.66	98.52	NOT ANALYZED	
65.28	20.87	9.90	0.25	2.61	98.91		
55.53	22.95	16.12	0.25	3.54	98.39		
72.36	15.03	8.55	0.20	1.64	97.78		
77.48	11.58	6.86	0.15	1.56	97.63		
88.29	2.74	5.12	0.10	1.09	97.34		
97.15	0.82	0.36	0.08	0.63	99.04	.062	.006
97.72	0.53	0.22	0.07	0.82	99.36	.030	.005
98.05	0.48	0.26	0.05	0.61	99.45	.024	.004
93.09	5.49	0.18	0.10	0.52	99.38	.024	.004
96.23	2.45	0.22	0.05	0.52	99.47	.016	.004
96.06	2.71	0.19	0.05	0.95	99.96	.022	.005
95.77	2.68	0.24	0.08	0.48	99.25	.032	.005
96.26	2.10	0.27	0.05	0.55	99.23	.028	.006
96.34	1.77	0.25	0.05	0.72	99.13	.032	.003
96.47	2.03	0.17	0.05	0.65	99.37	.038	.003
96.79	1.94	0.14	0.05	0.64	99.56	.026	.004
96.42	2.03	0.18	0.05	0.55	99.23	.026	.004
94.96	2.16	0.50	0.05	0.54	98.21	.026	.003
93.95	4.54	0.18	0.10	0.44	99.21	.020	.003
92.36	5.81	0.28	0.10	0.49	99.04	.022	.004
95.04	3.55	0.21	0.08	0.59	99.47	.020	.003
95.74	2.95	0.10	0.05	0.31	99.15	.018	.003
95.45	3.16	0.04	0.05	0.46	99.16	.024	.003
95.77	2.48	0.24	0.03	0.65	99.17	.024	.003
96.26	2.12	0.26	0.05	0.43	99.12	.022	.002
96.18	2.01	0.54	0.05	0.12	98.90	.020	.003
96.10	2.25	0.40	0.05	0.36	99.16	.020	.006
96.10	2.83	0.08	0.05	0.52	99.58	.020	.006
96.42	2.60	0.22	0.05	0.40	99.69	.016	.004

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
127-128 128-129 129-130 130-131 131-132 132-133 133-134 134-135 135-136 136-137 137-138 138-139 139-140	6	21	Limestone, medium-gray, fine-grained to microgranular, calcarenitic, dolomitic, with some scattered calcite faces; scattered pyrite; interbedded with greenish-gray siltstone.	
140-141 141-142 142-143 143-144 144-145 145-146 146-147 147-148 148-149 149-150	7	10	Limestone, medium-gray, very fine- to fine-grained, with coarse-grained interbands; crystalline and calcarenitic, dolomitic; light bluish-gray chert; a few stylolites.	STE. GENEVIEVE LIMESTONE
150-151 151-152 152-153 153-154 154-155 155-156 156-157 157-158 158-159 159-160 160-161 161-162 162-163 163-164 164-165 165-166 166-167 167-168 168-169 169-170 170-171 171-172 172-173 173-174	8	24	Limestone, light-gray to grayish-white, fine- to coarse-grained, oolitic, in part bioclastic, with scattered calcite faces; soft in upper part; a few stylolites.	

TABLE 15—*Continued*

County: Caldwell **Operator:** Ky. Geol. Survey-U. S. Geol. Survey
Property Owner: Garland Wood

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
78.86	16.86	1.22	0.10	1.17	99.21		
84.24	11.16	2.60	0.08	1.62	99.70		
92.02	4.87	1.34	0.05	0.93	99.21	NOT ANALYZED	
92.45	5.41	0.43	0.05	0.76	99.10		
90.87	7.61	0.66	0.08	0.67	99.89		
91.50	6.60	1.07	0.05	0.77	99.99		
95.13	2.25	1.20	0.03	0.69	98.60	.020	.014
96.92	1.87	0.47	0.05	0.50	99.81	.020	.011
94.11	4.44	0.74	0.03	0.60	99.92	.030	.014
92.61	6.03	0.32	0.08	0.41	99.45	.022	.011
93.32	5.37	0.18	0.08	0.42	99.39	.036	.008
94.11	4.69	0.20	0.03	0.56	99.59	.038	.007
94.55	4.60	0.10	0.05	0.49	99.79	.037	.005
95.37	3.48	0.56	0.05	0.37	99.83	.038	.006
94.27	4.64	0.20	0.05	0.40	99.56	.034	.006
95.88	2.48	0.50	0.03	0.48	99.37	.058	.013
96.71	1.59	0.64	0.03	0.45	99.42	.062	.012
95.85	1.91	0.74	0.03	0.65	99.18	.062	.009
96.27	1.72	0.59	0.08	0.38	99.04	.058	.011
96.12	1.97	0.53	0.05	1.14	99.81	.058	.011
97.03	1.97	0.46	0.03	0.41	99.88	.048	.013
96.56	1.84	0.76	0.03	0.45	99.64	.062	.015
94.74	3.14	1.19	0.03	0.69	99.69	.098	.017
92.85	4.49	1.04	0.08	0.77	99.23	.082	.022
97.42	0.95	0.08	0.03	0.47	98.95	.062	.004
97.58	0.83	0.17	0.03	0.43	99.04	.034	.007
98.06	0.71	0.20	0.03	0.64	99.64	.028	.006
97.66	0.76	0.65	0.03	0.63	99.73	.026	.003
97.58	0.94	0.48	0.03	0.91	99.94	.032	.004
97.58	0.95	0.26	0.03	1.17	99.99	.020	.013
98.04	0.21	0.42	0.03	0.48	99.18	.024	.005
97.59	0.33	0.13	0.05	0.49	98.59	.028	.004
96.42	2.34	0.26	0.05	0.50	99.57	.020	.004
93.91	4.96	0.25	0.08	0.63	99.56	.020	.011
81.--	17.[illegible]	0.10	0.13	1.40	99.99		
95.21	4.02	0.32	0.03	0.41	99.99	NOT ANALYZED	
94.35	4.96	0.22	0.03	0.43	99.99		
76.74	21.46	0.26	0.13	0.71	99.30		
56.61	40.64	1.35	0.18	0.83	99.61	NOT ANALYZED	
61.11	34.91	2.60	0.13	0.88	99.63		
97.19	1.91	0.36	0.03	0.29	99.78	.056	.011
97.58	1.54	0.44	0.03	0.36	99.95	.044	.009
98.45	1.27	0.00	0.03	0.21	99.96	.042	.011
98.53	0.44	0.36	0.03	0.59	99.95	.040	.014
97.27	0.76	0.57	0.03	0.54	99.17	.048	.017

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION Lithology	Formation
174-175				
175-176				
176-177			Limestone, medium-gray, very fine- to fine-grained, dolomitic; coarser grained and more crystalline in thin streaks near base; a few stylolites.	
177-178	9	7		
178-179				
179-180				
180-181				
181-182				
182-183				
183-184				
184-185				
185-186				
186-187				
187-188				
188-189				
189-190				
190-191				
191-192				
192-193				
193-194			Limestone, light-gray, fine- to coarse-grained, oolitic, in part bioclastic, with scattered calcite faces; very finely crystalline and dolomitic from 208 to 209 feet; noticeably lighter in color from 198 to 211 feet; a few stylolites.	STE. GENEVIEVE LIMESTONE
194-195				
195-196	10	30		
196-197				
197-198				
198-199				
199-200				
200-201				
201-202				
202-203				
203-204				
204-205				
205-206				
206-207				
207-208				
208-209				
209-210				
210-211				
211-212			Dolomite and dolomitic limestone, medium-gray, very finely to finely crystalline.	
212-213	11	3		
213-214				
214-215				
215-216				
216-217				
217-218				
218-219				

TABLE 15—*Continued*

County: Caldwell
Property Owner: Garland Wood
Operator: Ky. Geol. Survey-U. S. Geol. Survey

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
97.42	1.34	0.60	0.05	0.59	100.--	.046	.021
97.03	1.48	0.94	0.05	0.47	99.97	.053	.019
94.90	3.01	1.13	0.05	0.71	99.80	.064	.019
97.98	1.14	0.40	0.03	0.41	99.96	.048	.009
97.90	0.82	0.80	0.03	0.43	99.98	.050	.010
97.37	1.31	0.82	0.03	0.47	100.--	.044	.010
97.11	1.53	0.70	0.03	0.14	99.51	050	.012
95.69	1.74	1.15	0.05	0.15	98.78	054	.011
96.08	2.09	1.02	0.03	0.33	99.55	.114	.021
96.48	1.95	0.28	0.03	0.29	99.03	.078	.025
95.77	1.97	0.51	0.03	0.37	98.65	.082	.026
95.53	2.03	0.60	0.05	0.34	98.55	.074	.026
95.85	1.66	0.71	0.05	0.81	99.16	.078	.028
96.24	1.68	0.97	0.03	0.78	99.70	.076	.027
96.00	1.45	1.16	0.03	0.71	99.35	.066	.025
96.48	1.69	0.90	0.03	0.69	99.79	.076	.026
95.53	1.51	0.67	0.05	0.51	98.27	.068	.025
88.27	6.34	2.70	0.05	1.64	99.00	NOT ANALYZED	
65.45	24.93	5.41	0.15	2.05	97.99		
92.88	3.48	2.10	0.05	0.60	99.06		
95.09	2.00	1.32	0.03	0.31	98.69	NOT ANALYZED	
94.43	2.33	1.79	0.03	0.76	99.34		
51.96	35.53	9.08	0.10	2.19	98.86		
56.67	31.22	7.88	0.10	1.88	97.75		
59.03	30.65	6.49	0.10	1.69	97.96		
51.37	34.91	9.62	0.10	1.70	97.70	NOT ANALYZED	
52.55	36.27	6.96	0.10	1.47	97.35		
54.68	36.77	5.83	0.10	1.99	99.37		
58.14	29.39	8.09	0.15	1.92	97.69		
84.93	8.97	4.20	0.07	1.29	99.46	NOT ANALYZED	
93.03	3.67	2.12	0.05	1.11	99.98		
95.61	0.59	0.65	0.05	1.15	98.05	.054	.007
96.86	1.59	0.76	0.03	0.58	99.73	.070	.011
96.49	1.42	0.75	0.05	0.65	99.36	.142	.013
96.27	1.36	1.02	0.05	0.65	99.35	.080	.012
95.90	1.41	0.82	0.05	0.42	98.60	.054	.012
95.02	1.51	1.34	0.05	0.65	98.57	.060	.013
95.68	1.57	0.79	0.05	0.59	98.68	.060	.014
94.80	1.66	0.60	0.05	0.72	97.83	.050	.014
96.56	1.25	0.42	0.05	0.54	98.82	.050	.011
93.47	3.34	1.28	0.05	0.52	98.66	.038	.014
89.13	8.60	1.24	0.08	0.58	99.63	.056	.029
95.83	0.83	0.54	0.03	0.38	97.61	.054	.009
95.90	0.83	0.88	0.05	0.34	98.00	.056	.009

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
219-220 220-221 221-222 222-223 223-224 224-225 225-226 226-227 227-228	12	14	Limestone, light-gray to grayish-white, fine- to coarse-grained, oolitic, in part bioclastic, with a few stylolites.	
228-229 229-230 230-231 231-232 232-233 233-234 234-235 235-236 236-237 237-238	13	10	Limestone, medium-gray, very finely to medium-crystalline, in part calcarenitic; more finely crystalline and dolomitic at base; a few stylolites.	STE. GENEVIEVE LIMESTONE
238-239 239-240 240-241	14	3	Limestone, medium-gray, fine- to coarse-grained, calcarenitic and crystalline.	
241-242 242-243 243-244 244-245 245-246 246-247 247-248	15	7	Dolomite, dove-gray, very fine- to fine-grained, siliceous, with a few stylolites.	
248-249 249-250	16	2	Limestone, medium- to light-gray, very fine- to coarse-grained, calcarenitic and crystalline, with some oolites near base.	
250-251 251-252 252-253 253-254 254-255 255-256 256-257 257-258 258-259 259-260 260-261 261-262 262-263				

TABLE 15—*Continued*

County: Caldwell
Property Owner: Garland Wood

Operator: Ky. Geol. Survey-U. S. Geol. Survey

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
95.75	1.15	1.36	0.05	0.38	98.69	.060	.011
95.97	2.16	1.13	0.03	0.52	99.81	.052	.017
94.36	2.89	0.85	0.05	0.42	98.57	.054	.021
94.29	2.33	1.27	0.05	0.56	98.49	.084	.018
96.93	0.48	0.73	0.05	0.34	98.53	.026	.008
97.45	0.71	0.59	0.03	0.00	98.78	.050	.008
97.15	0.86	0.40	0.03	0.12	98.56	.040	.009
97.15	0.97	0.47	0.03	0.18	98.80	.044	.009
97.30	0.60	0.33	0.03	0.09	98.35	.034	.016
97.30	0.42	0.32	0.03	0.15	98.22	.034	.011
97.37	0.64	0.22	0.03	0.30	98.56	.038	.012
97.00	0.57	0.47	0.03	0.44	98.51	.036	.010
97.37	0.42	0.06	0.03	0.50	98.38	.022	.010
97.89	1.21	0.25	0.03	0.29	99.67	.028	.010
97.00	1.27	0.30	0.03	0.28	98.88	.032	.012
97.45	1.25	0.38	0.03	0.28	99.39	.032	.012
97.00	1.30	0.43	0.03	0.37	99.13	.042	.013
96.71	1.50	0.95	0.03	0.56	99.75	.042	.012
74.48	21.92	1.90	0.05	1.22	99.57	NOT ANALYZED	
56.08	37.13	4.13	0.08	1.72	99.14		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
263-264 264-265 265-266 266-267 267-268 268-269 269-270 270-271 271-272 272-273 273-274 274-275 275-276 276-277 277-278 278-279 279-280 280-281	17	31	Limestone, light-gray, fine- to coarse-grained, oolitic, in part bioclastic; calcarenitic lenses from 276 to 281 feet; predominantly very finely crystalline and dolomitic from 260 to 261 feet; a few stylolites.	STE. GENEVIEVE LIMESTONE
281-282 282-283	18	2	Dolomite and dolomitic limestone, dove-gray, very finely to finely crystalline.	

BOTTOM OF SAMPLED INTERVAL

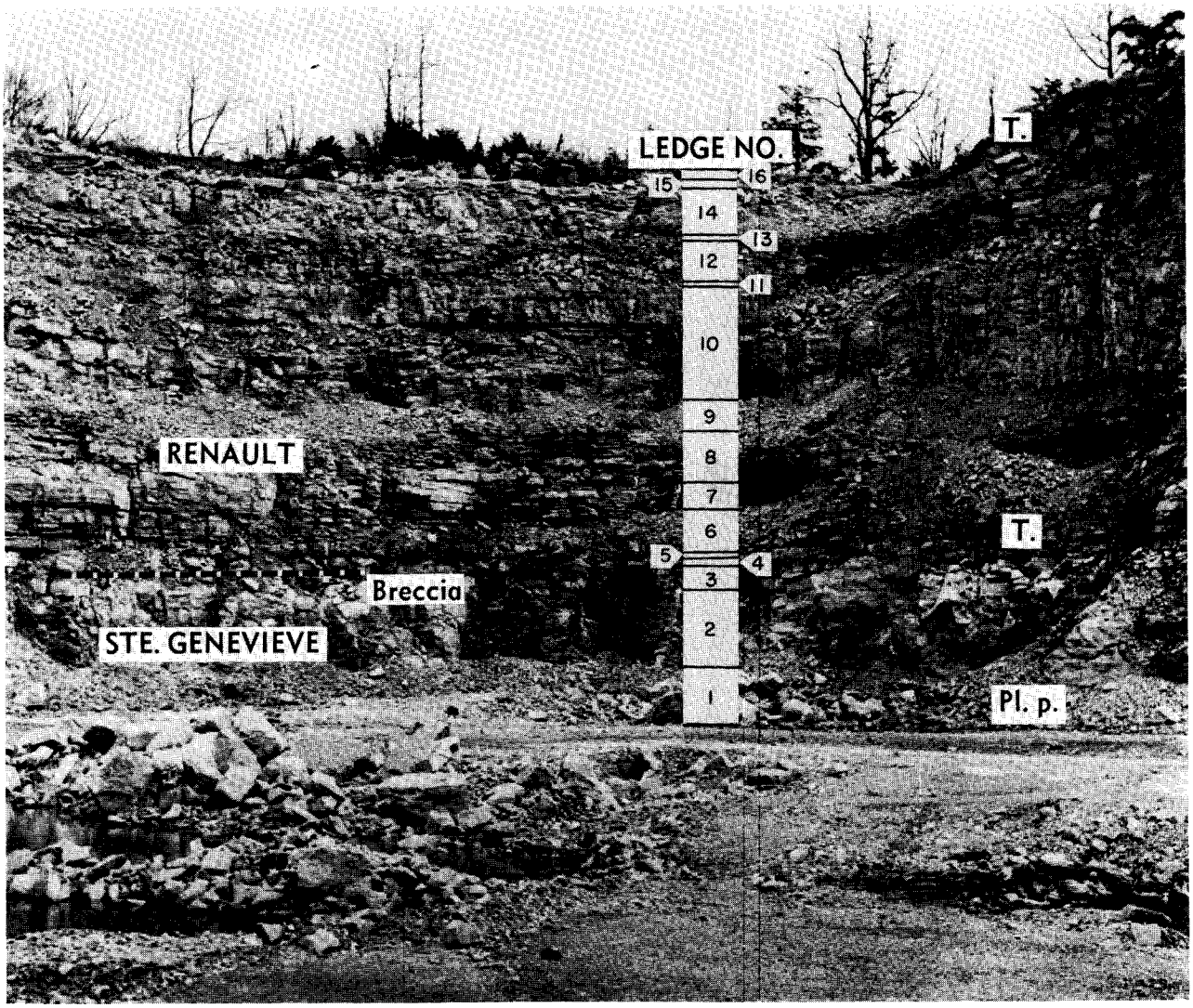
NOTE: The base of the Ste. Genevieve Limestone was at a depth of 313 feet in the core hole.

