BUILDING STONES.

MARBLE OF WHITE PINE COUNTY, NEV., NEAR GANDY, UTAH.

By N. H. Darton.

Introduction.—In September, 1907, in compliance with a request from Hon. J. K. Taylor, Supervising Architect of the Treasury, I made an examination of a marble deposit in eastern Nevada. The purpose was to determine its amount, conditions of occurrence, and commercial prospects and to collect samples for analysis and physical tests by the technologic branch of the Geological Survey.

Occurrence.—It was found that the marble is a member of a series of metamorphic pre-Cambrian rocks of the Snake Range. The strata are uplifted in a broad anticline and deeply incised by canyons emptying into Snake Valley. The exposures are all in the first canyon south of some warm springs and begin about 5 miles west by south of Gandy post-office, or 4 miles west of the Nevada-Utah State line. They extend up the canyon for 2 miles, constituting the greater part of the walls of the main canyon and of several of its branches. The marble member is about 150 feet thick and it is included between metamorphic schists. The underlying schists appear in a low arch near the "camp" in the canyon. They are about 40 feet thick and lie upon white quartzite of which only the top is exposed. The overlying schists are in turn overlain by Cambrian limestones of dark-blue color, which are prominent in the adjoining higher slopes and ridges. The marble constitutes the walls of the canyon for nearly 2 miles, but it pitches downward at both ends of the exposure.

Marble member.—The marble is a completely metamorphosed or recrystallized limestone, partly gray in color and partly white. A great variety of tints of various colors appear, but the larger part of the deposit is dark bluish gray, banded or mottled with light gray or white. Some beds show regular alternations of white and gray marble in thin layers which are usually wavy or contorted. A thick deposit of white marble occurs near the upper part of the member. This white marble is in very thick, massive beds in the western por-

tion of the canyon, where its thickness is about 35 feet. Eastward it outcrops along the canyon walls at various elevations and near the east end of the canyon, where it passes beneath the surface, it is 30 feet thick, but not massively bedded. In an exposure on slopes a short distance south of the canyon a low dome brings the white marble to the surface in an area of a few acres. Here portions of the rock are pink, in part in general tone and in part in mottlings. The extent of the pink marble is not revealed. The white marble in the upper part of the canyon is uniformly white, with a very slight but pleasing tinge of cream. Very little pure white rock was observed. The gray marble is the predominant variety, and although it varies in the proportion of white and gray bandings and mottlings, large bodies of it are of a uniform general tint. Some of the faces present from 75 to 100 feet of this rock. A few of the beds are separated by thin partings of mica, which considerably diminish the strength of the marble, but much of it does not part readily along its bedding planes.

Structure.—The marble deposits as exposed lie mainly in a wide, low arch with nearly flat, slightly undulating top, as shown in fig. 22. This

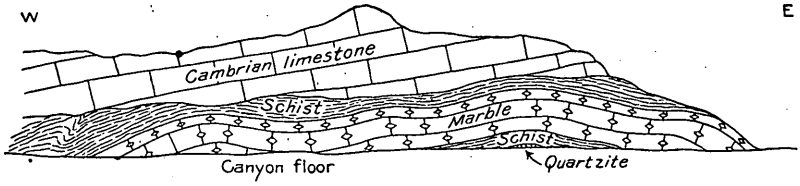

FIG. 22.—Section of marble in canyon west of Gandy, Utah. Scale: 1 inch=1 mile, approximately.

illustration shows that the marble is but very little disturbed. The beds are free from noticeable faults, but they are traversed by various joint planes, mostly far apart, so that they will facilitate quarrying. It is believed that the minor joint planes which occur in some of the outcrops will disappear as the surface material is removed. Most of the cliffs show large bodies of unbroken marble.

Character.—Analyses of the marble made in the St. Louis laboratory are given at the end of this report. So far as observed the rock carries no pyrites or other metallic minerals which would disfigure it on weathering. The natural weathered surfaces indicate that it would weather satisfactorily, so far as could be judged from experience in other regions. The crystalline structure of the rock is so complete that it polishes beautifully, and this character appears to extend through the entire deposit.

Quarry conditions.—The marble deposits are favorably situated for quarrying, as they lie nearly level for a long distance and are presented in sloping canyon walls. The sketch map (fig. 23) shows the general topographic conditions. The amount of marble is great, and there appears to be no reason why quarries should not be successful if they

are properly opened and operated. So far this marble has not been developed, except at a few points where samples of the surface material have been wedged off.

Shipment.—The canyon has a good road, over which the marble can be easily brought on a gentle down grade to the main wagon road in the adjoining Snake Valley. Thence, however, the distance to railroads ranges from 65 to 80 miles, over mountains or along valleys, where the expense of haulage is great.

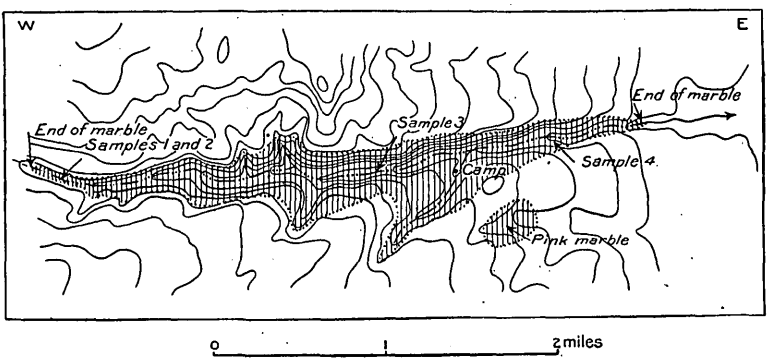

FIG. 23.—Sketch map of canyon west of Gandy, Utah Contour interval, 100 feet. Ruled area represents marble.

