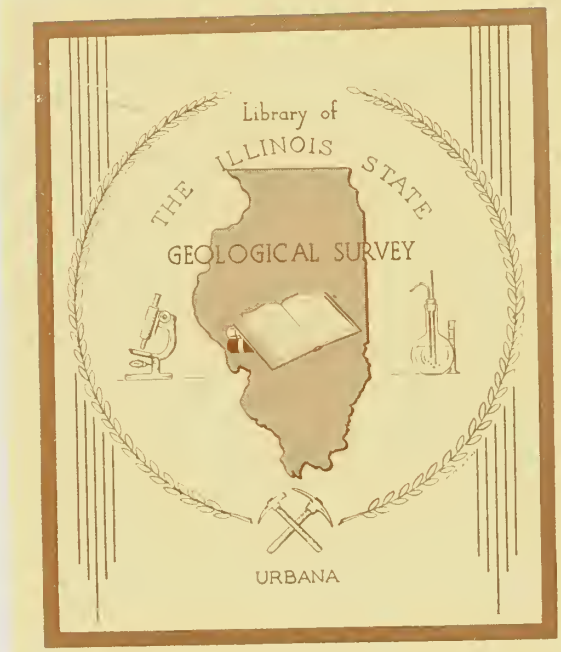

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BLACK AND BROWN TERRAZZO CHIPS FROM SOUTHERN ILLINOIS LIMESTONES

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ABSTRACT

The possible use of deposits of very dark gray to black limestone occurring in Hardin County and of a reddish brown limestone in northern Alexander County as sources of chips for use in terrazzo was investigated. Small terrazzo specimens were prepared and pertinent physical properties of the limestones were determined in the laboratory. Favorable comments on these samples were received from terrazzo contractors. The possibilities of developing these limestones are discussed.

INTRODUCTION

Terrazzo is a widely used type of flooring made by mixing cement and water with small graded chips of marble, limestone, or dolomite. The mixture is poured into place and allowed to harden. The surface is then ground smooth with abrasive wheels and finally waxed and polished. In 1960, 434,000 tons of terrazzo chips were sold or used by producers in the United States, the value of which was $5,140,000, or an average of $11.84 per ton (Cotter et al., 1961).

All terrazzo aggregates presently used in Illinois are imported from other states and countries, as far as is known. Buff-colored chips are brought from Missouri and Tennessee, and aggregate of less common but highly desirable colors such as black, green, brown, and white, generally comes from various states along the Atlantic coast, Colorado, and Texas. Some stone is imported from Belgium, Italy, and parts of Africa.

Illinois has a variety of gray, light gray, and light buff limestones that might make satisfactory terrazzo chips, but certain black or near-black limestones in Hardin County and a reddish brown limestone in Alexander County, both in extreme southern Illinois, seemed unique within the state and were given first attention. The black and brown limestones are, respectively, parts of the Salem-St. Louis and St. Clair Formations.

LOCATION AND NATURE OF DEPOSITS

Black and Near-Black Limestones

The black and near-black limestone of the Salem-St. Louis Formation in Hardin County appears to be best developed about 5 miles north of Rosiclare in parts of secs. 4, 5, and 8, T. 12 S., R. 8 E., and sec. 26, T. 11 S., R. 7 E., where the stone is exposed along hill slopes, in stream beds, and low bluffs along streams. The limestone is overlain by other limestone, cherty limestone, residual chert, and clay and is underlain by a coarsely granular, light gray limestone.

The black or near-black limestone is fine grained and fractures conchoidally into somewhat elongated and sharp-edged fragments. It consists principally of the mineral calcite with lesser amounts of fine-grained quartz, clay, carbonaceous materials, and dolomite. At a few places, carbonaceous partings occur between the limestone beds, and the stone in these beds is generally medium- to coarse-grained. Some of the limestone beds contain small areas in which abundant minute grains of silica are dispersed. These, when weathered, resemble nodules. They are, however, only slightly harder than the surrounding rock and on polished or waxed surfaces are barely visible. Some deposits contain tiny vertical veinlets of lighter colored calcite, and, in a few beds, light colored fossil corals are present, some of which have incomplete rims of siliceous material.