Cedar Bluff Stone Company's Cerulean Quarry

This open-face quarry, which is presently inactive, was operated initially by the Cerulean Stone Company and later by the Cedar Bluff Stone Company. Crushed limestone was produced for concrete aggregate, roadstone, riprap, railroad ballast, and agricultural limestone. The stone was quarried from the Renault Limestone and the upper part of the Ste. Genevieve Limestone (Fig. 20). When the site was visited by the writers in November 1967, it was filled with water to the top of Ledge 2. Foot-by-foot analyses are reported in Table 16.

No operable thicknesses of high-calcium limestone were found in the quarry. Thirteen feet of vaughanitic limestone in the Renault, in the interval from 56 to 69 feet, has an average magnesium carbonate content of 2.8 percent.

The quarry is adjacent to a main line of the Illinois Central Railroad and Ky. Highway 126. This highway intersects Ky. Highways 128 and 672 to the west, and Ky. Highway 124 to the east at the community of Cerulean Springs.



Abbreviations: Pl. p.—*Platycrinites penicillus*
T.—*Talarocrinus*

Figure 20. Photograph of Cedar Bluff Stone Company's Cerulean quarry showing ledge designations.

WCR

TABLE 16. CHEMICAL ANALYSES OF CEDAR BLUFF STONE COMPANY'S CERULEAN QUARRY

County: Trigg **Operator:** Inactive
Property Owner: Cedar Bluff Stone Company, Inc.
Location: 1½ miles northwest of Cerulean Springs on Ky. Highway 126
Carter Coordinate Location: 6, 7-F-22 (Gracey quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
95.1	2.3	1.50	0.22	0.30	99.4	NOT ANALYZED	
95.5	2.0	1.31	0.24	0.24	99.3		
95.5	2.1	1.57	0.25	0.27	99.7		
			NO SAMPLES				
81.0	14.6	2.02	0.93	0.80	99.4		
85.4	5.8	5.71	0.50	1.49	98.9		
85.1	7.4	5.01	0.46	1.25	99.2		
91.4	4.5	2.84	0.36	0.93	100.0		
89.4	5.8	3.72	0.35	0.70	100.0		
89.5	6.0	3.19	0.41	0.54	99.6		
87.5	6.5	4.41	0.41	0.51	99.3		
85.6	8.9	4.46	0.26	0.00	99.2		
82.5	11.4	4.74	0.48	0.50	99.6		
			NO SAMPLE				
90.0	2.8	5.40	0.45	0.58	99.2		
91.5	2.6	4.42	0.38	0.37	99.3		
91.8	2.8	3.59	0.40	0.52	99.1		
92.4	2.7	3.47	0.33	0.27	99.2		
93.6	3.0	2.20	0.21	0.31	99.3		
93.3	3.5	2.90	0.22	0.10	100.0		
93.4	2.7	2.71	0.20	0.26	99.3		
92.5	2.8	2.83	0.27	0.78	99.2		
92.6	2.6	2.64	0.32	0.49	98.7		
93.5	2.9	2.05	0.21	0.31	99.0		
93.0	2.8	2.46	0.23	0.36	98.9		
93.9	2.5	2.31	0.18	0.13	99.0		
90.7	2.6	3.86	0.41	0.75	98.3		
			NO SAMPLE				
91.6	2.7	3.39	0.24	0.10	97.9		
90.5	2.9	3.78	0.36	0.20	97.7		
88.5	4.2	3.64	0.40	0.57	97.3		
92.3	2.6	2.84	0.26	0.06	98.1		
91.5	2.8	3.19	0.33	0.31	98.1		
93.4	3.1	2.60	0.26	0.25	99.6		
93.5	3.0	2.47	0.19	0.32	99.5		
93.5	2.9	2.70	0.18	0.28	99.6		
92.1	3.0	3.44	0.27	0.46	99.3		
89.9	5.5	3.22	0.26	0.46	99.3		
86.4	7.8	3.82	0.31	0.64	99.0		
81.6	11.4	4.67	0.36	0.79	98.8		

Sampled by: Harry W. Settle and Eugene M. Luttrell
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: December 7, 1951

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
		3	Stripping.	
84-85 83-84 82-83	16	3	Limestone, light-gray, fine-grained, oolitic, hard, thick-bedded.	
79-82	15	3	Covered zone.	
78-79 77-78 76-77 75-76 74-75 73-74 72-73 71-72 70-71	14	9	Limestone, light-gray, microgranular, in part slightly crystalline and slightly dolomitic, with many pyrite cubes.	
69-70	13	1	Shale, green.	RENAULT LIMESTONE
68-69 67-68 66-67 65-66 64-65 63-64 62-63 61-62 60-61 59-60 58-59 57-58 56-57	12	13	Limestone, gray, vaughanitic, with some pyrite cubes near top; thick-bedded, with thinner beds in lower part.	
55-56	11	1	Shale, gray, with thin, rubbly limestone.	
54-55 53-54 52-53 51-52 50-51 49-50 48-49 47-48 46-47 45-46 44-45 43-44	10	16	Limestone, dark-gray and brown, vaughanitic, in part dolomitic; very thin-bedded.	

TABLE 16—*Continued*

County: Trigg **Operator:** Inactive
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
81.7	11.8	4.55	0.46	0.48	99.0	NOT ANALYZED	
75.7	14.9	6.64	0.55	0.96	98.8		
86.0	8.3	4.07	0.35	0.28	99.0		
83.4	10.0	4.87	0.38	0.50	99.2		
80.4	5.0	8.75	0.44	2.98	97.6		
80.6	5.2	8.82	0.46	2.68	97.8		
81.0	5.0	8.55	0.43	2.89	97.9		
84.1	4.7	7.01	0.38	1.99	98.2		
91.6	3.0	3.51	0.45	0.10	98.0		
90.1	3.6	3.78	0.40	0.36	98.2		
91.5	3.2	3.06	0.22	0.35	98.4		
88.4	3.8	4.54	0.40	0.83	98.0		
91.5	4.3	2.90	0.30	0.17	99.2		
85.4	7.0	4.37	0.38	0.80	98.0		
89.8	4.5	3.34	0.26	0.43	98.3		
94.5	2.0	1.86	0.08	0.00	98.4		
93.5	2.3	2.62	0.20	0.22	98.8		
90.3	3.0	3.68	0.35	0.57	97.9		
79.8	5.3	9.58	0.52	1.96	97.2		
88.0	3.4	5.31	0.32	0.58	97.6		
86.4	3.8	7.25	0.37	0.77	98.6		
88.6	3.3	5.17	0.37	0.78	98.2		
9.7	8.7	50.60	2.58	17.83	89.4		
87.6	2.9	6.83	0.37	0.52	98.2		
89.0	2.9	6.08	0.32	0.32	98.6		
98.0	1.21	0.24	0.12	0.00	99.6		
98.1	1.09	0.28	0.10	0.00	99.6		
98.7	1.03	0.23	0.05	0.00	100.0		
98.5	0.97	0.09	0.04	0.00	99.6		
97.0	1.76	0.51	0.13	0.04	99.4		
93.6	4.8	1.09	0.15	0.10	99.7		
90.1	6.7	2.14	0.20	0.42	99.6		
91.4	4.0	3.11	0.16	0.26	98.9		
88.1	7.3	3.30	0.18	0.08	99.0		
93.0	3.8	2.50	0.16	0.10	99.6		
93.9	2.9	2.06	0.13	0.11	99.1		
93.9	2.5	2.45	0.13	0.09	99.1		
94.0	3.0	2.33	0.12	0.00	99.5		
93.1	3.3	2.46	0.12	0.00	99.0		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
42-43 41-42 40-41 39-40				
38-39 37-38 36-37 35-36	9	4	Limestone, gray, vaughanitic, shaly.	
34-35 33-34 32-33 31-32 30-31 29-30 28-29	8	7	Limestone, gray to brown, vaughanitic, in part slightly crystalline; zone of abundant productoid brachiopods.	RENAULT LIMESTONE
27-28 26-27 25-26	7	3	Limestone, gray to tan, coarsely crystalline, fossiliferous, medium-bedded.	
24-25 23-24 22-23 21-22	6	4	Limestone, dark-gray, microgranular, shaly.	
20-21	5	1	Shale, gray.	
19-20 18-19	4	2	Limestone, bluish-gray to brown, medium-grained, oolitic, soft; in part microgranular and very fine-grained; medium-bedded.	
17-18 16-17 15-16 14-15	3	4	Limestone, light- to brownish-gray, medium-grained, oolitic, soft, thick-bedded; weathers white; breccia zone at top, with bluish-white and black brecciated chert.	
13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5	2	10	Limestone, gray, vaughanitic, with a few scattered hard oolites; thin- to medium-bedded; bluish-white nodular chert from 4 to 6 feet.	STE. GENEVIEVE LIMESTONE

TABLE 16—*Continued*

County: Trigg **Operator:** Inactive
Property Owner: Cedar Bluff Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
90.6	4.1	3.39	0.23	0.00	98.3	NOT ANALYZED	
90.4	3.7	3.55	0.23	0.02	97.9		
78.1	10.9	7.09	0.48	1.70	98.3		
70.4	14.8	9.65	0.70	2.35	97.9		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
3-4 2-3 1-2 0-1	1	4	Limestone, gray, vaughanitic, in part dolomitic, with some interbedded green clay.	STE. GENEVIEVE LIMESTONE

BOTTOM OF QUARRY (December 7, 1951)

Hopkinsville Stone Company Quarry

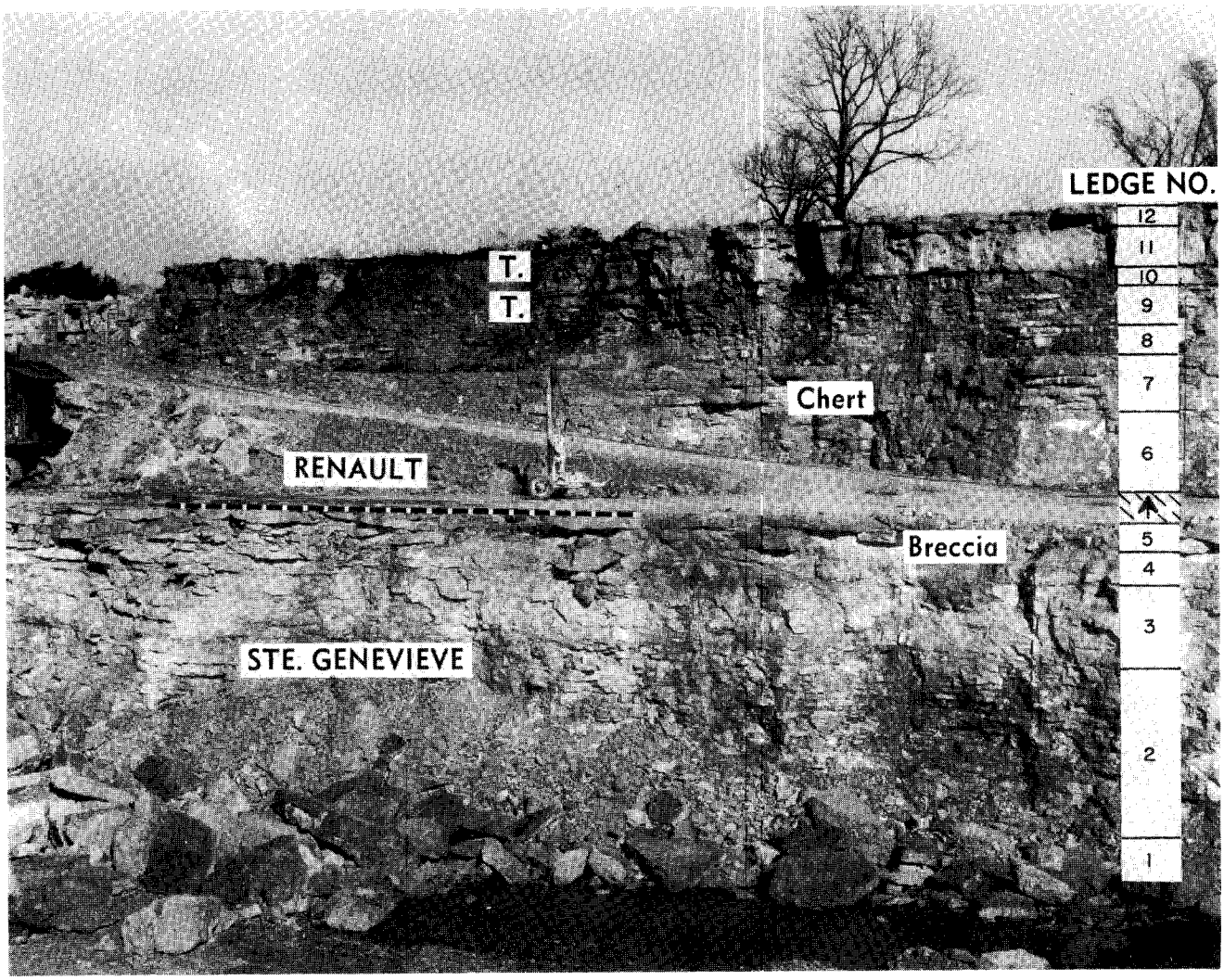
This quarry is an active open-face operation, producing crushed limestone for concrete aggregate, roadstone, riprap, and agricultural limestone. The stone has been quarried from the Renault and Ste. Genevieve Limestones (Fig. 21). The quarry was initially sampled in 1950 and the analyses reported by Stokley and McFarlan (1952, p. 41-43). The floor has been deepened and in 1968 was approximately 125 feet below the level of the 1950 floor. Nineteen feet of oolitic limestone has been exposed in the lower part of the quarry. Foot-by-foot analyses of the lower 20 feet in the 1968 quarry and of the 58-foot section sampled in 1950 are reported in Table 17.

In the Ste. Genevieve Limestone calcium carbonate content of individual samples is as great as 97.8 percent. Average chemical analysis of the purest zone, Ledges 1A-2A, is:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
0-20	96.29	1.83	0.61	0.03	0.26	.019	.012

Though there are no operable thicknesses of high-calcium limestone in the upper part of the quarry, the interval from 0 to 22 feet (Ledges 1-5) has an average magnesium carbonate content of 2.2 percent and an average total carbonate content of 96.3 percent. Figure 12 shows the relationship of the high-calcium zone in this quarry with the zones in the Ste. Genevieve Limestone at other locations in the region.

The quarry is 1½ miles north of Hopkinsville on U. S. Highway 41, and has a rail siding connecting with the Louisville & Nashville Railroad. Hopkinsville, the seat of Christian County, is also served by the Illinois Central Railroad, U. S. Highways 68 and Alt. 41, and a network of state highways. The Pennyrile Parkway, a state toll road, is currently under construction and will extend from south of the city northward to Henderson, on the Ohio River.



Abbreviation: T.—*Talarocrinus*

Figure 21. Photograph of Hopkinsville Stone Company quarry showing ledge designations in the upper part of the now-deepened quarry.

