LITHOGRAPHIC STONE.

By S. J. KÜBEL.

INTRODUCTION.

Lithographic stone is a fine, compact, homogeneous limestone, which may be either a pure carbonate of lime or dolomitic. Although limestone is one of the most common rocks, there are but few localities known where it is of a quality suitable for lithographic purposes. Thus, with the enormous amount of limestone known to occur in the United States, practically all of the lithographic stone used in this country is imported. The actual value of lithographic stone and the extent of the industry is but little understood by people in general, and it is thought by many that fabulous prices are obtained and that the market is very large. In many respects the reverse is true and the annual consumption in the United States amounts in value to less than $100,000. With this small amount used, it can readily be seen that there is no great profit for the producers, and the market must be kept in the hands of few concerns working in harmony. It must be stated, however, that the value of the annual consumption mentioned above is that of the stone at the point of shipment and does not include ocean freight or other charges. The cost to the consumer in the United States is probably more than double the amount quoted.

LITHOGRAPHIC STONE IN THE UNITED STATES.

Many samples of supposed lithographic stone said to have been obtained in this country have been sent to the engraving division of the Geological Survey for examination. Some of these gave promise of being good stone, but as a rule no information was given as to the locality nor the extent of the deposit. Then, again, the samples were usually very small, irregular pieces, that were worthless for purposes of examination, and it was impossible to determine their value by practical tests.

Inquiries and investigations indicate that there are prospects of lithographic stone in Alabama, Arizona, California, Colorado, South Dakota, Georgia, Illinois, Kentucky, Missouri, Nevada, Tennessee, Texas, and Utah. Some of these have been developed to a slight extent, and in some cases what might have become good quarries have

been damaged by heavy blasting, which would reduce the chances of finding stones of serviceable size and has probably hastened the abandonment of the properties. Many of these prospects have not been developed because of poor transportation facilities, which would make it doubtful if they could compete in price with the German stone. The information regarding the location of these prospects is in most cases indefinite, little being known except the name of the State.

At Custer, S. Dak., are located the quarries of the Black Hills Porcelain Clay and Marble Company. Samples of this stone have been examined and give indication of possessing high-class lithographic properties. It is reported that it occurs in large quantity, but thus far it has not been developed to any extent.

Perhaps the most important quarry opened is that at Brandenburg, Meade County, Ky., which is operated on practical lines by the American Lithographic Stone Company. The layer of limestone which furnishes the best stone is about 3 feet in thickness and is nearly horizontal. The overlying strata are easily and economically removed, and there are excellent natural facilities for the disposition of the waste material, an important factor in the cost of production. This quarry produces no "yellow" stone. Its entire output is a stone of good quality for an engraving and printing base for certain classes of work, and is of a blue-gray color. Stones of the largest sizes required have been obtained, and in some respects this product compares favorably with that from the German quarries. These stones are now on the market, some being in use in engraving establishments in the South and Southwest, and favorable reports are made by those using them. This is perhaps the first quarry to be developed and in active operation in this country.

It is not at all improbable that there are many localities in the United States where limestone can be found that is suitable for lithographic work, but unless it can be obtained in quantity, quarried economically, and has good transportation facilities it will be difficult for it to compete with the German stone. The output at the German quarries is not limited to lithographic stone, but there are by-products that add to the revenue of the quarry. If a market could be secured for the by-products of the lithographic-stone quarries in this country, there should be little difficulty in making them paying propositions. It must be remembered, however, that the market for these stones is limited, and that as soon as competition begins the price will be materially reduced, for the price of the German stone can be lowered considerably and the industry continue profitable. The production of one or two ample and well-managed quarries would be sufficient to supply the demands of this country and even to enter into competition in foreign markets.

FOREIGN SOURCES OF LITHOGRAPHIC STONE.

The main source of supply of lithographic stone is at Solnhofen, Bavaria, Germany. These quarries have been supplying the United States with stone for many years, but are said to be becoming unsatisfactory both in regard to quality and dependability of supply. This latter complaint in the lithographic world may be due to the falling off in the production at these quarries, but, on the other hand, it very probably is due to a large increase in the number of stones that are desired. Whatever the cause, the orders for German stone by firms in this country have not been expeditiously filled. These facts are tending to stimulate the search for good deposits of this stone in the United States.

Recently a limestone quarry has been opened in Harvey Township, Peterboro County, Ontario, Canada, and samples of the stone examined give evidence of having excellent lithographic properties. A stock company is being formed to develop the property.

CHEMICAL COMPOSITION OF LITHOGRAPHIC STONE.

As is well known, limestone is very variable in its composition, changing from a pure lime to one that is rich in magnesia (dolomitic limestone), and there is a similar variation in the composition of the lithographic stone.

In the table below are given the analyses of the lithographic stone (1) from Brandenburg, Ky., and (2) from Solnhofen, Bavaria, which were made in the chemical laboratory of the United States Geological Survey:

Analyses of Kentucky and Bavarian lithographic limestone.