The blackness of the stone is governed by its content of carbonaceous matter and varies from one deposit to another. There also is a variation between the strata of a given deposit, some beds being quite black, others dark gray or very dark gray. The greatest thickness of uniformly black stone seen during this study was 6 feet in the S½ of the SE¼ sec. 26, T. 11 S., R. 7 E. Prospecting and further search may well reveal greater thicknesses. The exact character and amount of the overburden on the black and near-black limestone is not determinable because of forest vegetation on the slopes above the outcrops. It probably consists of other limestone strata, some of them cherty, that are gray and of brown or reddish clay. The thickness of the overburden increases rapidly from a few feet at the outcrops of the black and near-black limestone to about 35 feet away from the outcrops.

The following detailed descriptions illustrate some of the better outcrops.

East-west gully in the NW¼ NW¼ NE¼ sec. 4, T. 12 S., R. 8 E.

Bed	Description	Thickness (ft)	Thickness (in)
21	Covered, soil; abundant chert fragments; reddish clay	Up to 35	0
20	Limestone, fine to medium grained, near-black	1	0
19	Covered	0	6
18	Limestone, black, fine grained, massive, fractured	1	10
17	Covered	0	6

Bed	Description	Thickness (ft)	Thickness (in)
16	Limestone, black, fine grained, massive	1	5
15	Covered	1	0
14	Limestone, black, fine grained, massive	1	0
13	Limestone, black, fine grained, massive	0	10
12	Limestone, near-black, fine grained, thin bedded	0	2
11	Limestone, black, fine grained, massive	0	8
10	Limestone, black, massive, with calcite veinlets up to 1/8-inch thick; scattered patchy concentrations of finely divided silica	1	4
9	Limestone, near-black, massive	0	7
8	Limestone, near-black, thin bedded	0	1
7	Limestone, black, massive	0	9
6	Limestone, black, fine grained, massive; scattered silica patches	2	6
5	Limestone, near-black, thin bedded	0	3
4	Limestone, near-black to black; some thin carbonaceous lenses 1/4-inch thick	1	8
3	Limestone, near-black; interbedded massive and thin beds	0	11
2	Covered	1	6
1	Limestone, near-black, medium grained, with scattered light gray calcite veinlets	1	6
	Stream bed		

Beds 6 to 18, except for the covered intervals, were sampled for this study and are possible source beds for terrazzo chips.

Small north-south gully in the center S½ NW¼ NE¼ sec. 8, T. 12 S., R. 8 E.

Bed	Description	Thickness (ft)	Thickness (in)
25	Covered, soil; abundant chert fragments; reddish clay	Up to 20	
24	Limestone, black, fine grained, massive; some scattered fossil fragments, light gray to near-black in color	0	9
23	Limestone, near-black, thin bedded	0	9
22	Limestone, black, fine grained, massive	0	9
21	Covered	0	6
20	Limestone, near-black, thin bedded, with some silica patches	1	0
19	Covered	0	6
18	Limestone, black, fine grained, massive	0	4
17	Covered	1	0
16	Limestone, near-black to black, fine grained, massive	1	1

Bed	Description	Thickness (ft)	Thickness (in)
15	Limestone, near-black to black, mostly fine grained, thin bedded, especially on weathered surfaces; patchy concentrations of finely divided silica are present and possible minor carbonaceous partings	0	10
14	Same as 15	0	10
13	Covered	6	
12	Limestone, near-black, massive, mostly fine grained; some light gray fossils (1/8-inch in diameter) along some beds roughly 1 inch thick. Some vertical veinlets of light gray calcite	0	11
11	Covered	2	0
10	Limestone, near-black, fine grained, massive; some light gray fossil fragments	1	3
9	Covered	1	6
8	Limestone, near-black, medium to fine grained, fossiliferous	1	7
7	Limestone, black, fine grained, massive	1	8
6	Covered	2	0
5	Limestone, black, fine grained	1	2
4	Covered	0	10
3	Limestone, near-black, medium to fine grained, massive	0	9
2	Limestone, near-black, medium grained	0	9
1	Covered		

Beds 3 to 24, except for the covered intervals, were sampled for this study and are possible sources for terrazzo chips.