WHH

TABLE 17. CHEMICAL ANALYSES OF HOPKINSVILLE STONE COMPANY QUARRY

County: Christian **Operator:** Hopkinsville Stone Company, Inc.
Property Owner: Hopkinsville Stone Company, Inc.
Location: 1½ miles north of Hopkinsville on U. S. Highway 41
Carter Coordinate Location: 7-E-25 (Kelly quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
91.0	2.6	4.60	0.43	0.46	99.1	NOT ANALYZED	
94.3	2.1	2.24	0.18	0.00	98.8		
93.5	2.1	3.67	0.25	0.00	99.6		
93.5	2.7	3.11	0.25	0.00	99.6		
92.8	4.0	2.91	0.23	0.00	100.0		
86.8	8.5	3.50	0.40	0.09	99.2		
95.0	2.7	1.66	0.20	0.11	98.6		
94.3	2.3	1.68	0.25	0.04	98.5		
94.3	2.4	2.53	0.25	0.47	99.9		
95.3	2.3	1.59	0.25	0.07	99.5		
94.2	2.2	3.23	0.28	0.10	100.0		
95.0	2.4	1.60	0.23	0.27	99.5		
92.1	3.2	3.21	0.30	0.64	99.5		
88.5	4.3	5.00	0.38	1.04	99.3		
88.9	3.9	4.40	0.33	0.89	98.3		
93.2	3.0	2.61	0.20	0.50	99.5		
91.4	3.2	3.82	0.30	0.72	99.4		
82.5	5.6	9.32	0.45	1.28	99.1		
84.3	5.8	7.10	0.45	0.94	98.5		
81.8	7.0	8.83	0.60	1.83	99.9		
87.1	5.2	5.77	0.40	0.86	99.3		
93.2	3.0	3.48	0.20	0.19	100.0		
92.4	3.4	3.51	0.20	0.47	100.0		
92.6	3.4	3.22	0.20	0.51	100.0		
92.5	3.5	3.39	0.20	0.38	100.0		
93.2	2.8	3.03	0.20	0.11	99.3		
92.8	2.5	2.90	0.20	0.01	98.4		
88.9	5.2	3.72	0.28	0.41	98.5		
88.9	4.6	3.64	0.25	0.50	97.9		
89.6	4.5	3.83	0.25	0.27	98.5		
90.0	4.2	3.84	0.20	0.43	98.6		
85.3	6.2	4.64	0.25	0.71	97.1		
88.2	4.7	4.45	0.25	0.51	98.1		
90.3	4.6	3.74	0.23	0.25	99.1		
89.6	3.4	4.11	0.22	0.22	97.6		
83.1	3.9	10.37	0.43	2.25	100.0		
92.8	2.8	3.13	0.23	0.52	99.5		
95.0	2.2	1.70	0.18	0.40	99.4		

Sampled by: Harry W. Settle
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: November 8, 1950

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION — Lithology	Formation
			TOP OF QUARRY	
		0-8	Stripping. Soil and vegetation.	
57 -58 56 -57 55 -56 54 -55 53 -54 189 52 -53	12	6	Limestone, gray, fine-grained, dense, in part crystalline, slightly fossiliferous.	
51 -52 50 -51 49 -50 185 48 -49	11	4	Limestone, gray, fine-grained, dense; with some hard, fine-grained, oolitic limestone.	
47 -48 183 46 -47	10	2	Limestone, gray, fine-grained, oolitic, hard.	
45 -46 44 -45 43 -44 42 -43 178 41 -42	9	5	Limestone, gray, fine-grained, dense, thin-bedded, with some interbedded green shale.	RENAULT LIMESTONE
40 -41 39 -40 38 -39 174 37 -38	8	4	Limestone, gray, fine-grained, dense, medium-bedded.	
36 -37 35 -36 34 -35 33 -34 32 -33 168 31 -32	7	6	Limestone, gray, fine-grained, dense, with abundant black nodular chert; thin-bedded.	
30 -31 29 -30 28 -29 27 -28 26 -27 25 -26 24 -25 160 23 -24	6	8	Limestone, dark-gray with blue streaks, fine-grained, dense, medium-bedded; zone of abundant productoid brachiopods.	
22 -23 21 -22 151.5 20½-21	5	2½	Limestone, dark-gray, oolitic, soft; breccia zone.	STE. GENEVIEVE LIMESTONE

TABLE 17—*Continued*

County: Christian **Operator:** Hopkinsville Stone Company, Inc.
Property Owner: Hopkinsville Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
97.7	1.71	0.58	0.09	0.00	100.0	NOT ANALYZED	
97.8	1.63	0.49	0.08	0.05	100.0		
97.4	1.71	0.64	0.09	0.09	100.0		
96.8	1.71	1.43	0.07	0.01	100.0		
95.7	1.66	1.85	0.13	0.04	99.4		
95.0	1.72	2.58	0.12	0.05	99.4		
95.0	1.68	2.31	0.06	0.12	99.1		
93.5	2.3	2.88	0.18	0.64	99.5		
92.8	2.3	2.95	0.15	0.56	98.8		
93.9	2.3	3.21	0.20	0.00	99.6		
93.5	2.4	2.94	0.20	0.00	99.1		
94.6	2.3	2.77	0.12	0.06	99.9		
92.1	2.7	3.57	0.20	0.65	99.2		
88.9	2.9	4.81	0.25	0.85	97.7		
90.7	2.9	5.06	0.30	0.85	99.8		
92.1	2.8	3.78	0.22	0.57	99.5		
91.4	3.4	4.22	0.26	0.74	100.0		
94.3	0.97	2.60	0.17	0.25	98.3		
93.5	3.0	2.74	0.22	0.49	100.0		
95.4	2.1	2.21	0.12	0.22	100.0		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
19 -20½ 18 -19 17 -18 153 16 -17	4	4½	Limestone, dark-gray, medium-grained, oolitic, soft, porous.	STE. GENEVIEVE LIMESTONE
15 -16 14 -15 150 13 -14	3	3	Limestone, light-gray, fine-grained, dense.	
12 -13 11 -12 10 -11 9 -10 8 -9 7 -8 6 -7 5 -6 141 4 -5	2	9	Limestone, gray, fine-grained, dense, thin-bedded.	
3 -4 2 -3 1 -2 137-138 0 -1	1	4	Limestone, light-gray, medium-grained, oolitic, hard, fossiliferous, medium-bedded.	

BOTTOM OF QUARRY (November 8, 1950)

2 Subsequent sampling events

105' GAP

1968 WHH2 12 - 32' 20'

1976 WHH3 0 - 12' 12'

TABLE 17—*Continued* WHH2

County: Christian **Operator:** Hopkinsville Stone Company, Inc.
Property Owner: Hopkinsville Stone Company, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
95.70	2.84	0.74	0.05	0.29	99.62	.028	.008
96.53	1.60	0.38	0.03	0.26	98.80	.008	.006
96.53	2.43	0.48	0.05	0.20	99.69	.014	.009
96.53	2.36	0.39	0.05	0.12	99.45	.012	.007
96.43	2.48	0.26	0.05	0.12	99.34	.012	.009
96.73	2.06	0.42	0.03	0.13	99.37	.016	.006
95.70	1.53	0.46	0.02	0.20	97.91	.016	.008
95.84	3.54	0.39	0.03	0.15	99.95	.012	.006
91.98	6.50	0.41	0.05	0.28	99.22	.010	.009
97.42	1.86	0.41	0.03	0.11	99.83	.016	.006
94.87	2.37	0.37	0.02	0.19	97.82	.016	.012
96.80	1.74	0.97	0.02	0.23	99.76	.018	.014
97.08	1.71	0.47	0.02	0.19	99.47	.016	.013
95.70	3.22	0.71	0.03	0.24	99.90	.028	.017
97.22	0.03	0.81	0.03	0.36	98.45	.014	.013
96.32	0.02	1.18	0.03	0.41	97.96	.046	.023
97.49	0.03	0.75	0.03	0.60	98.90	.028	.024
96.25	0.01	1.02	0.03	0.36	97.67	.022	.019
97.49	0.20	0.72	0.02	0.39	98.82	.024	.017
97.15	0.06	0.83	0.03	0.39	98.46	.030	.024

Sampled by: Preston McGrain and Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: February 8, 1968

DESCRIPTION				
Sample Level (Feet)	**Ledge No.**	**Thickness (Feet)**	**Lithology**	**Formation**

NOTE: The quarry has been deepened since November 1950. There is an interval of approximately 105 feet that has not been sampled between the level of the quarry bottom in 1950 and the top of the 20-foot section sampled in the basal part of the quarry in February 1968.

TOP OF SAMPLED INTERVAL

19-20	2A	1	Limestone, medium-gray, microgranular; subconchoidal fracture; stylolitic contact at base. Basal foot of ledge overlying the oolitic limestone.	
18-19 17-18 16-17 15-16 14-15 13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5 3-4 2-3 1-2 0-1	1A	19	Limestone, light-gray to white, medium- to fine-grained, oolitic; with a small amount of medium- to coarse-grained bioclastic limestone; some larger fossil fragments; stylolitic.	STE. GENEVIEVE LIMESTONE

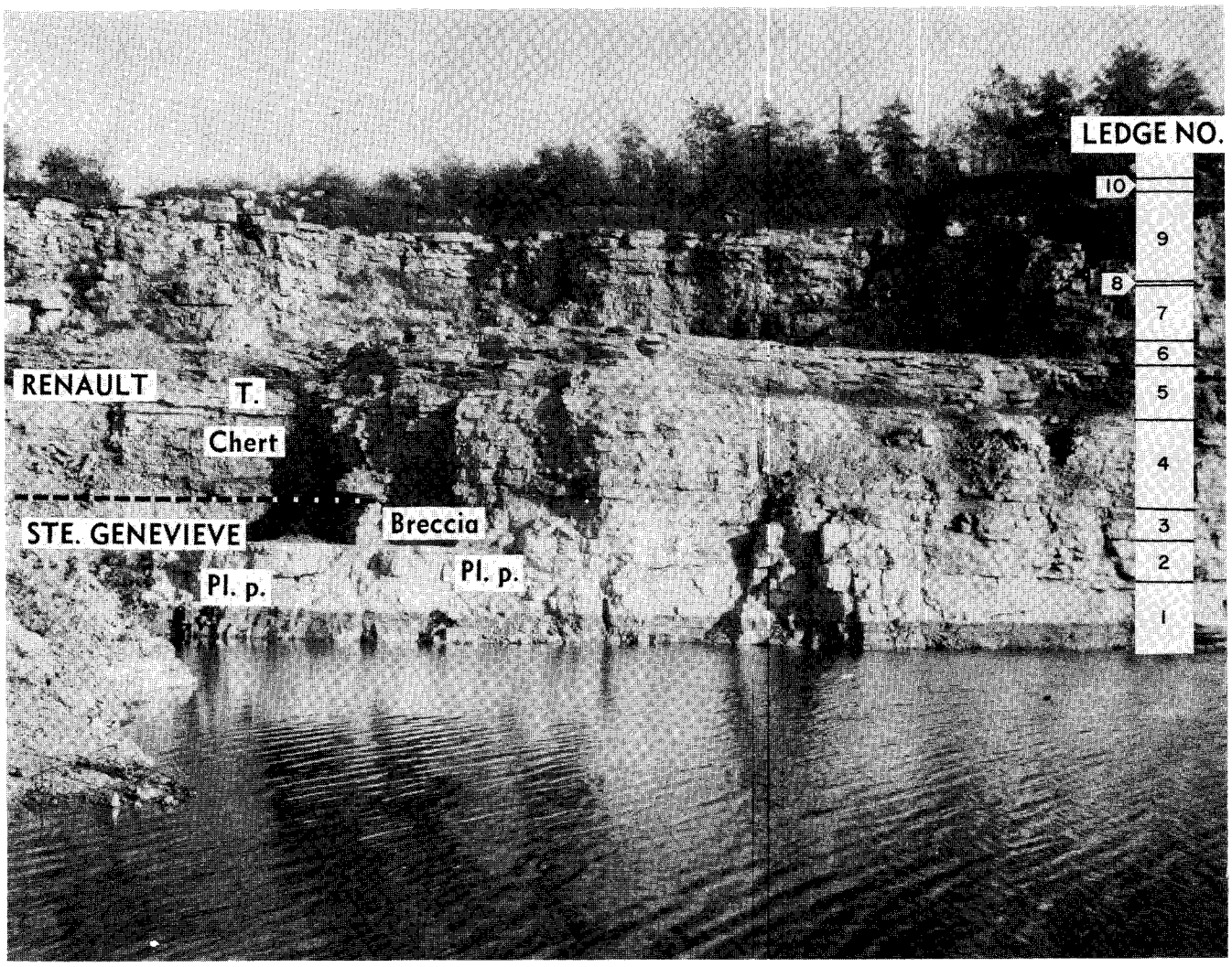
BOTTOM OF QUARRY (February 8, 1968)

Abandoned Cook Stone Company Quarry

This open-face quarry, which has been abandoned for a number of years, is reported to have been formerly operated by the Cook Stone Company. The stone was quarried from the Renault Limestone and the upper part of the Ste. Genevieve Limestone (Fig. 22). The site is presently utilized for water storage by the local Water and Sewerage Commission. Foot-by-foot analyses of the exposed face, as previously reported by Stokley and McFarlan (1952, p. 44-47), are presented in Table 18.

No operable thicknesses of high-calcium limestone were found in the quarry. The 17-foot section of Ste. Genevieve exposed above the water level has an average total carbonate content of 98.0 percent and contains an 11-foot zone of high-calcium stone. Seventeen feet of limestone in the Renault, in the interval from 53½ to 70½ feet, has an average magnesium carbonate content of 2.04 percent.

The abandoned quarry is at the northeastern edge of Hopkinsville, adjacent to North Vine Street.



Abbreviations: Pl. p.—*Platycrinites penicillus*
T.—*Talarocrinus*

Figure 22. Photograph of abandoned Cook Stone Company quarry showing ledge designations.

WCK

TABLE 18. CHEMICAL ANALYSES OF ABANDONED COOK STONE COMPANY QUARRY

County: Christian **Operator:** Abandoned
Property Owner: Water and Sewerage Commission
Location: At the northeast edge of Hopkinsville, adjacent to North Vine Street
Carter Coordinate Location: 14-E-25 (Hopkinsville quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
			NO SAMPLES				
			NO SAMPLES				
91.4	3.39	3.80	0.70	0.82	100.1	NOT ANALYZED	
97.0	0.91	1.84	0.10	0.04	99.9		
94.0	1.51	3.15	0.23	0.18	99.1		
94.0	2.27	2.25	0.25	0.53	99.3		
93.1	2.43	2.34	0.22	0.36	98.5		
94.1	2.12	2.02	0.23	0.21	98.7		
93.5	2.95	3.01	0.23	0.46	100.2		
94.5	2.21	2.66	0.20	0.36	99.9		
90.5	2.15	4.86	0.27	0.80	98.6		
93.3	2.10	3.22	0.22	0.36	99.2		
93.6	2.27	2.95	0.24	0.44	99.5		
94.9	1.82	2.45	0.22	0.14	99.5		
94.5	1.70	2.99	0.20	0.04	99.4		
93.9	2.37	2.41	0.25	0.07	99.8		
95.5	1.63	1.67	0.23	0.01	99.0		
95.4	1.90	1.55	0.25	0.13	99.2		
94.6	1.92	1.90	0.25	0.00	98.7		
94.0	2.48	2.13	0.30	0.12	99.0		
90.0	4.50	5.29	0.38	0.17	100.3		
88.1	5.44	5.16	0.44	0.51	99.7		
61.9	12.80	15.56	1.48	5.50	97.2		
88.9	4.00	4.55	0.50	0.80	98.8		
93.4	2.84	2.78	0.25	0.16	99.4		
94.0	2.27	2.31	0.22	0.00	98.8		
91.5	4.50	3.42	0.25	0.00	99.7		
79.9	13.60	4.73	0.48	0.29	99.0		
76.0	16.70	5.31	0.63	0.37	99.0		
84.5	10.40	3.55	0.54	0.56	99.6		
95.8	1.77	1.02	0.32	0.22	99.1		
94.1	2.12	2.18	0.38	0.21	99.0		
94.1	2.12	3.06	0.44	0.12	99.8		
89.8	3.56	4.57	0.57	0.69	99.2		
86.7	4.05	6.14	0.63	0.98	98.5		
87.4	4.14	5.72	0.64	0.84	98.7		

Sampled by: Harry W. Settle
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: September 2, 1949

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
			Stripping.	
	13	5	Limestone, gray, medium-grained, oolitic; weathers white.	
	12	9	Limestone, dove-gray, fine-grained, dense, flecked with calcite crystals; weathers white.	
	11	1-2	Clay, white, calcareous.	
$70\frac{1}{2}$-$71\frac{1}{2}$ $69\frac{1}{2}$-$70\frac{1}{2}$	10	2	Limestone, white, medium-grained, oolitic.	
$68\frac{1}{2}$-$69\frac{1}{2}$ $67\frac{1}{2}$-$68\frac{1}{2}$ $66\frac{1}{2}$-$67\frac{1}{2}$ $65\frac{1}{2}$-$66\frac{1}{2}$ $64\frac{1}{2}$-$65\frac{1}{2}$ $63\frac{1}{2}$-$64\frac{1}{2}$ $62\frac{1}{2}$-$63\frac{1}{2}$ $61\frac{1}{2}$-$62\frac{1}{2}$ $60\frac{1}{2}$-$61\frac{1}{2}$ $59\frac{1}{2}$-$60\frac{1}{2}$ $58\frac{1}{2}$-$59\frac{1}{2}$ $57\frac{1}{2}$-$58\frac{1}{2}$ $56\frac{1}{2}$-$57\frac{1}{2}$ $55\frac{1}{2}$-$56\frac{1}{2}$ $54\frac{1}{2}$-$55\frac{1}{2}$ $53\frac{1}{2}$-$54\frac{1}{2}$ $52\frac{1}{2}$-$53\frac{1}{2}$ $51\frac{1}{2}$-$52\frac{1}{2}$	9	18	Limestone, dove-gray, fine-grained, dense, flecked with calcite crystals, thick-bedded; weathers white.	RENAULT LIMESTONE
51 -$51\frac{1}{2}$	8	$\frac{1}{2}$	Shale, green, with shaly limestone.	
50 -51 49 -50 48 -49 47 -48 46 -47 45 -46 44 -45	7	7	Limestone, dove-gray, medium- to fine-grained, dense, flecked with calcite crystals, fossiliferous, in part dolomitic; weathers white.	
43 -44 42 -43 41 -42	6	3	Limestone, light-gray, fine-grained, oolitic; weathers bluish white.	
40 -41 39 -40 38 -39				