	Brandenburg, Ky.	Solnhofen, Bavaria.
Insoluble in hydrochloric acid.		
Silica, SiO_2	3.15	1.15
Aluminum-iron oxide $(AlFe)_2O_3$	.45	.22
Lime, CaO	.09	Trace.
Magnesia, MgO	None.	None.
Soluble in hydrochloric acid.		
Alumina, Al_2O_3	.13	.23
Ferrous oxide, FeO	.31	.26
Magnesia, MgO	6.75	.56
Lime, CaO	44.76	53.80
Soda, Na_2O	.13	.07
Potash, K_2O		
Hygroscopic water, H_2O	.41	.23
Water of composition, H_2O	.47	.69
Carbon anhydride, Co_2	43.06	42.69
Sulphuric anhydride, SO_3	None.	None.
Total	99.71	99.90

It will be seen from the above analyses that the Bavarian stone is a nearly pure limestone, while the one from Kentucky is a dolomitic one, containing 6.75 per cent of magnesia. Whether the pure or the dolomitic limestone will make the better lithographic stone has not been determined, for up to the present time it has been the Bavarian product that has been used. With the introduction of a dolomitic lithographic stone, some interest will be aroused as to the results obtained with it as compared with the purer limestones.

SUBSTITUTES FOR LITHOGRAPHIC STONE.

An interesting fact brought out by the writer's investigations is the use, to a limited extent, of onyx slabs for lithographic purposes in some of the Western cities. They were quarried near Salt Lake City, Utah. Opinions as to their utility are rather diverse, but it is admitted that for long runs on hard paper, printed dry, these onyx stones can be made more serviceable than the best grade of imported stone. The preparation of the stone for printing purposes depends to a great extent upon the intelligence and prejudice of the transferrer, and the peculiar coloring, characteristics, etc., of the onyx, which are so decidedly different from those of the well-known lithographic stone, will make its adoption for general use somewhat difficult. The introduction and use of this stone make an interesting phase of the search for domestic lithographic stone or a substitute for it.

Zinc and aluminum plates, particularly the latter, are being used to a considerable extent as a substitute for lithographic stone, and are giving good satisfaction on certain classes of work. While their introduction is comparatively recent, they materially affect the lithographic stone market.

PRODUCTION.

There has been no domestic production of lithographic stones until within the past year or two, and during 1900 all that was produced was obtained from the quarry at Brandenburg, Ky. The actual figures are withheld in the protection of individual statistics.

IMPORTS.

There is considerable variation in the importation of lithographic stones from year to year, dependent, to some extent at least, upon the condition of the business world.

From 1880 to 1889, inclusive, the imports amounted to $878,132, and from 1890 to 1900, inclusive, they were $874,560, which are nearly the same for the two decennials.

From 1890 to 1894 the imports were $486,707, and from 1895 to 1899 they were only $387,853, a falling off of nearly $100,000. This decline is probably due to business depression and partly to the substitution of zinc and aluminum plates for stone. There was a decided increase in the value of the imports for 1899 ($86,695) over that of

1898 ($60,522). The value of the imports for 1900 was $94,134, about the same as that of 1899. From observation of methods past and present, and as a result of conference with importers, the writer believes it safe to assume that the average of the imports for the past ten years will represent approximately the average for the ensuing ten years.

In the following table are given the values of the imports of lithographic stones into the United States for the years 1868 to 1900, inclusive:

Value of lithographic stone imported into the United States from 1868 to 1900, inclusive.

Year ending—	Value.	Year ending—	Value.	Year ending—	Value.
June 30—		June 30—		Dec. 31—	
1868	$13,258	1880	$56,310	1890	$105,288
1869	17,044	1881	77,894	1891	107,339
1870	14,225	1882	111,925	1892	107,777
1871	21,311	1883	104,313	1893	91,849
1872	36,146	1884	128,035	1894	74,454
1873	44,937	1885	54,022	1895	107,670
1874	36,902	1886	71,009	1896	74,044
1875	41,963	Dec. 31—		1897	58,922
1876	47,101	1887	83,182	1898	60,522
1877	44,503	1888	113,365	1899	86,695
1878	42,700	1889	78,077	1900	94,134
1879	37,746				

PRICES.

The value of the stones varies with the quality and size, from 3½ cents per pound for stones 16 by 22 inches to 17 cents for stones 43 by 64 inches. These prices are for "best yellow stones," such as are used in the printing work of the Geological Survey. "Gray" and "blue" stones cost considerably more. In the table below are given the values of thirty-six different sizes of imported German stones:

Value of lithographic stones.

No.	Size.	Price per pound.	No.	Size.	Price per pound.	No.	Size.	Price per pound.
		Cents.			*Cents.*			*Cents.*
1	16 by 22	3½	13	26 by 36	8	25	32 by 48	13
2	18 by 24	4½	14	26 by 38	9	26	34 by 48	13
3	19 by 25	4½	15	28 by 38	9	27	35 by 50	14
4	20 by 26	5	16	28 by 40	10	28	36 by 50	14
5	22 by 28	6	17	28 by 42	11	29	36 by 51	14
6	22 by 30	6	18	29 by 43	12	30	36 by 52	14
7	22 by 32	6	19	30 by 40	12	31	40 by 60	14
8	22 by 34	7	20	30 by 43	12	32	40 by 62	15
9	24 by 30	7	21	30 by 44	12	33	42 by 60	15
10	24 by 32	8	22	32 by 43	12	34	42 by 62	16
11	24 by 34	8	23	32 by 44	12	35	42 by 64	16
12	24 by 36	8	24	32 by 46	12	36	43 by 64	17