STATE OF ARKANSAS

ARKANSAS GEOLOGICAL AND CONSERVATION COMMISSION

Norman F. Williams, Geologist-Director

HIGH-CALCIUM LIMESTONES IN INDEPENDENCE AND IZARD COUNTIES, ARKANSAS

By

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Little Rock, Arkansas

1949

Aerial view of Penters Bluff on the White River, Izard County, Arkansas. The lower 240 feet of the bluff is Plattin limestone, and the upper 200 feet is mainly Fernvale and Kimmswick limestone. Boone chert cups the hills back at the bluff.

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ABSTRACT

Early in 1946 a reconnaissance survey was made in the Batesville area, Independence County, and along the White River in southern Izard County, Arkansas, to locate quarries or quarry sites capable of producing a large tonnage of chemical-grade limestone. Several abandoned and operating quarries were examined during the investigation as well as numerous accessible limestone outcrops, and representative samples were collected at the most promising localities. The geologic map that accompanies U. S. Geological Survey Bulletin 921-A was used as a guide in prospecting, which was limited for economic reasons to the areas immediately adjacent to the railroad. The geologic formations of the Batesville area are sedimentary shales, sandstones and limestones all of Paleozoic age. Although these sedimentary formations usually have shallow dips, the dissection of the area by stream erosion has resulted in many good exposures of these formations, particularly along the bluffs of the White River. Results of the field work and laboratory analyses of the samples indicate that the Fernvale and Kimmswick limestone formations, especially along the bluffs of the White River from Penters Bluff to Guion in Izard County, can be recommended as sources of chemical-grade limestone. The chemical-grade limestone in the Boone formation appears to be comparatively limited and local in extent. The Plattin limestone formation, the thickest of the limestone formations in this region, is apparently slightly siliceous in most of its outcrop, but it would be an excellent source of limestone for applications in which silica is not objectionable. The Reynolds Mining Corporation quarry located near the mouth of Lafferty Hollow, one mile west of Penters Bluff on the north side of White River, Izard County, Arkansas, was developed largely as a result of this limestone investigation. The quarry now supplies the Hurricane Creek alumina plant of the Reynolds Metals Company with approximately 275,000 tons of chemical-grade limestone per year.

INTRODUCTION

Purpose and Scope of the Project

A reconnaissance survey was made in the Batesville area by the writer early in 1946, for the purpose of locating quarries or potential quarry sites that could produce a large tonnage of high-calcium limestone. Since there was very little published information on the chemical composition of the various limestone formations occurring in the district, it was necessary to collect samples for analysis from all of these limestones, so that later detailed work could be limited to the favorable formations. Due to economic considerations, examinations and sampling were limited to the limestone outcrops and quarries that were adjacent to or within a mile of the railroads serving the area. The information obtained from this investigation was later mimeographed for distribution by the Division of Geology, but the continued interest in high-calcium limestones in the area indicated that a publication would be desirable. Hence this early investigation, in addition to more detailed chemical and geological data obtained at a later date from individual limestone deposits along the White River, has been incorporated in this published report.

The writer is indebted to Mr. A. M. Short, consulting geologist of St. Louis, Missouri, who participated in the initial reconnaissance survey in the Batesville area; to Mr. O. C. Schmedeman of the Reynolds Mining Corporation, Little Rock, Arkansas, for the use of the Corporation's geologic map and drill hole data from their Izard County limestone quarry; and to Mr. Howard Millar of the White River Limestone Products Company, Little Rock, for the use of geological and chemical data obtained from drill cores from their limestone deposit near Penters Bluff, Izard County. Grateful acknowledgment is made to Mr. Thomas Nolan, Acting Director of the U. S. Geological Survey, Washington, D. C., for permission to include the Preliminary Geologic Map of the Central Part of the Batesville Manganese District, Arkansas, in this report.