TABLE 18—*Continued*

County: Christian **Operator:** Abandoned
Property Owner: Water and Sewerage Commission

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
87.1	3.78	6.36	0.68	0.85	98.8	NOT ANALYZED	
80.0	5.50	8.13	1.05	1.97	96.7		
80.2	4.80	7.93	0.93	1.69	95.6		
77.5	6.50	10.07	0.95	2.38	97.4		
83.5	5.30	6.76	0.86	1.29	97.7		
80.1	8.00	7.89	0.83	1.92	98.7		
91.8	2.72	4.80	0.24	0.18	99.7		
94.4	3.34	2.39	0.17	0.23	100.5		
94.0	3.86	2.20	0.22	0.20	100.5		
93.0	3.26	2.09	0.19	0.26	98.8		
91.1	3.88	2.22	0.22	0.34	97.8		
91.9	3.56	2.10	0.22	0.22	98.0		
89.5	5.16	3.02	0.25	0.43	98.4		
92.0	3.55	2.27	0.20	0.11	98.1		
92.9	3.96	2.37	0.19	0.00	99.4		
91.4	3.96	2.78	0.18	0.00	98.3		
92.3	3.45	2.33	0.18	0.02	98.3		
91.0	3.93	2.93	0.20	0.35	98.4		
84.5	8.43	5.66	0.41	0.72	99.7		
89.5	2.97	5.30	0.24	0.43	98.4		
92.1	2.42	4.60	0.20	0.23	99.6		
96.4	2.11	1.08	0.13	0.39	100.1		
97.5	1.72	0.33	0.10	0.12	99.8		
98.1	1.51	0.15	0.10	0.08	99.9		
96.5	1.98	1.42	0.13	0.20	100.2		
94.6	1.83	2.27	0.17	0.19	99.1		
95.0	1.90	2.83	0.20	0.20	100.1		
93.5	2.57	3.42	0.22	0.32	100.0		
95.0	1.42	2.72	0.16	0.37	99.7		
95.0	2.69	2.08	0.18	0.25	100.2		
95.0	2.48	2.13	0.15	0.34	100.1		
95.0	3.02	0.55	0.15	0.00	98.7		
95.6	2.29	0.47	0.11	0.30	98.8		
92.1	6.40	0.72	0.23	0.00	99.5		
91.4	7.40	0.43	0.28	0.00	99.5		
94.5	4.20	0.45	0.15	0.00	99.3		
91.0	7.85	0.21	0.27	0.00	99.2		
91.0	7.75	0.57	0.27	0.00	99.5		
93.1	4.64	1.26	0.27	0.03	99.3		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
37 -38 36 -37 35 -36 34 -35 33 -34 32 -33	5	9	Limestone, greenish-blue, shaly, crystalline, slightly fossiliferous, rubbly.	
31 -32 30 -31 29 -30 28 -29 27 -28 26 -27 25 -26 24 -25 23 -24 22 -23 21 -22 20 -21 19 -20	4	13	Limestone, dove-gray, fine-grained, dense, flecked with calcite crystals, with black chert nodules scattered throughout; in part fine- to coarse-grained, bioclastic, in lower 2 feet; thin-bedded; weathers white.	RENAULT LIMESTONE
18 -19 17 -18 16 -17 15 -16 14 -15 13½-14	3	5½	Limestone, gray, whiter at base, medium-grained to microgranular, oolitic to crystalline; breccia zone at 16-17 feet; black chert streaks in basal part; shaly at top.	
12½-13½ 11½-12½ 10½-11½ 9½-10½ 8½- 9½ 7½- 8½ 7 - 7½ 6 - 7	2	7½	Limestone, dove-gray, fine-grained, dense, flecked with calcite crystals; weathers white.	STE. GENEVIEVE LIMESTONE
5 - 6 4 - 5 3 - 4 2 - 3 1 - 2 0 - 1	1	6	Limestone, white, medium-grained, oolitic, soft, massive.	

WATER LEVEL IN QUARRY (September 2, 1949)

Christian Quarries Quarry and Core

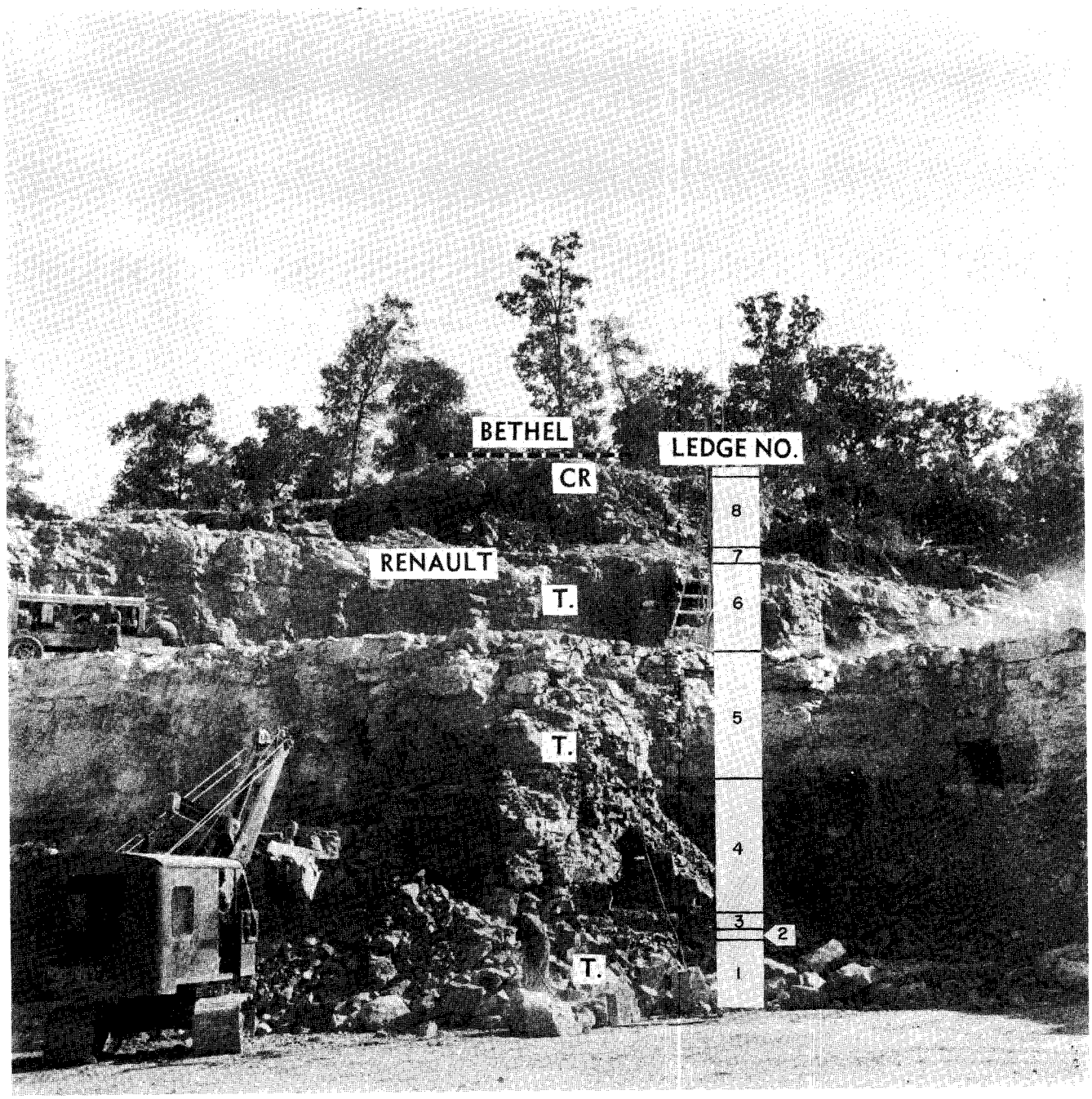
This quarry is an active open-face operation, producing crushed limestone for concrete aggregate, roadstone, and agricultural limestone. When the site was sampled in 1949, production was from the Renault Limestone (Fig. 23); but the quarry has been deepened, and recent production has been principally from the Ste. Genevieve Limestone. The floor in February 1968 was approximately 10 feet below the bottom of the core hole described in Table 19. Reported in this table are the foot-by-foot analyses of the 1949 face and a 102-foot core taken in the quarry floor. The analysis of this quarry and core was previously reported by Stokley and McFarlan (1952, p. 36-40), but values for phosphorus and sulfur content of the high-calcium zone in the core are presented here for the first time.

Calcium carbonate content of individual samples in the Ste. Genevieve is as great as 96.8 percent. Average chemical analysis of the purest zone is:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
81-102	95.6	2.2	1.25	0.24	0.13	.035	.012

Figure 12 shows the relationship of this high-calcium zone with the zones in the Ste. Genevieve at other locations in the region. Thirteen feet of limestone in the Renault, in the interval from 31 to 44 feet, has an average magnesium carbonate content of 2.3 percent.

The quarry is on the Christian Quarry Road at the east edge of Hopkinsville, immediately south of U. S. Highway 68 and half a mile east of U. S. Highway 41. It is adjacent to the route of the Pennyrile Parkway, under construction. Railroads and highways serving the Hopkinsville area are noted in the previous section on the Hopkinsville Stone Company quarry.



Abbreviations: T.—*Talarocrinus*
CR—Large crinoid stem (unidentified)

Figure 23. Photograph of Christian Quarries quarry showing ledge designations in the upper part of the now-deepened quarry. Analyses of a core taken in the 1949 floor follow the analyses of the quarry face.

WC Q

TABLE 19. CHEMICAL ANALYSES OF CHRISTIAN QUARRIES QUARRY AND CORE

County: Christian **Operator:** Christian Quarries, Inc.
Property Owner: Christian Quarries, Inc.
Location: At the east edge of Hopkinsville, on Christian Quarry Road, ½ mile east of U.S. 41
Carter Coordinate Location: 17, 18-E-25 (Hopkinsville quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
NO SAMPLES							
NO SAMPLES							
93.9	2.1	2.69	0.38	0.71	99.8	NOT ANALYZED	
93.2	1.90	3.05	0.38	0.73	99.3		
92.8	2.0	4.46	0.22	0.61	100.1		
92.8	2.1	4.21	0.33	0.54	100.0		
91.8	2.3	3.90	0.42	0.60	99.0		
80.3	3.8	10.04	0.76	2.84	97.7		
85.0	2.9	7.39	0.68	1.81	97.8		
86.0	2.3	7.85	0.38	0.76	97.3		
89.6	2.3	6.09	0.33	0.61	98.9		
94.6	2.2	2.06	0.38	0.54	99.8		
93.9	1.98	3.33	0.19	0.17	99.6		
92.8	2.0	3.38	0.27	0.75	99.2		
96.0	1.62	1.56	0.15	0.23	99.6		
91.2	7.1	0.88	0.30	0.49	100.0		
91.4	6.8	0.97	0.22	0.06	99.5		
88.5	9.1	0.86	0.11	0.37	98.9		
90.5	7.5	0.27	0.30	0.00	98.6		
90.5	8.0	0.31	0.40	0.14	99.4		
95.4	3.0	0.67	0.13	0.27	99.5		
94.0	3.5	0.52	0.20	0.94	99.2		
77.1	15.6	3.96	0.92	1.54	99.1		
97.4	1.3	0.27	0.13	0.31	99.4		
97.1	2.2	0.64	0.30	0.00	100.2		
91.4	5.3	2.83	0.19	0.43	100.1		
89.9	5.6	3.31	0.20	0.62	99.6		
92.4	4.38	2.76	0.22	0.39	100.1		
90.6	5.8	2.64	0.28	0.71	100.0		
91.6	3.48	3.34	0.26	0.56	99.2		
90.4	3.55	4.75	0.27	0.71	99.7		
91.4	3.25	4.06	0.26	0.58	99.6		
94.9	2.40	2.22	0.23	0.33	100.1		
94.1	3.02	2.50	0.25	0.45	100.3		
93.9	2.12	2.35	0.23	0.47	99.1		
93.9	2.78	2.44	0.19	0.22	99.5		
93.6	2.72	1.65	0.19	0.25	98.4		
94.4	3.08	2.32	0.24	0.51	100.5		
88.5	6.2	3.47	0.30	0.48	99.0		
85.4	7.9	4.04	0.43	0.63	99.4		

Sampled by: Harry W. Settle
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: 1949

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION Lithology	Formation
			TOP OF MEASURED SECTION Bethel Sandstone caps hill above quarry.	
48-64	8	16	Limestone, gray, crystalline.	
44-48	7	4	Clay shale, green.	
43-44 42-43 41-42 40-41 39-40 38-39 37-38 36-37 35-36	6	9	Limestone, fine-grained, dense, with scattered zones of crystalline texture, and with interbedded shale in upper part; thin-bedded in middle and upper part, medium-bedded in lower part. (Top ledge of quarry.)	
34-35 33-34 32-33 31-32 30-31 29-30 28-29 27-28 26-27 25-26 24-25	5	11	Limestone, light-gray, oolitic, hard, with a dense texture, thick-bedded.	RENAULT LIMESTONE
23-24 22-23 21-22 20-21 19-20 18-19 17-18 16-17 15-16 14-15 13-14 12-13 11-12 10-11 9-10 8-9	4	16	Limestone, fine-grained, dense, thin-bedded; some chert near middle; interbedded shale near top.	
7-8 6-7	3	2	Limestone, fine-grained, dense.	

TABLE 19—*Continued*

County: Christian **Operator:** Christian Quarries, Inc.
Property Owner: Christian Quarries, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
65.4	17.5	10.82	1.16	3.19	98.1	NOT ANALYZED	
92.4	3.71	2.89	0.30	0.14	99.4		
92.0	2.88	2.37	0.25	0.26	97.8		
91.8	4.15	2.91	0.24	0.14	99.2		
87.5	8.5	2.89	0.35	0.19	99.4		
83.9	11.0	3.28	0.42	0.45	99.1		
88.0	7.3	3.23	0.45	0.38	99.4		
89.4	6.0	2.87	0.45	0.44	99.2		
87.5	5.6	4.12	0.50	0.64	99.4		
78.4	10.8	7.12	0.70	1.43	98.5		
81.4	7.9	7.85	0.77	1.41	99.3		
76.0	8.6	9.37	0.94	2.83	97.7		
71.7	9.5	11.84	1.10	3.03	97.2		
73.5	9.3	11.60	1.00	3.44	98.8		
67.9	10.5	13.33	1.10	4.13	97.0		
77.5	7.9	9.10	0.75	2.02	97.3		
70.4	9.4	11.67	0.40	4.11	96.0		
88.1	6.1	4.28	0.70	0.10	99.3		
89.5	5.7	3.37	0.38	0.17	99.1		
88.9	6.5	3.28	0.33	0.12	99.1		
91.9	4.60	2.60	0.25	0.01	99.4		
93.5	3.87	2.14	0.20	0.00	99.7		
91.6	4.76	2.70	0.22	0.00	99.3		
89.5	6.20	3.24	0.25	0.17	99.4		
92.5	4.24	2.29	0.20	0.04	99.3		
85.0	8.9	4.30	0.38	0.66	99.3		
90.5	5.3	2.52	0.27	0.18	98.8		
82.1	10.0	4.56	0.50	0.78	97.9		
92.8	3.1	3.02	0.22	0.06	99.2		
83.6	5.6	7.69	0.53	1.10	98.5		
93.5	2.6	3.30	0.25	0.37	100.0		
84.8	3.8	8.49	0.60	1.28	99.0		
93.5	4.8	1.20	0.00	0.00	99.5		
73.9	22.1	3.47	0.17	0.00	99.6		
92.7	3.2	3.24	0.21	0.00	99.4		
94.5	3.1	2.37	0.00	0.00	100.0		
92.9	3.3	2.87	0.15	0.00	99.2		
93.0	3.1	3.03	0.17	0.12	99.4		
87.0	6.6	5.62	0.38	0.84	100.4		
91.0	4.8	4.14	0.26	0.40	100.6		
88.9	5.5	4.98	0.31	0.63	100.3		

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thick-ness (Feet)	Lithology	Formation
5-6	2	1	Limestone, green, shaly.	
4-5 3-4 2-3 1-2 0-1	1	5	Limestone, fine-grained, dense, thick-bedded.	
			BOTTOM OF QUARRY (1949) AND TOP OF CORED INTERVAL	
0-1 1-2 2-3	1A	3	Limestone, fine-grained, dense, medium-bedded.	
3-4 4-5 5-6 6-7 7-8 8-9 9-10 10-11	2A	8	Limestone, greenish-gray, shaly, slightly rubbly, thin-bedded.	RENAULT LIMESTONE
11-12 12-13 13-14 14-15 15-16 16-17 17-18 18-19 19-20 20-21 22-23 24-25 26-27	3A	15	Limestone, fine-grained, dense, thin-bedded, with black nodular chert.	
28-29 30-31 32-33	4A	7	Limestone, oolitic to crystalline, medium-bedded; includes breccia zone.	
34-35 36-37 38-39 40-41 42-43 44-45 46-47 48-49	5A	20	Limestone, fine-grained, dense, locally oolitic, medium- to thick-bedded.	STE. GENEVIEVE LIMESTONE

TABLE 19—*Continued*

County: Christian **Operator:** Christian Quarries, Inc.
Property Owner: Christian Quarries, Inc.