In stream bed, center of N½ SE¼ SE¼ sec. 26, T. 11 S., R. 7 E.

Bed	Description	Thickness (ft)
4	Soil	
3	Limestone, black, with abundant black chert nodules	5-6
2	Clay, silty, light gray and brown, highly fractured	3-4
1	Limestone, black, fine grained, massive with a few light gray fossils	6
	Covered	

Bed 1 was sampled for this study and is a possible source of terrazzo chips.

In addition to the foregoing, other outcrops of dark gray to black limestone were noted in the NW¼ NE¼ SE¼ sec. 8, T. 12 S., R. 8 E.; cen. sec. 4, T. 12 S., R. 8 E.; SE¼ SW¼ NE¼ sec. 28, T. 11 S., R. 8 E.; and SW¼ NE¼ NE¼ sec. 29, T. 11 S., R. 1 E.

Reddish Brown Limestone

The best outcrops noted of the reddish brown limestone of the St. Clair Formation occur in the southwest corner and in the center of the west half of sec. 12, T. 14 S., R. 3 W., Alexander County, about 2 miles east of McClure. The samples tested were taken from the outcrop in the southwest corner of the section where the following strata are exposed:

Bed	Description	Thickness (ft)
3	Covered, soil; interbedded limestone, silt, and shale (?)	10-30
2	Limestone, reddish brown with minor mottlings of greenish brown	22
1	Limestone, very cherty, gray	15
	Covered	

The number 2 bed was sampled for this investigation. It is very largely reddish brown, but about 10 percent of the rock is mottled greenish brown. The mottling is roughly uniform throughout the 22 feet of rock, but the limestone appears slightly less reddish brown in the upper 5 to 7 feet than in the lower part. There are a few lens-shaped beds that appear to be slightly clayey but most of the deposit probably is low in impurities. The stone occurs in massive beds up to 7 feet thick.

The limestone is very fine grained and contains many small fossils or fossil fragments up to about 1½ mm long which can be observed only with a microscope. It fractures into rough-surfaced, sharp-angled, somewhat elongated chips. The mineralogical composition of a specimen examined in detail was more than 97 percent calcite and less than 1 percent each of dolomite, quartz, and clay minerals.

PHYSICAL TESTS AND RESULTS

The field samples, consisting of fist-sized or larger chunks, were passed through a laboratory jaw crusher set at three-fourths of an inch. Any material coarser than half an inch was re-run through the crusher re-set to half an inch. The crushed material was screened into 4 sizes using square opening screens, with the results shown below. The size fractions commonly used for terrazzo aggregate are indicated by asterisks.

Size	Percent by weight	
	Black limestone	Reddish brown limestone
Retained on 1/2-inch sieve	20.6	13.9
*Passing 1/2-inch, retained on 3/8-inch sieve	32.8	33.8
*Passing 3/8-inch, retained on 1/4-inch sieve	14.2	15.5
*Passing 1/4-inch, retained on 1/8-inch sieve	16.2	17.0
Passing 1/8-inch sieve	16.2	19.8

The above data do not necessarily indicate the percentages of different size-grade chips that would result from commercial crushing and screening, but they do give a rough idea of the breaking characteristics of the two samples.

The Los Angeles wear test was made on the 3/8- to 1/2- and 1/2- to 3/4-inch size fractions of the two limestones in accordance with A.S.T.M. Designation C 131-55, using grading B. The black and near-black limestone had 21 percent wear and the brown stone had 23 percent. Since a common requirement for stone used in concrete roads is that it have a Los Angeles wear of not more than 35 percent, the two limestones may be regarded as having satisfactory hardness.