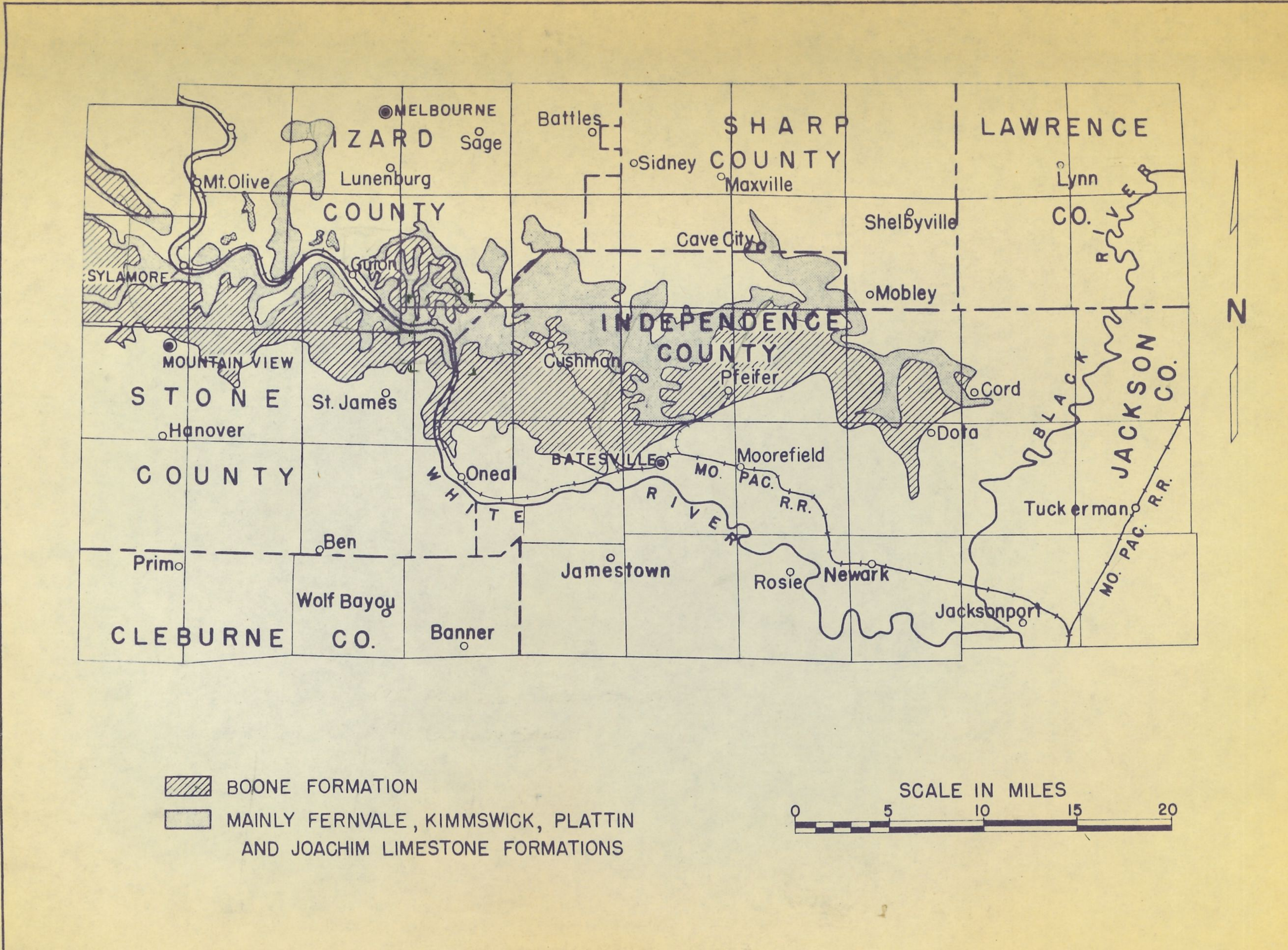


Fig. 1 Generalized geologic map showing the surface distribution of high-calcium limestone-bearing formations in northeastern Arkansas

Location, Extent, and Accessibility of the Area

High-calcium limestone formations outcrop in a belt 3 to 12 miles wide and 42 miles long, extending from the Community of Cord in northeastern Independence County westward to the town of Sylamore in the southwest corner of Izard County (Fig. 1). Outcrops of these limestones are known west of Sylamore, but with the exception of the Boone formation which extends westward across the state into Missouri and Oklahoma, these outcrops are few in number and relatively inaccessible.

The Batesville limestone district (see maps in envelope at back) report is particularly concerned, lies approximately in the center of the above belt. The main part of the district lies in the northwest quarter of Independence County and is bounded on the south by the White River and on the east by State Highway 11. The remainder of the Batesville district lies in the southeastern corner of Izard County, and it consists of an area 4 to 5 miles wide paralleling the White River and extending from the Izard-Independence County line northwest to the town of Guion. The town of Batesville, from which the district is named, lies at the southeast corner of the district.

The limestone area is served by the Missouri Pacific railroad, which follows the north and east sides of the White River valley from Batesville northwest across the area to Sylamore. Branch lines of the railroad also extend to the towns of Cushman and Pfeiffer in Izard County. The roads in the area are all gravel with the exception of State Highways 11 and 69, both of which are hard surfaced. Although several locks have been built on the White River in this area, it is believed that plans for making the river navigable have been abandoned. Since neither water nor rail transportation facilities are available, the limestone outcrops on the Stone County side of White River were not examined in this investigation.

Previous Investigations

The first publication describing limestones in the Batesville area was Volume IV of the Annual Report of the Arkansas Geological Survey for 1890, by T. C. Hopkins. Although this report covered limestone deposits throughout the state, much detail is included on the stone of the Batesville area. The report does not contain much analytical data on the various limestones, but it does give good descriptions of specific outcrops. Hopkins' formation names (see geologic column) do not conform to those now being used. His St. Clair marble formation includes the St. Clair, Fernvale, and Kimmswick limestone formations and his Izard limestone formation includes both the Plattin and Joachim limestone formations.

Much of the geological work published on the manganese deposits of the Batesville district is of importance in connection with the limestone formations. U. S. Geological Survey Bulletin 734, "Manganese Ore in the Batesville District, Arkansas", by H. D. Miser, published in 1922, is of particular value for its information on the stratigraphy of the Batesville area. Detailed descriptions of the Boone, St. Clair, Fernvale, Kimmswick, and Plattin formations are included. A later U. S. Geological Survey Bulletin (921-A) by Mr. Miser on manganese carbonate, published in 1941, contains a good geologic map of the Batesville district.

In 1941, the Arkansas Geological Survey published a pamphlet, "Limestones of Northern Arkansas", by George C. Branner. This report gives a brief history of the limestone industry in the northern part of the state, as well as numerous detailed chemical analyses of limestones from specific locations, and the distribution and character of the limestone formations of the region. Economic data included in the pamphlet are: production statistics, and a list of operating quarries with their locations.

The most recent geological publication on the Batesville area is Oil and Gas Investigations Map No. 12, entitled, "Geologic Maps and Structure Sections of the Batesville District, Independence County, Arkansas", by MacKenzie Gordon, Jr., and Douglas M. Kinney, published by the U. S. Geological Survey in 1944. This map is particularly valuable for its information on the distribution and description of the Boone formation in the immediate vicinity of Batesville.

Methods of Investigation

The geologic map that accompanies U. S. Geological Survey Bulletin 921-A was used as a guide in prospecting the area. Outcrops of the Boone, Fernvale, Kimmswick, and Plattin limestones adjacent to or within a mile of the railroads were visited. Those quarries and limestone outcrops that were favorably located and that indicated substantial reserves of limestone were examined and sampled. The outcrops or quarries were chip-sampled at 2 to 4 foot intervals along a line perpendicular to the bedding. All samples were analyzed in the Division of Geology chemical laboratory by Troy W. Carney, Chemist. A more detailed study was made of the Fernvale and Kimmswick limestones at the deposit of the White River Limestone Products Company near Penters Bluff, Izard County, Arkansas, since the cores from eleven drill holes at this deposit completely penetrated the Fernvale and Kimmswick limestone formations.

REGIONAL GEOLOGY

Stratigraphy

The rocks exposed in the Batesville district are all of sedimentary origin and range in age from Ordovician to Mississippian (see the composite geologic column). The formation names used by T. C. Hopkins in his 1890 limestone report are included in the geologic column to point out their relationship to the names now being used for the formations exposed in the Batesville district.