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
91.0	5.6	2.90	0.25	0.58	100.3	NOT ANALYZED	
85.9	8.7	4.86	0.30	0.58	100.3		
87.6	3.9	6.47	0.50	0.99	99.5		
85.0	3.4	8.23	0.63	1.51	98.8		
94.0	2.4	2.15	0.52	0.67	99.7	NOT ANALYZED	
93.5	1.87	2.38	0.30	0.41	98.5		
82.5	2.80	8.55	0.65	2.72	96.6		
36.4	31.6	21.49	2.23	6.32	98.0		
48.2	24.4	17.98	1.75	5.64	98.0	NOT ANALYZED	
59.3	17.0	15.22	1.24	3.49	96.3		
69.3	17.9	8.17	0.67	1.46	98.0		
90.7	2.9	2.77	0.35	0.80	97.5		
71.4	14.6	9.73	0.33	3.30	99.4		
96.0	2.3	2.04	0.19	0.00	100.5	NOT ANALYZED	
81.4	8.6	7.21	0.60	1.58	99.4		
91.0	4.8	3.83	0.30	0.15	100.1		
96.0	2.2	1.59	0.25	0.17	100.2	.030	.014
96.4	2.0	1.35	0.20	0.04	100.0	.022	.015
96.8	1.98	1.04	0.24	0.01	100.1	.038	.013
96.0	2.1	0.65	0.23	0.04	100.0	.022	.011
95.7	2.5	1.61	0.25	0.48	100.0	.030	.016
94.9	2.3	1.12	0.24	0.25	98.8	.034	.011
96.0	2.3	0.54	0.22	0.00	99.1	.088	.010
96.4	1.67	0.97	0.18	0.00	99.2	.028	.009
93.5	2.9	1.97	0.28	0.19	98.8	.030	.010
95.7	2.0	1.17	0.23	0.05	99.2	.026	.014
95.0	1.97	1.51	0.29	0.18	99.0	.030	.014

SAMPLES NOT ANALYZED

SAMPLES NOT ANALYZED

SAMPLES NOT ANALYZED

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
50-51 52-53 54-55 56-57 58-59 60-61 62-63	6A	10	Limestone, white, oolitic, soft, with interbedded shale zones; thick-bedded near top, thin-bedded near base.	
64-65 66-67 68-69 70-71	7A	9	Limestone, fine-grained and dense to crystalline, shaly, dolomitic, in part oolitic; shale at top; breccia zone of shale and limestone at base.	
72-73 74-75 76-77 78-79 80-81	8A	9	Limestone, fine-grained, dense, in part oolitic.	
82-83 84-85 86-87 88-89 90-91 92-93 94-95 96-97 98-99	9A	19	Limestone, white to light-gray, medium- to coarse-grained, oolitic, hard to soft; fossiliferous near top.	STE. GENEVIEVE LIMESTONE
100-101 101-102	10A	2	Limestone, gray, medium-grained, crystalline, with a few oolites.	
			BOTTOM OF CORED INTERVAL	
102-105	11A	3	Limestone, medium- to medium-light-gray, fine-grained, oolitic, in part recrystallized; ledge thins locally.	
105-109	12A	4	Limestone, greenish-gray, fine- to medium-grained, bioclastic, very argillaceous and silty, with some medium- to very coarsely crystalline calcite; trace of pyrite; in part, brownish-gray, microgranular to fine-grained, oolitic and bioclastic limestone; ledge thickens locally.	
109-112	13A	3	Limestone, light- to medium-gray, microgranular to medium-grained; some oolites and fossil fragments; in part argillaceous and silty; trace of pyrite.	
			BOTTOM OF QUARRY (February 1968)	

NOTE: The quarry has been deepened since 1949, and the floor in February 1968 was approximately 10 feet below the bottom of the core hole described above. Description of Ledges No. 11A through 13A has been added to the section sampled by H. W. Settle. In the core hole, in the interval from 21 to 101 feet, only every second 1-foot sample was analyzed.

Harry Berry Quarry

This quarry is an active open-face operation in the Ste. Genevieve Limestone, producing crushed stone for concrete aggregate, roadstone, and agricultural limestone. A ledge of soft oolitic limestone, which is partially exposed in the bottom of the pit, was sampled for analysis. The quarry manager reported to the writers that drilling had shown the total thickness of this ledge to be 28 feet at the north end of the quarry, 24 feet in the middle, and 20 feet at the south end. "Flinty rock" was reported underlying the oolitic limestone. At the time of sampling, only part of the exposed ledge was accessible because of water standing in the north end of the quarry. Foot-by-foot analyses of the sampled section are reported in Table 20.

Calcium carbonate content of individual samples is as great as 97.97 percent. Average chemical analysis of the purest zone is:

Samples (feet)	$CaCO_3$ (%)	$MgCO_3$ (%)	SiO_2 (%)	Fe_2O_3 (%)	Al_2O_3 (%)	S (%)	P (%)
0-14	97.01	1.82	0.75	0.03	0.18	.036	.011

Figure 12 shows the stratigraphic relationship of the high-calcium zone in this quarry with the zones in the Ste. Genevieve Limestone at other locations in the region.

The quarry is 4½ miles south of Hopkinsville on U. S. Highway Alt. 41. Railroads and highways serving the Hopkinsville area are noted in a previous section on the Hopkinsville Stone Company quarry.

WHA

TABLE 20. CHEMICAL ANALYSES OF HARRY BERRY QUARRY

County: Christian **Operator:** Harry Berry, Inc.
Property Owner: Edmonds Estate
Location: $4\frac{1}{2}$ miles south of Hopkinsville on U.S. Highway Alt. 41
Carter Coordinate Location: 7, 8-D-25 (Hopkinsville quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
NO SAMPLES							
84.13	3.30	6.99	0.06	2.03	96.52	.210	.049
97.35	1.51	0.92	0.02	0.20	100.--	.044	.006
97.77	1.44	0.60	0.03	0.16	100.--	.038	.016
97.97	1.34	0.46	0.02	0.16	99.95	.038	.018
97.49	1.33	0.84	0.02	0.20	99.88	.052	.012
97.22	1.39	1.02	0.03	0.13	99.79	.028	.011
97.70	1.45	0.64	0.02	0.16	99.97	.028	.011
96.87	1.72	0.68	0.03	0.18	99.48	.032	.012
96.05	2.07	1.36	0.03	0.22	99.73	.032	.010
95.56	2.60	1.06	0.05	0.28	99.55	.036	.011
97.08	1.84	0.44	0.03	0.14	99.53	.036	.010
97.08	2.18	0.46	0.02	0.19	99.93	.036	.011
96.60	2.57	0.48	0.03	0.19	99.90	.032	.011
96.94	2.12	0.57	0.03	0.22	99.88	.030	.011
96.46	1.97	0.94	0.05	0.09	99.51	.042	.011

Sampled by: Preston McGrain and Garland R. Dever, Jr.
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: February 8, 1968

DESCRIPTION				
Sample Level (Feet)	Ledge No.	Thickness (Feet)	Lithology	Formation
			TOP OF QUARRY	
			Approximately 90 feet of Ste. Genevieve Limestone is exposed above Ledge 2.	
14-15	2	1	Limestone, medium-gray, microcrystalline; stylolitic contact at base. Basal foot of ledge overlying the oolitic limestone.	STE. GENEVIEVE LIMESTONE
13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5 3-4 2-3 1-2 0-1	1	14	Limestone, light-gray to white, medium- to coarse-grained, oolitic; with a small amount of medium- to very coarse-grained bioclastic limestone; varying amounts of larger fossil fragments; crossbedded.	
			WATER LEVEL IN QUARRY (February 8, 1968)	

NOTE: Samples and ledge measurements are from the east face, near the middle of the quarry.

Subsegment sample 1968

6' GAP (6-12)

0-6' samples

CHESTER LIMESTONES

Rocks of the Chester Series in this region, which consist of alternating carbonate and clastic units, include eight formations that are composed predominantly of limestone or that contain limestone members (Fig. 24). These formations outcrop in parts of Crittenden and Livingston Counties, and extend southeastward through central Caldwell and northeastern Trigg Counties across the northern half of Christian County. Their pattern of occurrence throughout the area, especially in the fluorspar district, has been complicated by faulting. For detailed information on their occurrence the reader is referred to the new geologic quadrangle maps (Fig. 2) and the *Geologic Map of the Western Kentucky Fluorspar District* (Weller and Sutton, 1951).

FORMATION AND MEMBER		THICKNESSES, IN FEET
GROVE CHURCH SHALE		0-40
KINKAID LIMESTONE	Upper member	0-170
	Middle member	
	Lower member	
DEGONIA SANDSTONE		0-38
CLORE LIMESTONE		0-125
PALESTINE SANDSTONE		0-80
MENARD LIMESTONE		0-145
WALTERSBURG SANDSTONE		20-60
VIENNA LIMESTONE		15-40
TAR SPRINGS SANDSTONE		30-175
GLEN DEAN LIMESTONE		0-100
HARDINSBURG SANDSTONE		25-150
GOLCONDA FORMATION	Haney Limestone	80-170
	Big Clifty Sandstone	
	Beech Creek Limestone	
CYPRESS SANDSTONE		0-125
PAINT CREEK LIMESTONE —PAINT CREEK SHALE		<1-145
BETHEL SANDSTONE		10-210
RENAULT LIMESTONE		0-125

Figure 24. Formations of the Chester Series.

The lithologic character of the Chester limestones in this region and the available chemical data suggest that, in general, these rocks do not contain operable thicknesses of high-calcium limestone. The possible exceptions are the Paint Creek Limestone in the vicinity of Christian and Trigg Counties, and the Glen Dean Limestone in parts of Crittenden and Livingston Counties. Some low-magnesium limestone has been found in the Renault, Glen Dean, Menard, and Kinkaid Limestone.

The general lithology of the eight formations and the known occurrences of high-calcium limestones and low-magnesium limestones are summarized in the following sections.

Renault Limestone

In Christian and Trigg Counties the Renault generally consists of vaughanitic to medium-grained limestone, with some argillaceous, shaly, and oolitic beds. Interbedded shale is common in the middle and upper parts of the formation. In the vicinity of Hopkinsville a zone of abundant nodular chert occurs near the base.

To the northwest, shale is more common in the formation. A unit 15 to 40 feet thick, consisting of shale with thin interbeds of argillaceous limestone, occurs near the middle. Shale laminae and interbeds separate the limestones in the lower part and particularly the upper part of the formation. The limestones are generally fine to coarse grained and have some argillaceous, silty, and dolomitic beds. Oolitic beds occur locally in the upper part and more commonly in the lower part of the formation. The lithology of the total Renault section has been described at two quarries in Caldwell and Christian Counties (Tables 14 and 19).

The Renault Limestone has been analyzed on a foot-by-foot basis at six locations in Caldwell, Christian, Crittenden, and Trigg Counties (Tables 9, 14, 16, 17, 18, and 19). The intervals analyzed range from 10 to 72 feet thick. Though the calcium carbonate content of individual samples is as high as 97.4 percent, no operable thicknesses of high-calcium limestone have been found. Zones of low-magnesium limestone ranging from 13 to 17 feet thick occur at 3 of the locations in Christian and Trigg Counties (Tables 16, 18, and 19).

Paint Creek Limestone

In the vicinity of Christian and Trigg Counties the Paint Creek is composed of fine- to medium-grained limestone, commonly fossiliferous, with

some oolitic, shaly, and argillaceous beds. The oolitic beds are generally more common in the middle and upper parts of the formation. Some shale is interbedded with the limestone, and locally a shale unit up to 15 feet thick occurs in the lower half of the formation. To the northwest this formation is represented by the Paint Creek Shale, which is mainly a clastic unit composed of sandstone, shale, and siltstone, and contains relatively little limestone. The limestone in this area is generally medium to fine grained, commonly sandy and fossiliferous.

Stokley and Walker (1953, p. 60-62) reported several ledges of high-calcium oolitic and crystalline limestone in the Paint Creek at the Whitestone quarry in Warren County to the east, along the same belt of outcrop, and because of the general lithologic similarity of this pure stone to the Paint Creek limestone in the Christian-Trigg County area, the formation may be a possible source of high-calcium limestone. Chemical analyses have not been run on the Paint Creek Limestone in the region of this report, however.

Golconda Formation

The Golconda consists of three members which are, in ascending order, Beech Creek Limestone, Big Clifty Sandstone, and Haney Limestone. The Beech Creek and Haney Members are absent locally in the region.

The limestone of the Beech Creek Member is fine to very coarse grained, fossiliferous, commonly argillaceous, and partly sandy and dolomitic. The member has a maximum thickness of 10 feet where it is composed entirely of limestone, and it reaches a thickness of 30 feet in eastern Christian County where it consists typically of 2 or 3 thin limestones separated by shale.

The Haney Member is generally a sequence of interbedded limestones and shales. The limestones are fine to very coarse grained, commonly argillaceous and fossiliferous, with some oolitic, dolomitic, and cherty beds. There is less shale within the member in the southeastern part of the region.

Chemical analyses have not been run on either the Beech Creek Limestone or the Haney Limestone in this region.

Glen Dean Limestone

In general, the limestones in the Glen Dean are fine to coarse grained, commonly argillaceous and fossiliferous, with laminae and interbeds of shale. A relatively thick zone of medium- to coarsely crystalline limestone containing abundant bryozoan and crinoid fragments occurs near the middle part of the formation in parts of Crittenden and Livingston Counties, as shown on the geologic maps of the Golconda, Marion, and Salem quadrangles (Amos, 1966; Trace, 1962b, 1966).

In the Salem quadrangle the zone is approximately 30 feet thick, and one sample was taken for analysis from an outcrop located on the north side of the valley of Kit Love Branch in the north-central part of the quadrangle (Carter Coordinate location, 3-J-16). The sample was obtained from about 10 feet below the top of the zone. The analysis, which is given below, indicates that this zone may be a potential source of high-calcium limestone.

$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)	Total(%)
95.70	1.87	0.92	0.10	0.26	98.85

Southeast of this area, shale and sandstone dominate the middle part of the formation. In the Kelly quadrangle, in central Christian County, the middle shale and upper limestone units grade into and interfinger laterally with Tar Springs sandstone (Miller, 1964). The Glen Dean is absent locally in the region.

Vienna Limestone

The limestone in the Vienna is generally microcrystalline to finely crystalline, commonly siliceous, and locally fossiliferous and oolitic. Chert is very common and occurs as nodules, lenses, and layers. Shale is present as laminae and thin interbeds, and forms the upper 5 to 10 feet of the formation locally. Chemical analyses have not been run on the Vienna Limestone.

Menard Limestone

The limestones in the Menard are generally dark colored, microcrystalline to medium crystalline, commonly argillaceous, and partially dolomitic. The lower part of the formation is commonly very fossiliferous. Chert occurs locally as nodules, small irregular masses, and thin, discontinuous beds. Interbedded shale is present throughout the formation, and a unit that is dominantly shale occurs near the middle. The Menard is absent locally because of pre-Pennsylvanian erosion.

The Kentucky Department of Highways (1951, p. 34) reported the following partial analyses of representative samples from two ledges of an abandoned quarry in the Menard Limestone. The quar-

ry is located in Crittenden County, half a mile west of Tribune on Ky. Highway 120.

Ledge	Thickness (ft.)	Remarks	$CaCO_3$(%)	$MgCO_3$(%)	Insoluble (%)	R_2O_3(%)
	0-10	Stripping				
1	12	Flaky	81.59	2.04	12.04	4.24
	8	Shale		NO SAMPLE		
2	7½	Shaly	83.58	3.09	8.72	3.76
		Floor—shaly and very fossiliferous (October 1947)				

A detailed lithologic description of this quarry is reported by MacCary and Lambert (1956, p. 27-29).