Water absorption tests were made on the limestones by immersing three or more pieces (roughly 3 x 3 x 1 inches) of each limestone in water for 72 hours and determining the increase in weight. The very dark gray and black stone absorbed 0.06 percent water by weight and the brown stone 0.02 percent, indicating a very low water absorption.

Test plaques of terrazzo were prepared from the black, near-black, and reddish brown chips mixed with white portland cement, following in so far as possible the usual commercial procedures. The plaques were smoothed on grinding laps and coated with a wax sealer. They showed a uniformly even surface, indicating that the aggregates and the cement were of about equal hardness. It is believed these tests indicate that the chips possess desirable characteristics as terrazzo aggregates.

CONCLUSIONS REGARDING TESTS

Various tests have been proposed for terrazzo aggregates (Kessler et al., 1943), but as no limiting values have been set up defining the quality of good aggregate the results of such tests are not definitely significant. Therefore, our terrazzo test plaques were shown to several terrazzo contractors who expressed favorable opinions regarding the color, hardness, and general appearance of the terrazzo. These qualities and the low water absorption of the black, near-black, and reddish brown limestone make them good possibilities for terrazzo aggregate.

DEVELOPMENT CONSIDERATIONS

A major problem in connection with chips of the black, near-black, and reddish brown limestones may be the maintenance of a uniform color or a uniform range in color. The selection of deposits with a minimum color variation will obviously be desirable and selective quarrying of preferred beds may be necessary. To assess the color of the stone as it will appear in terrazzo it should be wet.

Selective quarrying may involve the removal of some stone unusable for terrazzo chips, and the crushing of suitable stone will produce some chips either too coarse or too fine to be used in terrazzo. A possible use for the minus 1/8-inch fraction is agricultural limestone. A test run on this fraction to determine neutralizing value of such stone gave a calcium carbonate equivalent value of 80 percent for the black stone and 96 percent for the reddish brown. The value for the black limestone is comparatively low but is within the usable range. Other size fractions of this stone would be usable for road surfacing and possibly for chips for bituminous roads. The fines and other grades of the reddish brown limestone doubtless would have commercial use. Its calcium carbonate equivalent is high and samples of the deposit have passed tests for concrete aggregate and chips for bituminous roads (Lamar, 1959, p. 31, 80).

The black and reddish brown limestone may also have possibilities for use as stucco chips. The brown limestone probably will resist the weather satisfactorily and hold its color. The weather resistance of the black and near-black limestone has not been determined. Some of the dark colored limestones develop a gray surface coating when weathered. The rate at which this coating develops is not known but, though it is probably slow, the black chips should be used with caution where they are exposed to the weather until their durability is determined.

Terrazzo chips should be essentially free of rock dust, clay, and shale. The deposits described contain insignificant amounts of clay and no shale, but washing or other suitable processing may be required to reduce the rock dust.

As indicated by the average price of $11.84 per ton for terrazzo aggregate in 1960, these aggregates are premium materials. Indications from potential users of the black and reddish brown chips are that a price of around $20 per ton might be expected for the black and near-black chips and $15 for the brown chips, f.o.b. the quarry. The possibility of such prices for the chips may make their production economical even though quarrying and preparation may involve considerably more expense than the quarrying of concrete aggregate, road stone, and agstone.

Although the deposits of black stone are several miles from rail transportation, there are good gravel roads throughout the region. The brown stone is within 2 miles of a railroad.

USE OF BLACK OR BROWN LIMESTONE AS MARBLE

In addition to the possible use of the black and brown limestones for terrazzo chips, they may be a potential source of commercial marble. The brown limestone takes a good polish and has a pleasing mottled appearance. The thick beds in which it occurs favor its processing by usual stone cutting methods. The stone also may be usable for exterior construction, particularly in accenting lighter colored stone.

Minor variations in composition among the various layers of the black stone result in slight variations in its ability to accept a polish, but some layers take a good polish (Lamar and Willman, 1955, p. 20). Commonly, thicker beds are used for marble sawing than are present in these deposits, but as black marble is uncommon the possibility that selected beds of the stone may be sources of such marble is worthy of note.

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