Composite Geologic Column

of the rocks exposed in the Batesville District, Arkansas

System	Formation names H.D. Miser, 1941	Thickness in feet	Formation names T.C. Hopkins, 1890
Carboniferous (Mississippian)	Batesville sandstone	20-200	Batesville sandstone
	Moorefield shale	100-250	Fayetteville shale
	Boone chert	300-400	Boone chert and limestone
	Unconformity		
Devonian	Chattanooga shale	0- 38	)---- Eureka shale
	Unconformity		
	Penters chert	0- 91	
	Unconformity		
Silurian	Lafferty limestone	0- 85	
	St. Clair limestone	0-100	)
	Unconformity		)
Ordovician	Cason shale	0- $12\frac{1}{2}$	)------ St. Clair limestone
	Unconformity		)
	Fernvale limestone	0-125	)
	Kimmswick limestone	12- 55	)
	Unconformity		
	Plattin limestone	128-240	)
	Unconformity		)------ Izard limestone
	Joachim limestone	20-150	)
	St. Peter sandstone	120-200	)------ Saccharoidal sandstone

Two maps have been included in this report (see envelope at back) to show the distribution of the geologic formations in the area. Plate I, which was adapted from a portion of the Geological Map of the Batesville District, Arkansas, (U. S. Geological Survey Bulletin 921-A) shows the geology of the area immediately north of the White River between Penters Bluff and Guion. The second map is a copy of the U. S. Geological Survey's Preliminary Map of the Central Part of the Batesville Manganese District, Arkansas, by D. M. Kinney published in 1949. This map covers the area of important Fernvale, Kimmswick, and Plattin limestone outcrops east of Penters Bluff in Independence County.

Regional Structure

The rocks in the limestone district have undergone little deformation. Since the region lies on the south flank of the Ozark uplift, all of the formations have a shallow regional dip to the south which has been complicated by gentle folding producing low domes and shallow basins. Several normal faults have also been mapped in the area.

The High-Calcium Limestone Formations

The formations of most interest as potential sources of chemical limestone are the Boone chert and limestone, the St. Clair limestone, the Fernvale limestone, the Kimmswick limestone, and the Plattin limestone. The two geologic maps in the envelope at the back of this report show the distribution of these formations in the Batesville district.

The Boone chert formation is perhaps the most widely exposed of the formations listed. It is composed of a lower member (10 to 100 feet thick) consisting of dark gray, blue or green chert interbedded with light gray, fine-grained limestone, and an upper member (100 to 200 feet thick) composed of light-gray, fine- to coarse-grained limestone interbedded with white, tan and gray chert. West of Spring Creek and east of Polk Bayou near Pfeiffer most of the upper member consists of medium- to coarse-grained gray limestone. Only at these two locations does the Boone formation have chemical limestone possibilities. The Batesville White Lime Company operates a limestone quarry (see Plate II) in the area west of Spring Creek in sections 4 and 9, T. 13N., R. 7W. Here, a coarse-grained upper bed and a fine-grained lower bed of chemical-grade limestone, with a maximum combined thickness of 110 feet, are overlain and underlain by more siliceous beds which converge to the east and

Plate 2 View of the operating quarry of the Batesville White Lime Company six miles west of Limedale, Independence County. The quarry is in the Upper Boone formation.

west resulting in a lens-shaped deposit. The limestone from this deposit furnishes stone for the company's lime burning plant (see Plate III) at Limedale, 6 miles west of Batesville. East of Polk Bayou, the limestone in the upper member of the Boone is a slightly siliceous gray, fine-grained stone that is well exposed in the Pfeiffer and Scheid quarries.

The St. Clair limestone is composed of a massive, coarse-grained, pinkish gray, fossilferous limestone exposed in several small areas but absent in most of the Batesville area. At a few localities, the limestone is light gray in color and very fine-grained. The bulk of the St. Clair limestone resembles the Fernvale limestone, but the light color is one of the features that distinguishes it from the Fernvale.

The Fernvale limestone is widely exposed in the Batesville area, particularly along the White River from Penters Bluff to Guion. The thickness varies from 0-125 feet, the maximum being at Penters Bluff. The formation consists almost wholly of limestone with local occurrences of manganese oxides and carbonates and a small quantity of chert in upper part. The limestone is coarse-grained, massive and cross-bedded, and is gray in color, usually with a pinkish cast. Its exposed ledges are friable and have rough surfaces, and on some steep slopes their slabs break off parallel with exposed surfaces that are at high angles to the bedding. Since the limestone is very pure, in places underground caves, hollows, and channels commonly filled with clay have been formed by solution. The upper surface of the formation is irregular and may contain fissures that are filled with materials of the succeeding deposit, usually conglomeratic.

The Kimmswick limestone is an even-bedded, massive, light gray, fine-grained limestone. Locally it may be coarse-grained or the uppermost beds may

Plate 3   Batesville White Lime Company plant
at Limedale, Arkansas.

be compact and grayish-blue in color. The formation varies from 12 to 55 feet in thickness in this area. Although the limestone is generally fossiliferous, identifiable fossils have been obtained at only a few places. Exposed boulders and ledges of the limestone occur throughout a large part of the belts of outcrop and in places their weathered surfaces are rough and knotty. This limestone is characteristically very pure containing locally only a few thin chert lenses in the upper part of the formation.

The Plattin limestone is an even-bedded, very fine-grained, grayish-blue compact limestone which breaks with a conchoidal fracture. Thin seams and small individual crystals of calcite are characteristic of this rock. It is exposed over a large part of the Batesville district and varies in thickness from 128 to 240 feet. Many areas where the Plattin limestone is exposed have an exceedingly blocky surface (see Plate IV). Although some individual beds may be fairly pure, the limestone formation as a whole is slightly siliceous. An excellent exposure of this formation may be seen at Penters Bluff (see Frontispiece) on the east side of White River where the Plattin is exposed in the lower 200 feet of the Bluff. Numerous other good exposures may be seen all along the north side of White River from Penters Bluff to Guion.