Clore Limestone

This formation consists of interbedded limestones and shales. The limestones are generally dark colored, microcrystalline to medium crystalline. Many of the beds are argillaceous, and some are dolomitic and sandy. The Clore is absent locally because of pre-Pennsylvanian erosion. Chemical analyses have not been run on Clore limestones.

Kinkaid Limestone

The Kinkaid consists of two limestone members separated by a middle member composed of interbedded shales and limestones. A sandstone occurs locally in the lower part of the middle member. The upper limestone member and part of the middle member are absent throughout much of the area because of pre-Pennsylvanian erosion, and the entire formation has been removed locally.

The upper member contains coarse- to fine-grained fossiliferous and microgranular limestones, and layers of nodular chert are common. The limestone of the lower member is generally microgranular to medium grained, with some very fossiliferous beds. Thin interbedded shales occur in the upper few feet of the lower member, and nodular chert is abundant locally.

A 24-foot zone of low-magnesium limestone occurs in the lower member of the Kinkaid at the Alexander Stone Company quarry in Crittenden County (Table 21).

Alexander Stone Company Quarry

This is an active drift-mine operation producing crushed limestone for concrete aggregate, roadstone, and agricultural limestone. The stone is mined from the lower member of the Kinkaid Limestone. The site was formerly operated as an open-face quarry (Fig. 25), and the present mining operation is restricted to the thicker bedded stone of Ledge 1 in the figure. Foot-by-foot analyses of the quarry face are reported in Table 21.

The average magnesium carbonate content of the limestone in Ledge 1 is less than 3 percent and meets the specifications generally cited for this constituent in limestones used in the manufacture of portland cement. The average chemical analysis of this ledge is:

Samples (feet)	$CaCO_3$(%)	$MgCO_3$(%)	SiO_2(%)	Fe_2O_3(%)	Al_2O_3(%)
0-24	89.7	2.3	5.27	0.35	1.29

The quarry is 9 miles northeast of Marion, adjacent to U. S. Highway 60-641 and Ky. Highway 365. A main line of the Illinois Central Railroad is located approximately half a mile east of the site. The quarry is 4.7 (airline) miles southeast of the Ohio River.

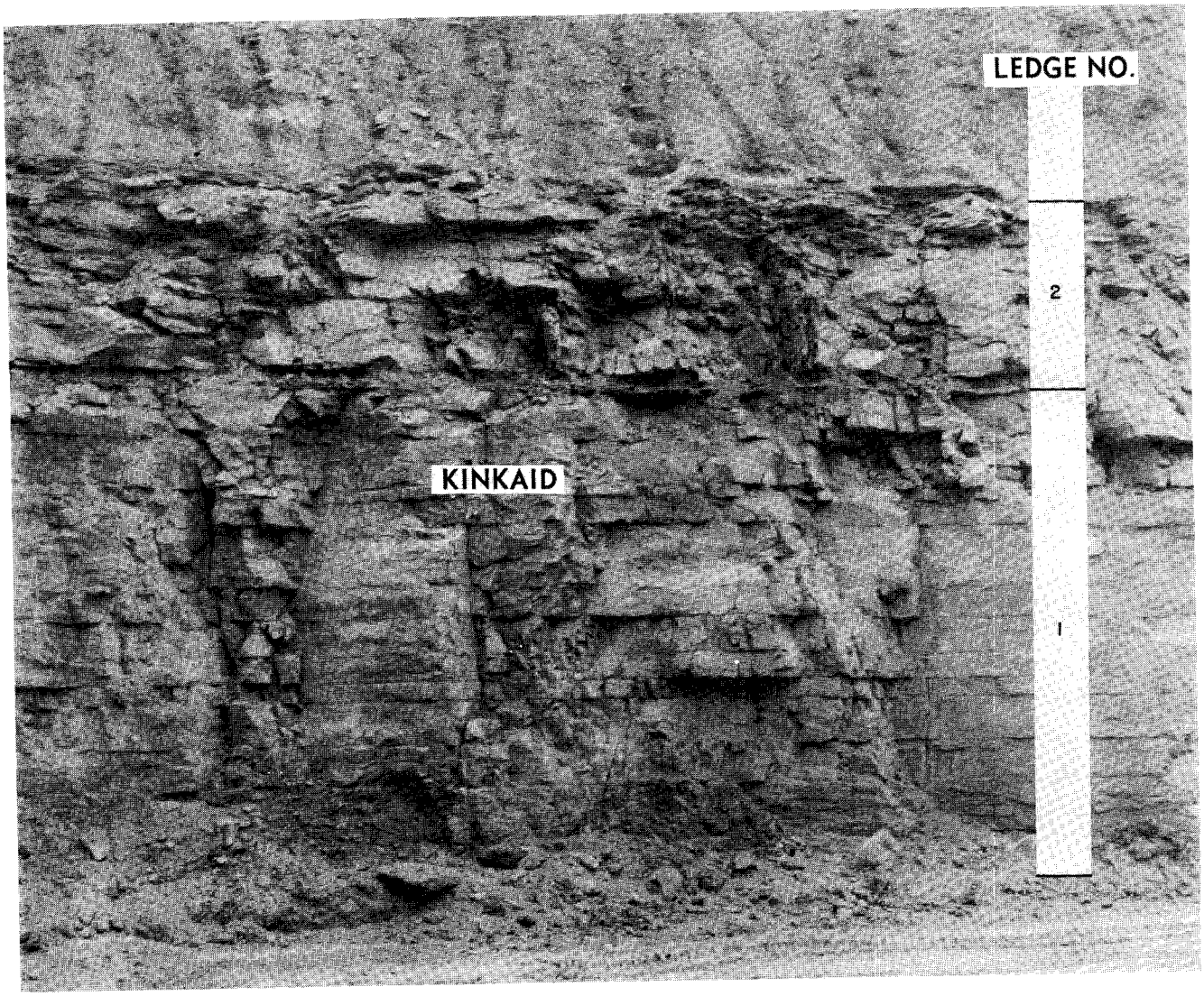


Figure 25. Photograph of Alexander Stone Company quarry showing ledge designations.

WKM

TABLE 21. CHEMICAL ANALYSES OF ALEXANDER STONE COMPANY QUARRY

County: Crittenden **Operator:** Alexander Stone Company, Inc.
Property Owner: Alexander Stone Company, Inc.
Location: 9 miles northeast of Marion on U.S. Highways 60-641
Carter Coordinate Location: 21-L-18 (Repton quadrangle)

CHEMICAL ANALYSIS							
% $CaCO_3$	% $MgCO_3$	% SiO_2	% Iron Oxide	% Alumina	% Total	% S	% P
			NO SAMPLES				
63.0	8.2	18.80	2.02	4.38	96.4	NOT ANALYZED	
46.5	6.9	29.92	2.05	8.75	94.1		
41.5	12.6	30.21	3.05	7.49	94.9		
45.7	15.1	26.01	2.85	5.99	95.7		
66.5	6.8	18.35	1.30	4.63	97.6		
64.0	11.2	17.75	1.93	3.07	98.1		
49.9	15.9	23.09	2.60	4.54	96.0		
53.4	15.6	21.69	2.30	4.12	97.1		
88.2	2.3	6.62	0.82	0.95	98.9		
88.0	1.5	6.99	1.16	0.76	98.4		
82.6	2.6	9.96	1.60	1.74	98.5		
87.8	2.6	6.50	0.72	1.17	98.9		
90.9	2.0	4.79	0.60	0.84	99.1		
86.5	2.4	6.78	0.27	2.39	98.3		
91.3	1.4	4.08	0.14	0.88	97.8		
90.9	2.0	4.88	0.20	1.20	99.2		
90.9	1.9	4.66	0.16	1.36	98.9		
88.2	2.8	6.18	0.35	1.64	99.2		
89.5	2.3	5.32	0.32	1.33	98.8		
91.8	1.9	4.45	0.20	0.83	99.2		
90.2	2.9	4.70	0.22	1.21	99.2		
86.1	3.7	6.83	0.15	2.27	99.1		
91.4	2.6	4.13	0.12	1.02	99.3		
87.0	3.7	5.69	0.28	1.84	98.5		
93.1	2.1	3.65	0.07	0.67	99.6		
90.9	2.4	4.35	0.10	1.26	99.0		
91.9	2.1	3.74	0.16	1.60	99.5		
92.6	2.1	3.80	0.10	0.95	99.6		
90.0	2.5	4.76	0.21	1.40	98.9		
91.5	2.1	4.02	0.13	1.09	98.8		
89.4	2.0	5.45	0.14	1.61	98.6		
91.6	2.1	4.18	0.22	0.92	99.0		

Sampled by: Frank H. Walker and Louis R. Ponsetto
Analyzed by: Mining Engineering Laboratory, University of Kentucky
Date Sampled: July 3, 1956

Sample Level (Feet)	Ledge No.	Thickness (Feet)	DESCRIPTION: Lithology	Formation
			TOP OF QUARRY	
		10	Stripping. Shale and soil.	
31-32 30-31 29-30 28-29 27-28 26-27 25-26 24-25	2	8	Limestone, light- to medium-gray, fine-grained, crystalline, fossiliferous, argillaceous, dolomitic; 4-inch shale at 24 feet; very shaly toward top.	KINKAID LIMESTONE
23-24 22-23 21-22 20-21 19-20 18-19 17-18 16-17 15-16 14-15 13-14 12-13 11-12 10-11 9-10 8-9 7-8 6-7 5-6 4-5 3-4 2-3 1-2 0-1	1	24	Limestone, dark-gray, fine- to medium-grained, crystalline, fossiliferous, medium- to thick-bedded.	
			BOTTOM OF QUARRY (July 3, 1956)	

SUMMARY OF CHEMICAL CHARACTERISTICS

In the following sections the analytical data on each constituent are summarized for the zones of high-calcium limestone found in the region, with special emphasis on a comparison of the characteristics of the zones in the Ste. Genevieve Limestone and the Warsaw Limestone. The occurrences of low-magnesium limestone and high-carbonate limestone are also summarized.

Calcium Carbonate Content

The average calcium carbonate content of the zones of high-calcium limestone in the Ste. Genevieve and Warsaw formations is shown in Figure 26. The average values in the Ste. Genevieve Limestone range from 95.47 to 98.2 percent, and in the Warsaw Limestone from 95.57 to 97.49 percent. The diagram shows no characteristic difference between the calcium carbonate content in the two formations, though the highest values do occur in the Ste. Genevieve. The high-calcium zones found in the Warsaw have a greater thickness on the average than those in the Ste. Genevieve. Only 3 of the 15 zones in the Ste. Genevieve are at least 30 feet thick, the maximum thickness being 36 feet. In the Warsaw, 8 of the 10 high-calcium zones are more than 30 feet thick, and the maximum thickness is 68 feet.

As indicated previously in the section on Chester limestones, operable thicknesses of high-calcium limestone may occur in the Paint Creek and Glen Dean Limestones.

Magnesium Carbonate Content

The principal occurrences of low-magnesium limestone in the Ste. Genevieve and Warsaw formations correspond with the occurrences of high-calcium limestone. The average magnesium carbonate content of the high-calcium zones is shown in Figure 26. In the Ste. Genevieve the values range from 0.72 to 3.04 percent, and in the Warsaw from 0.67 to 1.65 percent. The diagram shows that the magnesium carbonate content of the high-calcium zones is generally lower in the Warsaw Limestone than in the Ste. Genevieve Limestone.

The analysis of a sample taken from a Ste. Genevieve outcrop in Livingston County reported 0.59 percent magnesium carbonate. The complete analysis of this sample is presented in the section on the Ste. Genevieve in Crittenden and Livingston Counties.

At a number of locations in the region the interval of low-magnesium limestone extends above, below, or between the high-calcium zones. The stone in these thicker intervals may be suitable for uses that have rigid specifications on the magnesium carbonate content of the raw material but do not specify high-calcium limestone. These extended intervals are:

Location	Interval (feet)	$MgCO_3$ (%)	Formation
Canton core (Table 2)	122½ -200	1.20	Warsaw
Canton quarry (Table 3)	13 - 33	2.10	Warsaw
Reed quarry (Table 6)	3 - 53	1.93	Warsaw
Goodrich core (Table 7)	116 -186½	1.24	Warsaw
Herrin core (Table 8)	682 -748	0.58	Warsaw
Three Rivers quarry (Table 11)	2 - 47	1.79	Ste. Genevieve
Princeton quarry (Table 14)	47 - 69	2.7	Ste. Genevieve

Zones of low-magnesium limestone containing only minor amounts of high-calcium limestone have also been found in the Ste. Genevieve and Warsaw formations. There are 10 of these zones, from 10 to 22 feet thick, and the average magnesium carbonate content ranges from 1.16 to 2.3 percent. The 22-foot zone occurs in the Hopkinsville Stone Company quarry (Table 17), and its average value is 2.2 percent.

As previously indicated in the section on the Chester limestones, some low-magnesium stone has been found in the Renault, Glen Dean, Menard, and Kinkaid Limestones. Three zones, from 13 to 17 feet thick, have been found in the Renault and have average values of 2.04 to 2.8 percent. Twenty-four feet of the lower member of the Kinkaid has an average content of 2.3 percent. A sample of crystalline, bioclastic limestone from the Glen Dean contained 1.87 percent magnesium carbonate. A Department of Highways analysis reported 2.04 percent for a representative sample from a 12-foot ledge in the Menard Limestone.

A sample of oolitic limestone from the upper member of the St. Louis Limestone contained 0.64 percent magnesium carbonate.

Total Carbonate Content

For many uses, magnesium carbonate is considered a deleterious constituent in the limestone raw material. However, some metallurgical, chemical, and industrial uses requiring very pure stone do not specify high-calcium limestone but do specify that the total carbonate content of the limestone (calcium carbonate plus magnesium carbonate) exceed a certain percentage, generally 95 percent or more.

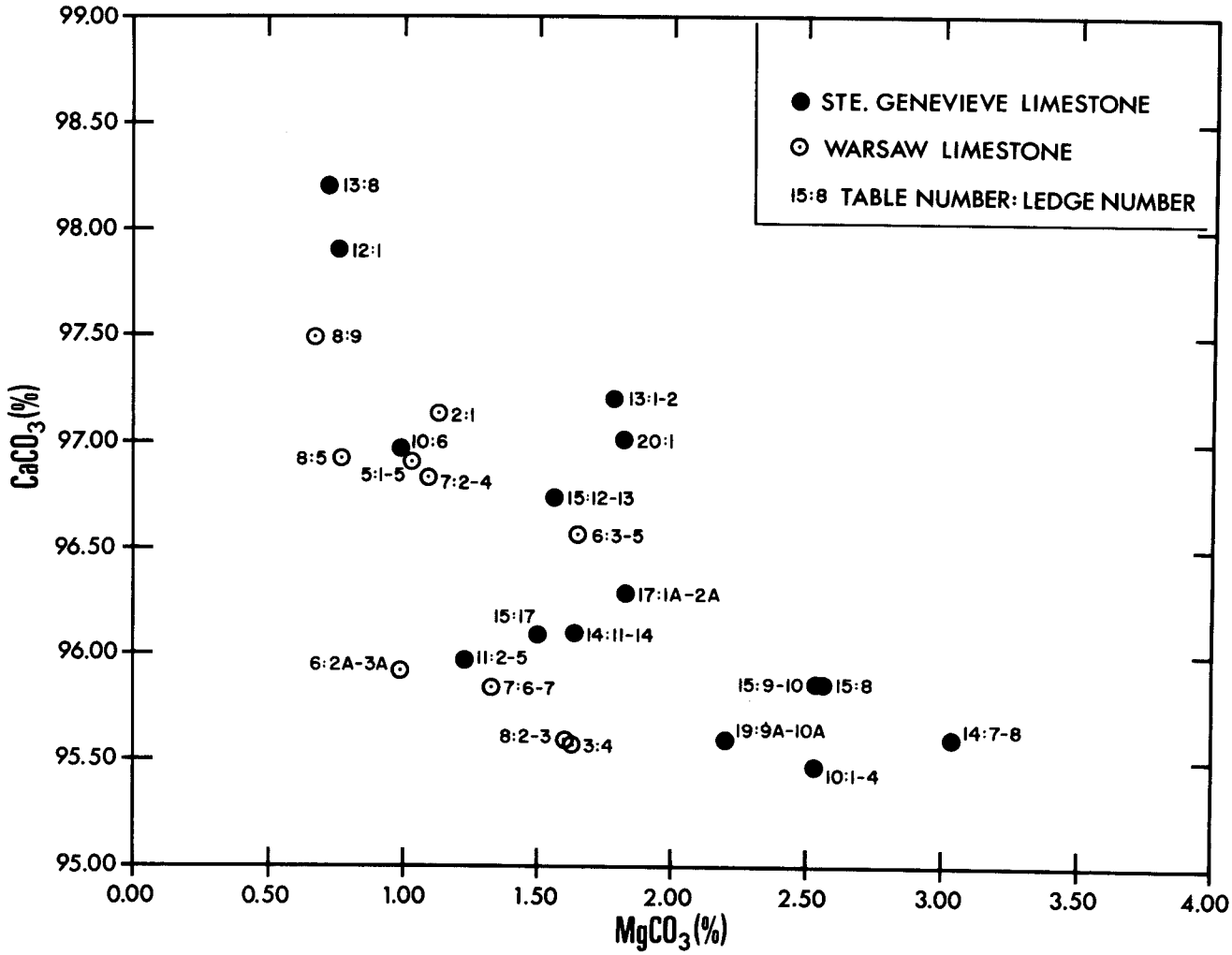


Figure 26. Average calcium carbonate and magnesium carbonate content in the high-calcium zones of the Warsaw and Ste. Genevieve Limestones.