Crushing strength.—Four samples of the marble were collected, but all were either from outcropping ledges or within a few inches of the surface; they do not, therefore, indicate the strength which the quarry stone may be expected to have. Samples No. 1 and No. 2 were white marble from the west end of the canyon. No. 3 is banded gray marble and No. 4 is white marble obtained near the east end of the exposures. The blocks were 4-inch cubes, and they were tested in the structural-materials laboratories of the Geological Survey at St. Louis, under supervision of Mr. R. L. Humphrey.

Physical tests of marble from White Pine County, Nev.

Cube No.	Specific gravity.	Weight per cubic foot (pounds).	Crushing strength (pounds per cubic foot).	Absorption (per cent).
1	2.663	166	16,780	0.50
2	2.656	165.6	16,995	.57
3	2.696	168.1	20,145	.18
4	2.705	168.4	18,355	.16

Composition.—The subjoined analyses were made of the four samples in the St. Louis laboratory. The materials were air dried.

Analyses of marble from White Pine County, Nev.

	1.	2.	3.	4.
Laboratory No	262	263	264	265
Silica (SiO_2)	.60	.40	.28	.50
Alumina (Al_2O_3)	.33	.26	.23	.26
Ferric oxide (Fe_2O_3)	.22	.24	.24	.34
Manganese oxide (MnO)	.02	Trace.	.03	Trace.
Lime (CaO)	48.58	53.69	49.56	53.69
Magnesia (MgO)	5.66	1.43	5.00	1.35
Sulphuric anhydride (SO_3)	.10	.08	.07	.07
Water at 100° C	.00	.00	.01	.00
Carbon dioxide (CO_2)	44.39	43.78	44.50	43.68
Ignition loss	.05	.02	.03	.05
	99.95	99.90	99.97	99.94

SURVEY PUBLICATIONS ON BUILDING STONE AND ROAD METAL.

The following list comprises the more important publications on building stone and road metal by the United States Geological Survey. The annual volumes on Mineral Resources of the United States contain not only statistics of stone production but occasional discussions of available stone resources in various parts of the country. Many of the Survey's geologic folios also contain notes on stone resources that may be of local importance.

ALDEN, W. C. The stone industry in the vicinity of Chicago, Ill. In Bulletin No. 213, pp. 357–360. 1903.

BAIN, H. F. Notes on Iowa building stones. In Sixteenth Ann. Rept., pt. 4, pp. 500–503. 1895.

DALE, T. N. The slate belt of eastern New York and western Vermont. In Nineteenth Ann. Rept., pt. 3, pp. 153–200. 1899.

——— The slate industry of Slatington, Pa., and Martinsburg, W. Va. In Bulletin No. 213, pp. 361–364. 1903.

——— Notes on Arkansas roofing slates. In Bulletin No. 225, pp. 414–416. 1904.

——— Slate investigations during 1904. In Bulletin No. 260, pp. 486–488. 1905.

——— Note on a new variety of Maine slate. In Bulletin No. 285, pp. 449–450. 1906.

——— Recent work on New England granites. In Bulletin No. 315, pp. 356–359. 1907.

——— The granites of Maine. Bulletin No. 313, pp. 69. 1907.

DALE, T. N., and others. Slate deposits and slate industry of the United States. In Bulletin No. 275. 1906.

DILLER, J. S. Limestone of the Redding district, California. In Bulletin No. 213, p. 365. 1903.

ECKEL, E. C. Slate deposits of California and Utah. In Bulletin No. 225, pp. 417–422. 1904.

HILLEBRAND, W. F. Chemical notes on the composition of the roofing slates of eastern New York and western Vermont. In Nineteenth Ann. Rept., pt., 3, pp. 301–305. 1899.

HOPKINS, T. C. The sandstones of western Indiana. In Seventeenth Ann. Rept., pt. 3, pp. 780–787. 1896.

——— Brownstones of Pennsylvania. In Eighteenth Ann. Rept., pt. 5, pp. 1025–1043. 1897.

HOPKINS, T. C., and SIEBENTHAL, C. E. The Bedford oolitic limestone of Indiana. In Eighteenth Ann. Rept., pt. 5, pp. 1050–1057. 1897.

KEITH, A. Tennessee marbles. In Bulletin No. 213, pp. 366–370. 1903.

RIES, H. The limestone quarries of eastern New York, western Vermont, Massachusetts, and Connecticut. In Seventeenth Ann. Rept., pt. 3, pp. 795–811. 1896.

SHALER, N. S. Preliminary report on the geology of the common roads of the United States. In Fifteenth Ann. Rept., pp. 259–306. 1895.

——— The geology of the road-building stones of Massachusetts, with some consideration of similar materials from other parts of the United States. In Sixteenth Ann. Rept., pt. 2, pp. 277–341. 1895.

SIEBENTHAL, C. E. The Bedford oolitic limestone [Indiana]. In Nineteenth Ann. Rept., pt. 6, pp. 292–296. 1898. [See also HOPKINS, T. C., and SIEBENTHAL, C. E.]

SMITH, G. O. The granite industry of the Penobscot Bay district, Maine. In Bulletin No. 260, pp. 489–492. 1905.