DESCRIPTION OF INDIVIDUAL DEPOSITS

Pfeiffer Quarry

This quarry, now abandoned, formerly produced building stone. It is located on a spur of the Missouri Pacific Railroad in the W$\frac{1}{2}$ of the SW$\frac{1}{4}$ of sec. 25, T. 14N., R. 6W. The quarry is roughly rectangular in plan and extends into the hillside about 75 feet. Twenty-eight feet of massive limestone with a 15 foot overburden of clay and limestone boulders is exposed in the quarry face. The quarry floor has not penetrated the base of this massive

Plate IV Typical blocky outcrop of the Plattin limestone at Penters Bluff Station, on the Missouri Pacific Railroad.

stone. The strata dip about 5° southwest toward the quarry face. The limestone lies in the upper member of the Boone formation and is a dense, fine-grained light gray stone. A chip sample representing the 25 foot face was analyzed with the following results:

Laboratory Analysis #626

SiO_2	5.2 %
Fe_2O_3	0.14
Al_2O_3	0.36
$CaCO_3$	93.2
MgO	Tr
	98.90

The Wilford Quarry

The Wilford building stone quarry has produced a small amount of dimension stone and is located in the S½ SW¼ sec. 34, T. 14N., R. 6W., about two miles north of Batesville. The quarry is rectangular in plan and exposes a face of massive limestone 20 feet thick. The bottom of the limestone formation has apparently not been penetrated by the workings. The exposed limestone is part of the Fernvale formation and is very coarsely crystalline, fossiliferous and brownish-pink in color. As the workings are accessible only by secondary road, the sample taken was a grab sample (#627) to indicate generally the quality of the Fernvale limestone in the area. The analysis follows:

Laboratory Analysis #627

SiO_2	Trace
Fe_2O_3	0.14%
Al_2O_3	0.51
$CaCO_3$	99.4
MgO	Nil
	100.05

Scheid Quarry

This quarry is located in the center of sec. 4, T. 13N., R. 6W., on a spur of the Missouri Pacific Railroad and is operating intermittently at the present time producing dimension stone. In addition to the quarrying equipment there are four stone planing machines on the property. The quarry face is about 18 feet high and exposes a massive, buff to gray, fine-grained limestone. Since the Scheid quarry limestone closely resembles that at the Pfeiffer quarry, it also appears to be a limestone from the upper member of the Boone formation. The following analysis was obtained from a representative sample of the quarry face:

Laboratory Analysis #628

SiO_2	2.05%
Fe_2O_3	0.09
Al_2O_3	0.86
$CaCO_3$	98.0
MgO	Nil
	101.00

Abandoned Quarry of the Batesville White Lime Company

This quarry is located on a narrow guage railroad spur near the southwest corner of sec. 3, T. 13N., R. 7W., about three-fourths of a mile east of the present quarry of the Batesville White Lime Company. The quarry face exposes about 25 feet of massive, gray, fine-grained limestone from the upper member of the Boone formation. A grab sample taken from the quarry face gave the following chemical analysis:

Laboratory Analysis #629

SiO_2	6.3 %
Fe_2O_3	0.30
Al_2O_3	0.75
$CaCO_3$	92.7
MgO	Nil
	100.05

Limestone Exposures along Railroad
from O'Neal to Penters Station

Exposures in the railroad cuts along the Missouri Pacific Railroad on the east side of White River were examined from O'Neal to Penters Station. From O'Neal north a distance of $2\frac{1}{2}$ miles to Ned Hollow the fossiliferous, gray, cherty limestone of the Boone formation is exposed. From Ned Hollow north to Penters Station the outcrops along the railroad are mainly Penters chert and Boone chert with no significant limestone outcrops.

Limestone Exposures at Penters Station

About 50 yards south of Penters Station in the extreme northwest corner of sec. 15, T. 14N., R. 8W., is an extensive outcrop of Fernvale and St. Clair limestone on the nose of a hill which extends from the track level a vertical distance of 100 feet. The Fernvale formation here is about 90 feet thick and the St. Clair about 10 feet. About 100 yards back from the track the Boone and Penters chert formations cap the limestones thus limiting the amount of stone obtainable by quarrying at this locality. However, a considerable tonnage would be available here if the workings were extended underground beneath the chert capping. The analysis of the composite samples representing the 100 foot thickness of limestone follows:

Laboratory Analysis #631

SiO_2	0.45%
Fe_2O_3))---- Al_2O_3)	0.60
$CaCO_3$	98.9
MgO	Nil
	99.95

At Penters Station in the extreme southeast corner of sec. 9, T. 14N., R. 8W., the railroad cut exposes about 25 feet of the Plattin limestone formation. The beds dip to the west about 6° and are composed of massive, hard, dark gray limestone beds 2 to 4 feet thick separated by shaly seams 1 to 4 inches thick. Neither the bottom nor the top of the limestone formation is exposed in the cut and the geologic map indicates an additional vertical thickness of Plattin of 200 feet up the hill to the northwest. The analysis of the sample representing the 25 foot face is as follows:

Laboratory Analysis #630

SiO_2	2.85%
Fe_2O_3	0.14
Al_2O_3	1.11
$CaCO_3$	95.7
MgO	Nil
	99.80

Investigations along State Highway #69 from Batesville to Cushman

Outcrops adjacent to State Highway #69 were examined from Batesville to Cushman. With the exception of a small outcrop of St. Clair limestone these exposures were either massive chert or cherty limestone of the Boone formation.

The St. Clair limestone outcrop exposed near the community of James has a vertical thickness of about 25 feet. The thin exposure of this limestone plus the fact that it occurred in a steep bluff with a heavy overburden of Boone chert render the locality unsuitable for quarrying.

Investigations along the Cushman Branch of the Missouri Pacific Railroad

Outcrops were examined along the railroad from the railroad overpass on Highway #106 north to the community of Limedale where the lime plant of the Batesville White Lime Company is located. This entire outcrop consisted of interbedded limestone and chert of the Boone formation.

Investigations of Outcrops just East of Polk Bayou

Limestone outcrops were examined and sampled on a hill in the $N\frac{1}{2}$ of $NW\frac{1}{4}$ sec. 4, T. 13N., R. 6W., where the Boone, Fernvale, Kimmswick and Plattin formations are exposed. This site is not suitable for quarrying due to the distance from a railroad (1 mile), and the heavy overburden of Boone chert. Samples were taken to get an indication of the purity of the various formations in the locality. The first sample which represents the lower 30 feet of the hill outcrop is Plattin limestone, and it had the following analysis:

Laboratory Analysis #632

SiO_2	19.50%
Fe_2O_3	0.45
Al_2O_3	1.55
$CaCO_3$	78.7
MgO	Trace
	99.20

The second sample represents 70 feet of Kimmswick and Fernvale limestone overlying the Plattin limestone and was analyzed with the following results:

Laboratory Analysis #633

SiO_2	0.35%
Fe_2O_3	0.65
Al_2O_3	0.85
$CaCO_3$	97.25
MgO	Trace
	99.10

The Williamson Switch Limestone Quarry

Although this quarry was examined as a potential source of agricultural limestone, its close relationship to the Batesville chemical limestone investigations justifies including its description here. The quarry is now abandoned and is situated about 75 yards west of Wilson Creek and 50 yards north of the Missouri Pacific Railroad in the SW$\frac{1}{4}$ of sec. 6, T. 14N., R. 8W., Izard County, Arkansas. The quarry is semi-circular in plan, cut into the side of a hill with a maximum face height of 35 to 40 feet, tapering off at either end. Structurally the quarry is located on the southeast limb of a low northeasterly-trending anticline. The dip of the limestone beds in the quarry is 6° to the Southeast. The formation in which the quarry is located is the Plattin limestone which at this locality is a dense, gray, very fine-grained limestone with abundant seams of crystalline calcite. A moderate tonnage of limestone is available for quarrying at this locality as the quarry is situated on the nose of a hill from which the overlying Boone formation has been eroded. The analysis of a composite sample from the quarry face follows:

Laboratory Analysis #739

$CaCO_3$	95.70%
$MgCO_3$	Trace

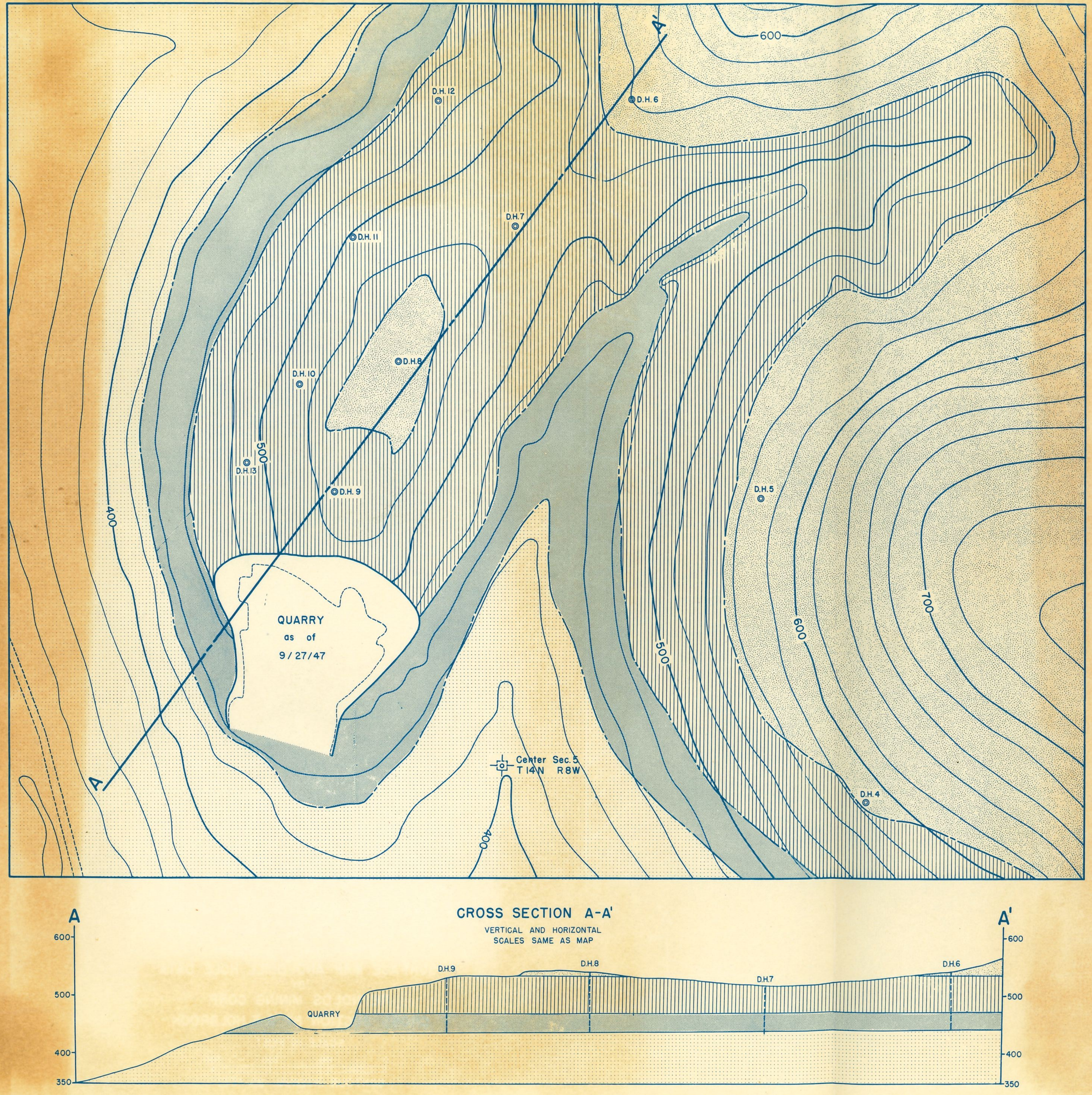
Fe_2O_3	0.51
Al_2O_3	0.51
SiO_2	2.57
	99.29

The Reynolds Mining Corporation Quarry

The development of this quarry in the Batesville area was largely a result of the original report on the limestone investigations in this area by the Division of Geology. The quarry is located in the NW$\frac{1}{4}$ sec. 5, T. 14N., R. 8W., Izard County, in a valley about 1 mile up the White River from Penters Bluff. Limestone from both the Fernvale and Kimmswick formations is being quarried here at the present time to supply the chemical limestone requirements of the Hurricane Creek alumina plant of the Reynolds Metal Company. The quarry (see Plate V) affords an excellent exposure of the Fernvale-Kimmswick contact as well as exposures of the unweathered rock in those formations, and it is recommended for examination by prospectors for chemical limestone in the Batesville area. In the development of the quarry the company geologists prepared a detailed geologic and topographic map of the quarry site and drilled several test holes in the deposit. The cores obtained from the drilling were logged and then split for analysis, the maximum interval analyzed being 5 feet.