The principal occurrences of high-carbonate limestone in the Ste. Genevieve and Warsaw formations correspond with the occurrences of high-calcium limestone. In the Ste. Genevieve the average total carbonate content in the high-calcium zones ranges from 97.19 to 98.9 percent, and in the Warsaw from 96.91 to 98.26 percent.

At a number of locations in the region the interval of high-carbonate limestone extends above, below, or between the high-calcium zones, and at a few locations there are intervals of high-carbonate limestone that contain no high-calcium stone. These extended intervals with a thickness of 20 feet or more are listed below. This list does not include high-carbonate zones that consist entirely of high-calcium limestone.

Location	Interval (feet)	Total Carbonate (%)	Formation
Western Materials core (Table 1)	21- 60	97.96	Warsaw
Reed quarry (Table 6)	3- 55	98.06	Warsaw
Herrin core (Table 8)	442-529	97.29	Warsaw
	682-702	95.47	
Crittenden Spring quarry (Table 10)	0- 40	97.96	Ste. Genevieve
Princeton quarry (Table (14)	0- 39	98.3	Ste. Genevieve
Cobb core (Table 15)	150-236	98.27	Ste. Genevieve
Hopkinsville Stone Co. quarry (Table 17)	0- 22	96.3	Ste. Genevieve
Christian Quarries (Table 19)	33- 53	95.7	Ste. Genevieve

Silica Content

The average silica (SiO_2) content in the zones of high-calcium limestone in the Ste. Genevieve and Warsaw formations is shown in Figure 27. The average values in the Ste. Genevieve Limestone range from 0.24 to 1.48 percent, and in the Warsaw

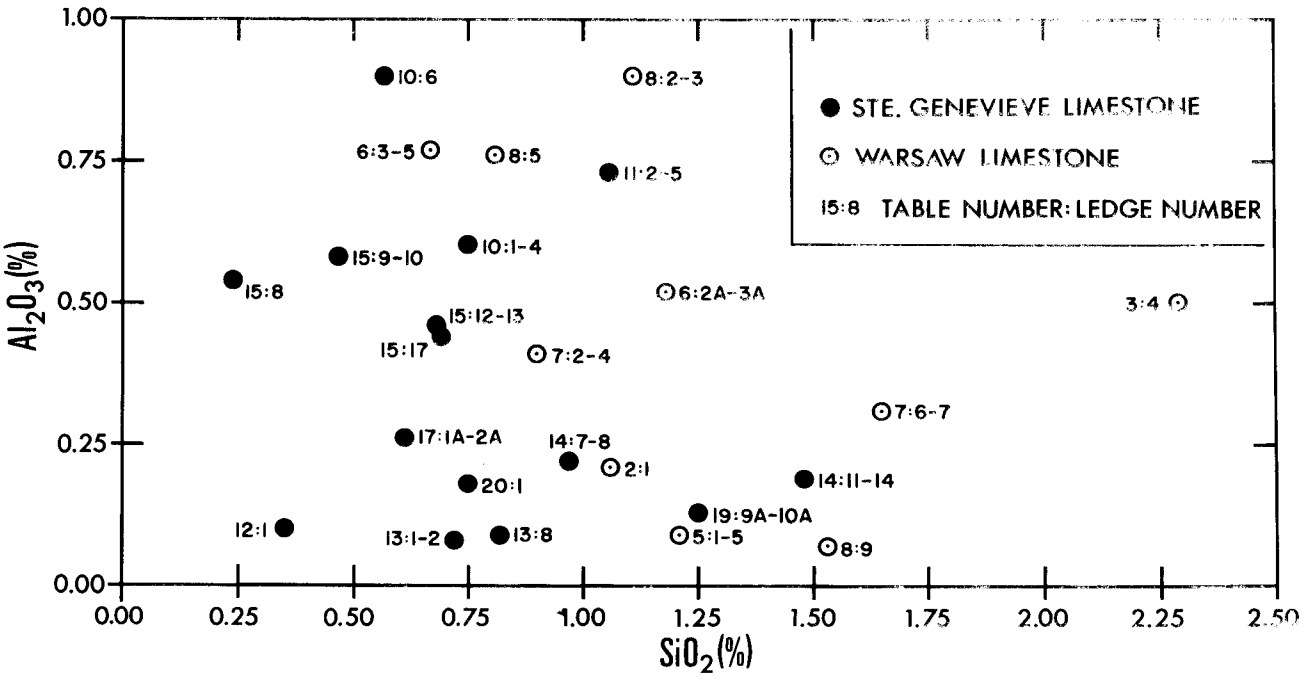


Figure 27. Average alumina and silica content in the high-calcium zones of the Warsaw and Ste. Genevieve Limestones.

Limestone from 0.67 to 2.29 percent. The diagram shows that the silica content of the high-calcium zones is generally lower in the Ste. Genevieve than in the Warsaw.

An outcrop sample of Ste. Genevieve limestone from Livingston County contained 0.10 percent silica. The complete analysis of this sample of high-calcium stone is given in the section on the Ste. Genevieve in Crittenden and Livingston Counties.

A sample of high-calcium limestone from the Glen Dean (Chester) contained 0.92 percent silica.

Iron Oxide Content

The average iron oxide (Fe_2O_3) content in the high-calcium zones in the Ste. Genevieve Limestone ranges from 0.03 to 0.24 percent, and in the Warsaw Limestone from 0.00 to 0.11 percent. Five of the Warsaw zones, which range in thickness from 24 to 50 feet, have an average content of 0.00 to 0.02 percent.

The high-calcium limestones in the Warsaw at the three locations in Crittenden, Livingston, and Marshall Counties have a lower iron oxide content than the high-calcium limestones in Lyon, Trigg, and Calloway Counties. The values range from 0.00 to 0.04 percent at the three northern locations, and from 0.06 to 0.11 percent at the locations to the south. The total thickness of limestone with a relatively low iron oxide content is generally greater than the thickness of the high-calcium zones at the northern locations. There are 3 zones in the Herrin core, 20, 38, and 80 feet thick, with an average content of 0.00 percent (Table 8); 2 zones in the Reed quarry and test hole, 50 and 52 feet thick, with an average content of 0.02 percent (Table 6); and 1 zone in the Goodrich core, 68½ feet thick, with an average content of 0.04 percent (Table 7).

A sample of high-calcium limestone from the Glen Dean (Chester) contained 0.10 percent iron oxide.

Alumina Content

The average alumina (Al_2O_3) content in the zones of high-calcium limestone in the Ste. Genevieve and Warsaw formations is shown in Figure 27. The average values in the Ste. Genevieve Limestone range from 0.08 to 0.90 percent, and in the Warsaw Limestone from 0.07 to 0.90 percent. The diagram shows no characteristic difference between the alumina content in the two formations.

A sample of high-calcium limestone from the Glen Dean (Chester) contained 0.26 percent alumina.

Sulfur Content

The average sulfur (S) content in the zones of high-calcium limestone in the Ste. Genevieve and Warsaw formations is shown in Figure 28. The average values in the Ste. Genevieve Limestone range from 0.001 to 0.061 percent, and in the Warsaw Limestone from 0.017 to 0.145 percent.

The average sulfur content in the Warsaw is lower at the locations in Lyon and Trigg Counties than at the locations in Crittenden, Livingston, and Marshall Counties. In the TVA quarry and Canton core (Tables 5 and 2) the content is 0.017 and 0.030 percent, and in the Reed quarry and test hole and Goodrich core (Tables 6 and 7) the values range from 0.053 to 0.074 percent. The higher sulfur content at the latter locations, which are approximately 4¼ miles apart, is believed to be attributable to a greater amount of residual organic material in the bioclastic limestone. Traces of bitumen were observed in the samples from the Reed quarry and test hole.

The average sulfur content in the three high-calcium zones in the Herrin core from northern Crittenden County (Table 8) ranges from 0.030 to 0.145 percent. Pyrite, which was present in visible trace amounts, may have contributed to the high sulfur content in the core, but because of the low percentage of iron the principal source is probably the same as in the Reed quarry and test hole and the Goodrich core. Neither gypsum nor anhydrite was observed at these three locations.

It was noted previously that although the high-calcium zones in the Ste. Genevieve occur primarily in oolitic limestone, some zones include some nonoolitic limestone. At several locations the sulfur content was found to be higher in these high-calcium nonoolitic zones than in the oolitic zones:

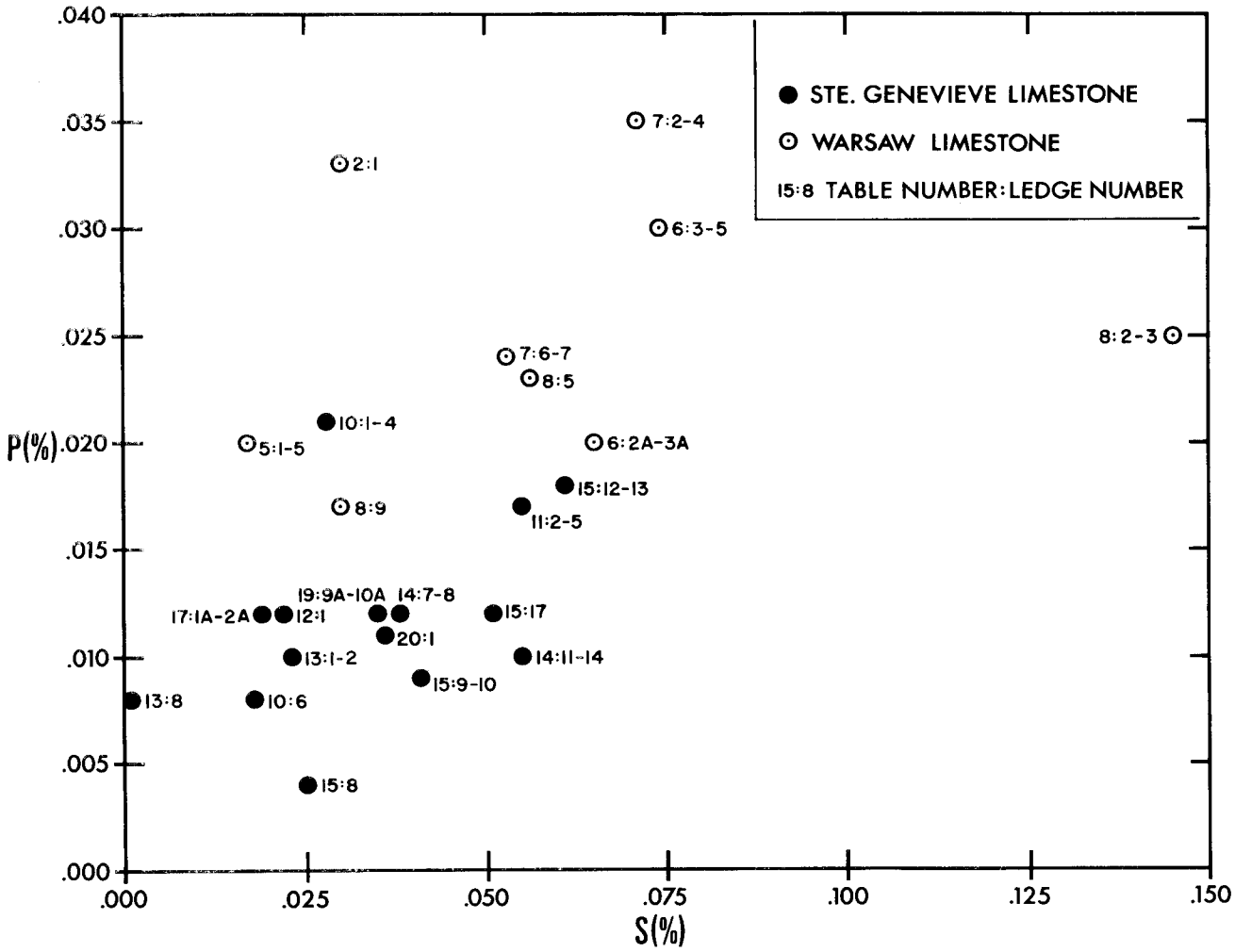


Figure 28. Average phosphorus and sulfur content in the high-calcium zones of the Warsaw and Ste. Genevieve Limestones.

Location	Interval (feet)	Lithology	S(%)
Fredonia Valley quarry (Table 13)	22- 30	Crystalline and fossiliferous	.038
	0- 22	Oolitic	.018
Princeton quarry (Table 14)	24- 31	Crystalline and calcarenitic	.039
	21- 24	Oolitic	.037
Cobb core (Table 15)	214-228	Oolitic, in part bioclastic	.054
	228-236	Crystalline, in part calcarenitic	.075

Phosphorus Content

The average phosphorus (P) content in the zones of high-calcium limestone in the Ste. Genevieve and Warsaw formations is shown in Figure 28. The average values in the Ste. Genevieve Limestone range from 0.004 to 0.021 percent, and in the Warsaw Limestone from 0.017 to 0.035 percent. The diagram shows that the phosphorus content of the high-calcium zones is generally lower in the Ste. Genevieve than in the Warsaw. In the Ste. Genevieve the high-calcium strata are predominantly oolitic limestones whereas in the Warsaw they are bryozoan- and crinoid-rich bioclastic limestones. The higher phosphorus content in the Warsaw bioclastic limestones is believed to be attributable to fossil skeletal material and residual organic material.

In the high-calcium zones in the Ste. Genevieve at several locations the phosphorus content was also found to be higher in the nonoolitic limestones than in the oolitic limestones:

Location	Interval (feet)	Lithology	P(%)
Fredonia Valley quarry (Table 13)	22- 30	Crystalline and fossiliferous	.012
	0- 22	Oolitic	.009
Princeton quarry (Table 14)	24- 31	Crystalline and calcarenitic	.014
	21- 24	Oolitic	.006
Cobb core (Table 15)	214-228	Oolitic, in part bioclastic	.014
	228-236	Crystalline, in part calcarenitic	.026

INDUSTRY SPECIFICATIONS

The general chemical specifications for a number of metallurgical, chemical, industrial, and agricultural uses of limestone are listed in Table 22.* These data represent the range of values in published specifications compiled from several reports. The figures should be considered as general guides because the requirements of individual companies vary, depending upon such factors, for example, as the location of the deposit with respect to transportation and the composition of other raw materials used with the limestone. Also, improvements in industrial technology generally result in more stringent specifications, though in some cases they have permitted the use of lower grade raw materials.

The data in Table 22* are specifically for the limestone raw material, which may be used directly or converted to lime prior to utilization. The table includes the analysis of a sample of limestone used commercially for mineral feed in Kentucky. As a further guide, specifications are also given for lime used as flux in basic oxygen furnaces and for the maximum allowable limits for the major deleterious constituents in cement.

Although high-calcium limestone is a minimum requirement for a majority of uses, several industries can utilize dolomitic limestone or dolomite if the total carbonate content of the rock is sufficiently high, and these are noted in the table.

Recent research on air-pollution control indicates that limestone may prove an efficient agent in reducing sulfur dioxide in flue gases. This development offers further utilization of limestone in the growing field of pollution control in addition to its widespread use as filter stone in sewage-disposal plants.

* Table 22 follows references.

REFERENCES

American Waterways Operators, Inc., 1965, Big load afloat: Washington, D. C., American Waterways Operators, Inc., 106 p.

Amos, D. H., 1965, Geology of parts of the Shetlerville and Rosiclare quadrangles, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-400.

——— 1966, Geologic map of the Golconda quadrangle, Kentucky-Illinois, and the part of the Brownfield quadrangle in Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-546.

——— 1967, Geologic map of part of the Smithland quadrangle, Livingston County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-657.

Amos, D. H., and Finch, W. I., 1968, Geologic map of the Calvert City quadrangle, Livingston and Marshall Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-731.

Amos, D. H., and Wolfe, E. W., 1966, Geologic map of the Little Cypress quadrangle, Kentucky-Illinois: U. S. Geol. Survey Geol. Quad. Map GQ-554.

Blade, L. V., 1966, Geologic map of parts of the Hamlin and Paris Landing quadrangles, western Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-498.

Bowen, O. E., Jr., 1957, Limestone, dolomite, and lime products, p. 293-306 *in* Wright, L. A., *Editor,* Mineral commodities of California: California Div. Mines Bull. 176, 736 p.