A portion (Plate XI) of the company's geologic map together with the logs and analyses (Table I) of core from the drill holes occurring on that portion of the map have been included in this report. It is believed that this detailed geological and chemical information on the Kimmswick and Fernvale formations can be considered to some extent representative of these

Plate V Quarry of Arkansas Limestone Company at Myersville, Izard County, on the White River. The lower 15 feet of the quarry face is Kimmswick limestone and the upper 55 feet is Fernvale limestone.



LEGEND

- BOONE CHERT — INCLUDES SOME UNDERLYING CASON SHALE AND ST. CLAIR LIMESTONE
- FERNVALE LIMESTONE
- KIMMSWICK LIMESTONE
- PLATTIN LIMESTONE
- ROAD
- D.H.9 DIAMOND DRILL HOLE
- FORMATION CONTACT

N

GEOLOGIC MAP

OF THE

REYNOLDS MINING CORPORATION LIMESTONE QUARRY SITE

IZARD COUNTY, ARKANSAS

SURFACE MAP AND DRILL HOLE DATA

BY

REYNOLDS MINING CORP.

CROSS SECTION BY D. F. HOLBROOK

SCALE IN FEET

0 100 200 300

CONTOUR INTERVAL 20 FEET

formations along the north side of the White River between Penters Bluff and Guion.

It should be noted that the NE-SW cross-section accompanying the geologic map was taken in the direction of quarrying which is approximately the direction of strike of the formations; hence, the beds appear to be flat-lying even though they do have a distinct dip to the northwest.

The chemical analyses in Table I are characteristic of the formations concerned, with the possible exception of the siliceous limestone occurring in the bottom 5 to 8 feet of the Kimmswick formation. Of particular interest in the analytical data is the low iron content of the upper part of the Kimmswick formation.

The White River Limestone Products Company Deposit

During the summer of 1948 the White River Limestone Products Company of Little Rock, Arkansas, completed a core drilling investigation of their limestone deposit near Penters Bluff on the White River. That portion of the deposit that was drilled lies on the southern and southeastern flanks of a hill in the W$\frac{1}{2}$ SW$\frac{1}{4}$ of sec. 10, T. 14N., R. 8W., Izard County. The following formations are exposed in the hillside, the Plattin limestone lying at the foot of the hill:

Formation	Thickness in feet
Boone chert and limestone	45 (±)
St. Clair limestone	15 (±)
Cason shale	2
Fernvale limestone	121
Kimmswick limestone	30
Plattin limestone	190 (±)

In all, 11 holes were drilled at the deposit varying from 18 to 200 feet in depth. Since the individual holes were drilled at 2 different levels on the hillside, both the formations encountered and the degrees to which each formation was penetrated varied between drill holes. An examination of core from all the drill holes indicated that the Cason shale, the Fernvale limestone, and the Kimmswick limestone formations had been completely penetrated by at least one hole, and that the lower 10 feet of the St. Clair limestone and the upper 50 feet of the Plattin limestone formations had been cored. The geologic log of drill hole No. 2 together with the chemical analyses from samples of the core have been included here (Plate VII). No. 2 was selected since the entire thickness of the Fernvale and Kimmswick limestone formations and the top 50 feet of the Plattin limestone formations were penetrated in this hole. The core was chip-sampled at 2 foot intervals except for the 10 feet of core at the top of the Fernvale formation which was sampled at 1/2 foot intervals. It should be noted that the upper 10 feet of the Fernvale limestone was sampled and analyzed separately from the rest of the formation to avoid having the impurities of the top of the formation contaminate the higher grade stone in the main body.

ECONOMIC POSSIBILITIES

In this report a chemical grade limestone is defined as having a minimum calcium carbonate content of 98 percent. Thus, the only formations that would qualify as sources of chemical grade stone are the Boone chert formation and the St. Clair, the Fernvale, and the Kimmswick limestone formations. The only locality where the Boone formation contains chemical grade limestone beds of any thickness is the Batesville White Lime Company's present quarry site. As has been pointed out, this particular deposit appears to be local in nature; hence, it is not recommended that the Boone formation be prospected for additional deposits of chemical limestone in the Batesville area. The St. Clair limestone formation, although suitable from a chemical standpoint, is so limited in areal distribution and in thickness that it would not justify prospecting as the sole source for any large quantity of limestone.

The Fernvale limestone formation because of its wide distribution, its thickness and its chemical composition is a good potential source of chemical-grade limestone. It should be noted, however, that the upper 40 to 50 feet of the limestone formation contains disseminated and manganese carbonates and oxides that might render that portion useless for certain industrial applications. The Kimmswick limestone formation although thin in much of the area is rather widely distributed and is a high-purity limestone suitable for chemical uses.

The Plattin limestone formation considered as a unit is characteristically slightly siliceous (SiO_2 4%), even though individual beds may prove to be very pure. This limestone would certainly deserve consideration for any industrial application in which the silica content would not be objectionable because of the thickness, areal extent, and accessibility of its outcrops. It should prove excellent for use as agricultural limestone (agstone) where a minimum of 85% $CaCO_3$ or equivalent is required.

In general the most favorable area for prospecting for chemical-grade limestone is along the Missouri Pacific Railroad from Penters Bluff to Guion, in Izard County, Arkansas. Both the Fernvale and Kimmswick limestone formations are well developed in the bluffs along the White River in this area (see Plate I). The chief difficulty in locating a quarry site capable of yielding a large tonnage of stone is that the Boone chert formation caps most of the hills in the area; hence, quarrying is limited to those relatively small areas where the overlying Boone has been eroded. If underground mining methods could be economically employed, the tonnage of chemical grade limestone available in these bluffs would be practically unlimited.

Of the 151,000,000 tons of limestone sold or used in 1945 for all purposes, 49,000,000 tons or approximately one-third of the total was used in the chemical and processing industries. The limestone used in these industries is either used directly as sized stone or it may be first converted to lime by calcination depending on the particular process involved. The metallurgical industries use by far the largest tonnages of high-calcium limestones principally as a flux in iron blast furnaces. The alkali industry, which produces soda ash, is second in tonnage of chemical limestone used. Other important users of chemical-grade limestone in the order of tonnage consumed are: the paper, calcium carbide, and glass industries. The remainder of the chemical limestone used is divided among many industries. The quantities used by these industries are relatively so small that they would appear to be of minor consequence, but the importance of limestone to industry cannot be measured by its tonnage because for many industries limestone is an essential raw material for which there is no substitute.