Boynton, R. S., 1966, Chemistry and technology of lime and limestone: New York, John Wiley & Sons, 520 p.

Butts, Charles, 1917, Descriptions and correlation of the Mississippian formations of western Kentucky, 119 p. *in* Mississippian formations of western Kentucky: Kentucky Geol. Survey, ser. 4, v. 5.

Ericksen, G. E., and Cox, D. P., 1968, Limestone and dolomite, p. 227-252 *in* Mineral resources of the Appalachian Region: U. S. Geol. Survey Prof. Paper 580, 492 p.

Finch, W. I., 1968, Engineering geology of the Calvert City quadrangle, Livingston and Marshall Counties, Kentucky: Kentucky Geol. Survey, ser. 10, Inf. Circ. 16, 28 p.

Fox, K. F., Jr., 1965, Geology of the Cadiz quadrangle, Trigg County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-412.

Fox, K. F., Jr., and Olive, W. W., 1966, Geologic map of the Birmingham Point quadrangle, western Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-471.

Fox, K. F., Jr., and Seeland, D. A., 1964, Geology of the Canton quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-279.

Hardin, G. C., Jr., 1955, Babb fault system, Crittenden and Livingston Counties: U. S. Geol. Survey Bull. 1012-B, p. 7-37.

Hardin, G. C., Jr., and Trace, R. D., 1959, Geology and fluorspar deposits, Big Four fault system, Crittenden County, Kentucky: U. S. Geol. Survey Bull. 1042-S, p. 699-724.

Harvey, R. D., 1968, Mineralogy and petrography of carbonate rocks related to control of sulfur dioxide in flue gases—a preliminary report: Illinois Geol. Survey Environmental Geol. Notes, no. 21, 9 p.

Hays, W. H., 1964, Geology of the Grand Rivers quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-328.

Hook, J. W., and Clark, B. E., 1962, Selected features of the Kentucky fluorspar district and the Barkley Dam site: Geol. Soc. Kentucky Field Trip Guidebook, 35 p.

Kentucky Department of Commerce, 1964, Gas-oil-electric facilities in Kentucky: Frankfort, Dept. Commerce map, scale 1:500,000.

——— 1966, Kentucky chemical industry: Frankfort, Dept. Commerce, 30 p.

Kentucky Department of Highways, 1947, Annual report of quarries: Frankfort, Dept. Highways, Testing Laboratory, 70 p.

——— 1951, Report of quarries: Frankfort, Dept. Highways, Div. Materials, 170 p.

——— 1954, Report of aggregate sources: Frankfort, Dept. Highways, Div. Materials, 102 p.

——— 1959, Kentucky aggregates: Frankfort, Dept. Highways, Div. Materials, 144 p.

Key, W. W., 1960, Chalk and whiting, p. 233-241 *in* Gillson, J. L., and others, *Editors,* Industrial minerals and rocks, 3d ed.: Am. Inst. Mining Metall. Petroleum Engineers, 934 p.

Klemic, Harry, 1965, Geology of the Honey Grove quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-376.

——— 1966a, Geologic map of the Hammacksville quadrangle, Kentucky-Tennessee: U. S. Geol. Survey Geol. Quad. Map GQ-540.

1966b, Geologic map of the Oak Grove quadrangle, Kentucky-Tennessee: U. S. Geol. Survey Geol. Quad. Map GQ-565.

——— 1966c, Geologic map of the Herndon quadrangle, Kentucky-Tennessee: U. S. Geol. Survey Geol. Quad. Map GQ-572.

——— 1967, Geologic map of the Hopkinsville quadrangle, Christian County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-651.

Klemic, Harry, and Ulrich, G. E., 1967, Geologic map of the Roaring Spring quadrangle, Kentucky-Tennessee: U. S. Geol. Survey Geol. Quad. Map GQ-658.

Klemic, Harry, Ulrich, G. E., and Moore, S. L., 1968, Geologic map of part of the Johnson Hollow quadrangle, Trigg County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-722.

Lamar, J. E., 1959, Limestone resources of extreme southern Illinois: Illinois Geol. Survey Rept. Inv. 211, 81 p.

——— 1961, Uses of limestone and dolomite: Illinois Geol. Survey Circ. 321, 41 p.

Lambert, T. W., and MacCary, L. M., 1964, Geology of the Briensburg quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-327.

Lineback, J. A., 1966, Deep-water sediments adjacent to the Borden Siltstone (Mississippian) delta in southern Illinois: Illinois Geol. Survey Circ. 401, 48 p.

McCann, T. P., 1956, Deep tests in Cumberland County, Tennessee, and Crittenden County, Kentucky, p. 16-23 *in* McGrain, Preston, and others, *Editors,* Proceedings of the technical session, Kentucky Oil and Gas Association annual mid-year meeting, May 25, 1956: Kentucky Geol. Survey, ser. 9, Special Pub. 9, 83 p.

MacCary, L. M., and Lambert, T. W., 1956, Itinerary: selected geologic features of southwestern Kentucky: Geol. Soc. Kentucky Field Trip Guidebook, 30 p.

McFarlan, A. C., 1943, Geology of Kentucky: Lexington, Univ. Kentucky, 531 p.

McFarlan, A. C., Swann, D. H., Walker, F. H., and Nosow, Edmund, 1955, Some old Chester problems—correlations of lower and middle Chester formations of western Kentucky: Kentucky Geol. Survey, ser. 9, Bull. 16, 37 p.

McGrain, Preston, 1964, A deposit of high-calcium limestone near Barkley Lake, Kentucky: Kentucky Geol. Survey, ser. 10, Inf. Circ. 14, 12 p.

——1968, Economic geology of Calloway County, Kentucky: Kentucky Geol. Survey, ser. 10, County Rept. 2, 35 p.

McGrain, Preston, and Dever, G. R., Jr., 1966, Geology of cement raw materials in Kentucky, p. 31-44 *in* Proceedings of the second forum on geology of industrial minerals: Indiana Geol. Survey and Indiana Univ., 197 p. (Kentucky Geol. Survey, ser. 10, Reprint 20.)

Martin, N. W., and Gibson, R. C., 1966, Deleterious constituents in cement raw materials, p. 91-100 *in* Proceedings of the second forum on geology of industrial minerals: Indiana Geol. Survey and Indiana Univ., 197 p.

Miller, T. P., 1964, Geology of the Kelly quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-307.

Moore, S. L., 1968, Geologic map of the Pembroke quadrangle, Christian and Todd Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-709.

Mote, R. H., and Kaufman, Alvin, 1956, The mineral industry of Kentucky, p. 439-456 *in* Minerals Yearbook, 1953, v. 3: U. S. Bur. Mines, 1169 p. (Kentucky Geol. Survey, ser. 9, Reprint 13.)

Nelson, W. H., 1964, Geology of the Pleasant Green Hill quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-321.

Nelson, W. H., and Seeland, D. A., 1968, Geologic map of the Gracey quadrangle, Trigg and Christian Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-753.

Olive, W. W., 1965, Geology of the Hico quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-332.

Palmer, J. E., 1966, Geologic map of the Dalton quadrangle, western Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-490.

Reed, A. H., Jr., McGrain, Preston, and Rivers, M. E., 1959, The mineral industry of Kentucky, p. 463-480 *in* Minerals Yearbook, 1957, v. 3: U. S. Bur. Mines, 1244 p. (Kentucky Geol. Survey, ser. 10, Reprint 1.)

——1960, The mineral industry of Kentucky, p. 417-437 *in* Minerals Yearbook, 1959, v. 3: U. S. Bur. Mines, 1134 p. (Kentucky Geol. Survey, ser. 10, Reprint 7.)

Riley, H. L., and McGrain, Preston, 1967, The mineral industry of Kentucky, p. 339-354 *in* Minerals Yearbook, 1966, v. 3: U. S. Bur. Mines, 891 p. (Kentucky Geol. Survey, ser. 10, Reprint 24.)

Rock Products, 1968, One hundred largest quarries: Rock Products, v. 71, no. 10 (October 1968), p. 59-73.

Rogers, W. B., 1963, Geology of the Eddyville quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-255.

——1965, Geology of the Model quadrangle in Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-409.

Rogers, W. B., and Hays, W. H., 1967, Geologic map of the Fredonia quadrangle, western Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-607.

Sample, R. D., 1965, Geology of the Princeton West quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-385.

——1967, Geologic map of the Lamasco quadrangle, western Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-608.

Schilling, S. A., and Hale, R. W., 1966, A market study of selected commodities related to the Upper Green River waterway: Columbus, Ohio, Battelle Memorial Institute (for Kentucky Dept. Commerce), 27 p.

Schnabel, R. W., and MacKallor, J. A., 1964, Geology of the Fenton quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-317.

Seeland, D. A., 1968a, Geologic map of the Cobb quadrangle, Trigg and Caldwell Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-710.

——1968b, Geologic map of part of the Repton quadrangle in Crittenden County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-754.

Seeland, D. A., and Wilshire, H. G., 1965, Geologic map of part of the Rushing Creek quadrangle in southwestern Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-445.

Stokley, J. A., 1949, Industrial limestones of Kentucky: Kentucky Geol. Survey, ser. 9, Rept. Inv. 2, 51 p.

Stokley, J. A., and Luttrell, E. M., 1952, High-calcium limestone in the Kentucky Lake area: Kentucky Geol. Survey, ser. 9, Inf. Circ. 2, 5 p.

Stokley, J. A., and McFarlan, A. C., 1952, Industrial limestones of Kentucky no. 2: Kentucky Geol. Survey, ser. 9, Rept. Inv. 4, 95 p.

Stokley, J. A., and Walker, F. H., 1953, Industrial limestones of Kentucky no. 3: Kentucky Geol. Survey, ser. 9, Rept. Inv. 8, 62 p.

Swann, D. H., 1963, Classification of Genevievian and Chesterian (Late Mississippian) rocks of Illinois: Illinois Geol. Survey Rept. Inv. 216, 91 p.

Tennessee Valley Authority, 1949, Geology and foundation treatment, Tennessee Valley Authority projects: Tennessee Valley Authority Tech. Rept. 22, 548 p.

Trace, R. D., 1962a, Geology and fluorspar deposits of the Levias-Keystone and Dike-Eaton areas, Crittenden County, Kentucky: U. S. Geol. Survey Bull. 1122-E, 26 p.

——1962b, Geology of the Salem quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-206.

——1966, Geologic map of the Marion quadrangle, Crittenden and Caldwell Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-547.

Trace, R. D., and Kehn, T. M., 1968, Geologic map of the Olney quadrangle, Caldwell and Hopkins Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-742.

Ulrich, E. O., 1917, The formations of the Chester series in western Kentucky and their correlates elsewhere, 272 p. *in* Mississippian formations of western Kentucky: Kentucky Geol. Survey, ser. 4, v. 5.

Ulrich, G. E., 1966, Geologic map of the Church Hill quadrangle, Christian County, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-556.

Ulrich, G. E., and Klemic, Harry, 1966, Geologic map of the Caledonia quadrangle, Trigg and Christian Counties, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-604.

U. S. Army Corps of Engineers, 1952, Navigation charts, Cumberland River, Nashville District, mouth to Lock and Dam No. 8 near Carthage, Tenn.: U. S. Army Corps of Engineers, 55 p.

Weis, P. L., and Theobald, P. K., 1964, Geology of the Mont quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-305.

Weller, Stuart, 1921, Geology of the Colconda quadrangle: Kentucky Geol. Survey, ser. 6, v. 4, 148 p.

——1923, Geology of the Princeton quadrangle: Kentucky Geol. Survey, ser. 6, v. 10, p. 1-105.

——1927, Geology of the Cave in Rock quadrangle: Kentucky Geol. Survey, ser. 6, v. 26, p. 1-128.

Weller, Stuart, and Sutton, A. H., 1951, Geologic map of the western Kentucky fluorspar district: U. S. Geol. Survey Mineral Inv. Field Studies Map MF-2, scale 1:62,500.

Wolfe, E. W., 1964, Geology of the Fairdealing quadrangle, Kentucky: U. S. Geol. Survey Geol. Quad. Map GQ-320.

TABLE 22. SPECIFICATIONS FOR USES OF LIMESTONE

USE	CHEMICAL REQUIREMENTS								REFERENCES
	$CaCO_3$	$MgCO_3$	SiO_2	Fe_2O_3	Al_2O_3	S	P	Miscellaneous	
METALLURGICAL									
Flux—Ferrous Metals									
Blast furnace		<8- <31%	<1- <5%		<2%	Max. 0.1-0.5%	Max. 0.002-0.02%		Boynton (1966), Ericksen and Cox (1968), Lamar (1961)
	Total carbonate >95%								Boynton (1966)
Open hearth	Min. 97-98%		<1-max. 3%		<1.5%	Low	Max. a trace (0.002)		Ericksen and Cox (1968), Lamar (1961)
	96.5-98%	0.5-1.25%	0.40-0.75%		0.20-0.50%				Schilling and Hale (1966)
Flux—Nonferrous Metals									
General	Specifications similar to those for blast furnace, but high-calcium limestone preferred								Boynton (1966), Lamar (1961)
Aluminum oxide	>97%		<1%						Lamar (1961)
LIME MANUFACTURE									
High-calcium lime	Min. 97-98%								Ericksen and Cox (1968), Lamar (1961)
Low-magnesium lime		6-40%	<3% noncarbonate impurities						Lamar (1961)
High-magnesium lime		>40%	<3% noncarbonate impurities						Lamar (1961)
PORTLAND CEMENT MANUFACTURE									
General	Min. varies	Max. 3-6.3%				Low	<0.2%	Total alkalies—max. 0.5%	Bowen (1957), Boynton (1966), Ericksen and Cox (1968), Lamar (1961)
White cement				<0.01%				Low manganese	Lamar (1961)
CHEMICAL PROCESS INDUSTRIES									
General chemical use	Min. 97-98%								Bowen (1957), Ericksen and Cox (1968)
Alkali	>95%		<1%						Lamar (1961)
Beet sugar	Min. 95-97%	MgO Max. 1-4%	<1-max. 4%	Max. 0.5%					Lamar (1961)
Calcium carbide	>97- >98%	MgO <0.5- <2%	Max. 1-3%	0.05-0.75%		Max. a trace	Max. 0.004%- <1.2%		Bowen (1957), Lamar (1961)
Calcium nitrate	>95%								Lamar (1961)
Glass—general	>98%			Max. 0.02-0.05%		Low	Low		Bowen (1957), Lamar (1961)
	Total carbonate >98%—where dolomite is used instead of limestone								Bowen (1957), Lamar (1961)
Glass—special and optical				FeO Max. 0.01-0.02%					Boynton (1966)
Monocalcium phosphate	>95%		Very pure limestone						Boynton (1966), Lamar (1961)
Pulp and paper	Min. 95-97%		<2%						Boynton (1966), Lamar (1961)
INDUSTRY FILLERS (WHITING)									
Ceramic—Class 1	Min. 96%	Max. 1%							Key (1960), Lamar (1961)
—Class 2	Min. 89%	Max. 8%							Key (1960), Lamar (1961)
—Classes 1 & 2	Min. total carbonate 97%		Max. 2.0%	Max. 0.25%		SO_3 Max. 0.1%			Key (1960), Lamar (1961)
Paint	>96%-min. 98%	Max. 1%	Max. 2.0%	Max. 0.25%		SO_3 Max. 0.1%			Ericksen and Cox (1968), Lamar (1961)
	Min. 96%	Max. 2%	Max. 0.5%	Max. 0.05%	Max. 0.30%			$CaSO_4$—max. 1%	Key (1960)
Rubber	Min. 98%		Trace	Trace	Trace			Max.: Mn—0.02%; CuO—0.005% Alkalinity—0.03%	Key (1960)
MISCELLANEOUS INDUSTRIAL USES									
Coal-mine dusting			Max. 5%						Boynton (1966), Lamar (1961)
Acid neutralization	>95%								Boynton (1966), Lamar (1961)
AGRICULTURE									
Mineral feed	>95%-min. 98.5%		Low		Low			Low fluorine; low arsenic	Boynton (1966), Lamar (1961)
Agricultural limestone	Min. calcium carbonate equivalent value of 80 (pure limestone has C.C.E. value of 100, pure dolomite, 108.6)								Boynton (1966), Lamar (1961)

ADDITIONAL DATA:

Commercial Sample, Mineral Feed Limestone	96.14%	1.94%	1.11%	0.11%	0.49%				Analysis by Kentucky Geological Survey
Lime For Basic Oxygen Furnace	CaO Min. 94%		Max. 1.5%	Max. 1.5%	Max. 1.5%	Max. 0.03%			Schilling and Hale (1966)
Deleterious Constituents in Cement		MgO Max. 5.0%				SO_3 Max. 2.3-4.0%	P_2O_5 Max. 2.0-2.5%	$Na_2O + .658K_2O$—max. 0.6%	Martin and Gibson (1966)