TABLE 1. ANALYSES OF DRILL CORES FROM THE REYNOLDS MINING CORPORATION LIMESTONE DEPOSIT

Hole	From	To	Formation	SiO_2	Fe_2O_3	Total Carbonate
4	0	1.5	Cason			
	1.5	6.0	Fernvale	2.20	3.60	89.5
	6.0	11.5	"	1.61	3.40	92.5
	11.5	16.5	"	1.96	2.90	93.5
	16.5	21.5	"	1.11	0.36	96.0
	21.5	26.5	"	0.58	0.22	97.6
	26.5	31.5	"	0.42	0.22	97.1
	31.5	36.5	"	0.48	0.47	96.5
	36.5	41.5	"	0.31	0.18	98.1
	41.5	46.5	"	0.73	0.21	97.1
	46.5	51.7	"	0.46	0.18	97.6
	51.7	56.7	"	0.80	0.15	97.1
	56.7	61.4	"	0.26	0.56	98.6
	61.4	66.4	"	0.24	0.23	98.6
	66.4	71.4	"	0.16	0.17	98.1
	71.4	76.4	"	0.13	0.19	99.1
	76.4	80.9	"	1.45	0.14	96.5
	80.9	85.9	Kimmswick	0.17	0.34	98.1
	85.9	90.9	"	0.24	0.16	99.1
	90.9	95.9	"	0.13	0.08	99.3
	95.9	100.9	"	0.12	0.12	98.6
	100.9	107.3	"	0.01	0.32	99.1
	107.3	112.3	"	0.09	0.17	98.6
	112.3	117.3	"	0.38	0.39	98.1
	117.3	119.4	"	2.23	0.24	96.5
	119.4	121.2	"	5.19	0.23	91.0
	121.2	126.7	Plattin	1.20	0.26	96.5

Hole	From	To	Formation	SiO_2	Fe_2O_3	Total Carbonate
5	0.0	2.5	St. Clair	0.31	0.20	99.49
	2.5	5.0	"	0.23	0.24	99.80
	5.0	9.2	"	Lost in coring.		Believed to be clay
	9.2	11.6	Cason	25.77	3.28	10.22
	11.6	15.8	"	52.12	3.61	5.98
	15.8	16.6	"	31.43	2.09	30.20
	16.6	23.1	Fernvale	2.94	2.42	94.13
	23.1	28.1	"	1.03	2.14	94.89
	28.1	33.1	"	1.38	2.02	93.46
	33.1	36.6	"	1.18	1.27	95.76
	36.6	40.9	"	1.30	2.37	94.53
	40.9	45.9	"	0.27	0.66	98.6
	45.9	50.9	"	0.81	0.85	97.2
	50.9	55.9	"	0.50	1.01	97.2
	55.9	60.9	"	0.37	0.23	98.8
	60.9	65.9	"	0.36	0.14	97.8
	65.9	70.9	"	0.29	0.11	98.4
	70.9	75.9	"	0.12	0.10	98.3
	75.9	79.9	"	0.16	0.07	99.3
	79.9	81.9	"	0.11	0.07	99.3
	81.9	84.9	Kimmswick	0.25	0.05	99.0
	84.9	89.1	"	0.35	0.10	99.1
	89.1	94.1	"	0.18	0.06	99.6
	94.1	98.9	"	0.20	0.07	99.3
	98.9	103.9	"	0.17	0.09	99.24
	103.9	108.9	"	0.17	0.07	99.44
	108.9	111.8	"	1.10	0.10	97.91
	111.8	114.1	"	9.61	0.18	89.11
	114.1	116.9	Plattin	2.78	0.22	96.07
	116.9	121.9	"	2.21	0.24	96.63

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
6	0.0	7.4	Shale & Clay	33.42	3.27	6.44
	7.4	10.6	Fernvale	5.04	4.56	78.13
	10.6	15.6	"	1.05	1.39	93.97
	15.6	20.0	"	11.07	1.06	74.81
	20.0	25.0	"	0.20	0.96	98.11
	25.0	30.0	"	0.37	0.63	98.01
	30.0	35.0	"	0.24	0.30	98.32
	35.0	40.0	"	0.48	0.77-	97.29
	40.0	45.0	"	0.37	0.80	97.91
	45.0	50.0	"	1.54	0.24	95.97
	50.0	55.0	"	0.76	0.14	96.99
	55.0	60.0	"	0.36	0.15	98.21
	60.0	65.0	"	0.27	1.06	97.70
	65.0	68.4	"	0.25	0.10	98.83
	68.4	73.4	Kimmswick	0.38	0.10	98.37
	73.4	78.4	"	0.31	0.12	99.13
	78.4	83.4	"	0.20	0.08	99.60
	83.4	88.4	"	0.25	0.10	98.46
	88.4	93.4	"	0.17	0.08	99.88
	93.4	98.5	"	2.13	0.10	97.23
	98.5	99.6	"	13.82	0.28	73.03
	99.6	101.1	Plattin	1.85	0.18	97.85

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
7	0.0	3.2	Fernvale	0.64	1.70	95.64
	3.2	5.0	"	0.30	0.26	99.19
	5.0	9.5	"	0.28	0.12	99.55
	9.5	14.5	"	0.34	0.18	98.98
	14.5	19.5	"	0.87	0.22	97.75
	19.5	24.5	"	0.95	0.18	98.00
	24.5	29.5	"	0.38	0.16	98.37
	29.5	34.5	"	0.65	0.16	97.28
	34.5	39.5	"	0.72	0.16	97.08
	39.5	44.0	"	0.42	0.14	98.47
	44.0	48.6	"	0.14	0.10	98.67
	48.6	52.4	Kimmswick	0.22	0.10	98.88
	52.4	57.4	"	0.32	0.08	99.81
	57.4	62.4	"	0.04	0.08	100.01
	62.4	66.3	"	0.47	0.08	99.19
	66.3	71.3	"	0.19	0.08	99.40
	71.3	76.3	"	0.14	0.12	98.88
	76.3	79.3	"	2.10	0.10	97.34
	79.3	81.8	"	11.47	0.14	86.16
	81.8	85.2	Plattin	1.55	0.22	96.82

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
8	0.0	2.0	Cason	19.70	9.06	8.76
	2.0	8.5	"	55.06	7.06	4.12
	8.5	10.6	Fernvale	3.42	5.94	72.51
	10.6	14.9	"	2.42	2.46	84.98
	14.9	19.9	"	1.50	1.52	93.73
	19.9	24.9	"	0.34	1.18	97.34
	24.9	29.4	"	0.22	0.34	99.91
	29.4	34.2	"	0.33	0.16	99.19
	34.2	39.2	"	0.31	0.22	98.98
	39.2	44.2	"	0.55	0.22	97.95
	44.2	49.2	"	0.38	0.12	99.70
	49.2	54.2	"	0.28	0.12	98.98
	54.2	59.2	"	0.65	0.14	98.26
	59.2	64.2	"	0.35	0.14	99.40
	64.2	69.2	"	0.19	0.14	100.02
	69.2	71.6	"	0.12	0.28	100.63
	71.6	72.9	"	0.34	0.16	99.81
	72.9	77.9	Kimmswick	0.25	0.10	99.86
	77.9	82.9	"	0.32	0.08	99.40
	82.9	87.9	"	0.33	0.10	99.40
	87.9	92.9	"	0.14	0.10	100.22
	92.9	97.9	"	0.09	0.10	100.11
	97.9	102.5	"	4.53	0.10	94.76
	102.5	106.3	Plattin	1.29	0.24	98.37

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
9	0.0	3.1	Fernvale	1.36	3.58	89.58
	3.1	7.1	"	.89	1.08	95.76
	7.1	9.0	"	1.47	1.86	94.08
	9.0	13.9	"	.74	0.66	96.78
	13.9	18.9	"	.70	0.20	96.78
	18.9	23.9	"	.24	0.16	98.73
	23.9	28.9	"	.23	0.12	99.13
	28.9	33.9	"	.68	0.20	97.29
	33.9	38.9	"	.53	0.18	98.83
	38.9	44.0	"	.57	0.18	97.81
	44.0	49.0	"	.51	0.16	98.32
	49.0	54.0	"	.37	0.14	98.11
	54.0	59.0	"	.19	0.12	99.34
	59.0	62.2	"	.09	0.30	98.93
	62.2	66.2	Kimmswick	.26	0.14	98.93
	66.2	71.2	"	.41	0.12	98.32
	71.2	76.2	"	.29	0.10	98.83
	76.2	80.2	"	.30	0.08	98.83
	80.2	85.2	"	.20	0.10	98.83
	85.2	90.2	"	2.37	0.14	95.76
	90.2	93.0	"	5.78	0.14	93.21
	93.0	94.1	Plattin	2.44	0.26	95.76

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
10	0.0	2.9	Fernvale	.97	1.32	95.25
	2.9	5.8	"	.74	0.66	97.19
	5.8	8.2	"	.38	0.18	98.52
	8.2	12.0	"	.33	0.14	98.73
	12.0	15.0	"	.33	0.12	98.21
	15.1	19.3	"	.41	0.10	98.47
	19.3	24.3	"	.59	0.16	97.14
	24.3	29.3	"	.59	0.18	97.70
	29.3	34.3	"	.56	0.14	98.83
	34.3	39.3	"	.80	0.16	97.60
	39.3	44.3	"	.49	0.14	98.11
	44.3	49.3	"	.34	0.02	99.03
	49.3	52.4	"	.28	0.04	99.49
	52.4	56.4	Kimmswick	.33	0.04	99.03
	56.4	61.4	"	.46	0.10	98.37
	61.4	66.4	"	.25	0.02	98.42
	66.4	71.4	"	.41	0.04	99.24
	71.4	76.4	"	.23	0.02	98.83
	76.4	81.3	"	2.33	0.08	96.68
	81.3	83.2	"	4.24	0.10	94.43
	83.2	84.0	Plattin	2.23	0.20	95.66

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
11	0.0	4.9	Fernvale	.22	0.32	98.78
	4.9	8.9	"	.52	0.20	98.21
	8.9	13.4	"	.40	0.32	98.21
	13.4	15.9	"	.48	0.16	98.32
	15.9	19.3	"	.58	0.18	98.32
	19.3	24.3	"	.52	0.14	98.67
	24.3	29.3	"	.37	0.18	99.03
	29.3	34.3	"	.30	0.12	99.50
	34.3	37.6	"	.22	0.18	99.13
	37.6	41.6	Kimmswick	.37	0.10	99.13
	41.6	46.6	"	.35	0.04	98.62
	46.6	51.6	"	.25	0.02	99.90
	51.6	56.6	"	.32	0.10	99.69
	56.6	61.6	"	.22	0.12	99.34
	61.6	66.6	"	1.22	0.08	98.52
	66.6	67.8	"	5.51	0.14	93.72
	67.8	73.0	Plattin	.89	0.12	98.01

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
12	0.0	5.0	Fernvale	.37	0.32	98.62
	5.0	9.1	"	.66	0.24	97.50
	9.1	13.0	"	.20	0.16	99.34
	13.0	15.6	"	.16	0.10	99.80
	15.6	19.3	Kimmswick	.25	0.10	99.03
	19.3	24.3	"	.37	0.10	98.32
	24.3	29.3	"	.23	0.10	99.03
	29.3	34.3	"	.17	0.08	99.34
	34.3	39.3	"	.28	0.10	99.90
	39.3	44.2	"	.92	0.10	98.06
	44.2	46.2	"	6.10	0.14	92.39
	46.2	50.2	Plattin	1.93	0.28	96.58

Hole	From	To	Formation	SiO_2	FeO_3	Total Carbonate
13	0.0	3.5	Fernvale	.31	0.24	98.73
	3.5	6.6	"	.58	0.44	97.70
	6.6	9.7	"	.39	0.16	98.73
	9.7	14.2	"	.48	0.24	98.52
	14.2	19.2	"	.81	0.20	98.01
	19.2	24.2	"	.32	0.08	99.24
	24.2	29.2	"	.33	0.08	98.93
	29.2	32.9	"	.20	0.16	99.13
	32.9	34.8	Kimmswick	.34	0.12	98.73
	34.8	39.8	"	.38	0.12	99.29
	39.8	44.8	"	.21	0.10	99.90
	44.8	49.8	"	.30	0.10	98.83
	49.8	54.8	"	.24	0.10	99.70
	54.8	59.8	"	.88	0.12	98.62
	59.8	64.1	"	5.16	0.14	92.80
	64.1	65.8	Plattin	2.22	0.34	94.74