"Serpentine, Ophicalcite, & Verdantique Marbles"

(Including "Serpentines of the various States and Territories"
(circa 1886 – beginning on pp. 362)

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B. SERPENTINE, OPHICALCITE, VERDANTIQUE MARBLE.

(1) COMPOSITION, ORIGIN, AND USES OF SERPENTINE.

Serpentine is essentially a hydrous silicate of magnesia, consisting when pure of nearly equal proportions of silica and magnesia with from 12 to 13 per cent. of water. The massive varieties quarried for architectural purposes are always more or less impure, containing frequently from 10 to 12 per cent. of iron protoxides, together with varying quantities of chrome iron (chromite), iron pyrites, hornblende, olivine, minerals of the pyroxene group, and the carbonates of lime and magnesia.

The origin of serpentine rocks has long been a matter of dispute among geologists. Recent investigations tend to show that in many cases they result unmistakably from the alteration of igneous eruptive rocks, especially the olivine bearing varieties, such as the peridotites and gabbros. In the varities ophicalcite, consisting of intermingled serpentine and calcite or dolomite, the serpentine is apparently in all cases derived by a procees of hydration and decalcification from a non-aluminous pyroxene. The theory long ably advocated by Dr. Hunt to the effect that the serpentine occurring intercalated with beds of schistose rocks and limestones resulted from metamorphism of silico-magnesian sediments deposited by sea waters is now very generally abandoned, and it is doubtful if the substance ever occurs as an original deposit even in the eozoonal forms, but is presumably always secondary.*

Serpentine is a soft, though somewhat tough, compact rock of variable color, usually greenish, though often variously streaked and spotted with yellow, yellowish green, brownish or more rarely red, its color depending, according to Delesse,† upon the degree of oxidation undergone by the included ferruginous mineral. The name serpentine is

* For further information on this point the reader is referred to such papers as T. G. Bonney on the serpentine and associated rocks of the Lizard District. Quar. Jour. Geol. Soc. of London, 1877, Vol. XXXIII, p. 11, p. 884, and on the serpentine and associated rocks of the Ayrshire coast, same journal, 1878, Vol. XXXIV, p. 769. Also T. S. Hunt on Geological History of Serpentine, Trans. Royal Soc. of Canada, Vol. I, Sec. IV, p. 169, and Wadsworth's Lithological Studies; also Williams on Serpentine of Syracuse, N. Y., Am. Jour. Sci., Aug. 1887.

† Zirkel, Petrography, Vol. I, p. 320.

from the Latin *Serpentinus*, a serpent, owing to its color and spotted appearance. Several varieties are recognized, the general name *Verdantique marble* being often applied indiscriminately to all, though the name (Verde Antico) was originally applied only to the various veined and brecciated serpentinous rocks, used by the Romans, and obtained from Italy, Greece, and Egypt. Ophite (from the Greek *Οφιτης*, like a serpent) is the name also often given to those varieties consisting of an intimate mixture of serpentine and calcite or dolomite. These rocks are also called ophiolite and ophicalcite by various writers.

Precious serpentine is the pure translucent massive varitey of a rich oil green color. Chrysotile and amianthus are the names applied to the fibrous silky variety, such as that from Canada, which is mined and utilized as asbestus.

Owing to its softness, which is such that it can be readily carved or turned on a lathe and its beautiful colors when polished, serpentine has long been a favorite with all civilized nations for ornaments and interior decorative work. The rock, however, occurs almost universally in a badly jointed condition, so that blocks of small size only can be obtained, or if large, they are liable to break under pressure or even in process of dressing. (See illustration, Plate VI.) In the great majority of cases, moreover, the stone is unsuited for polished work that is to be exposed to the weather, since it shortly loses its gloss, wears unevenly, and becomes as unsightly as it was once beautiful. The Lizard (England) serpentine can be obtained, it is stated, in blocks 7 to 8 feet in length and from 2 to 3 feet in diameter, and it is being now much used in churches for ornamental fonts, pulpits, and small shafts and pilasters, as well as for vases and inlaid work.* According to Delesse† this stone takes a beautiful and lasting polish, as shown by certain tombstones in Westminster Abbey which were erected in 1710. The celebrated Verdi di Prato, from near Florence, Italy, although equally beautiful, however, is subject to rapid decay, and is hence entirely unsuited for exterior work. Serpentine for ornamental work is at the present time scarcely at all quarried in the United States, although inexhaustible quantities are found in many instances and of exceptionally fine quality. The following are the principal localities in the United States, nearly all of which are represented in some form in the national collection.

(2) SERPENTINES OF THE VARIOUS STATES AND TERRITORIES.

California.—Inexhaustible quantities of serpentine of a deep green or yellowish color occur in the region round about San Francisco, and often in such situations as to be easily available, as at the head of Market street. So far as observed none of the material is of such a quality as to render it of value for ornamental work, while its gloomy

*Hull, Building and Ornamental Stones, p. 102.

† Materiaux de Construction, p. 75.

color renders it equally objectionable for purposes of general construction.

The rock is also abundant in other parts of the State, but the writer having seen none of the material, excepting as displayed in small fragments in the State museum at San Francisco, will refrain from further remarks on the subject.

Connecticut.—The serpentine deposits of Connecticut are thus described by Professor Shepard.* "Connecticut prospers, however, in the green marbles of Milford, a material for decoration much more beautiful and highly prized than white marble. These were first detected in 1811. Two quarries were soon after opened, one near the village of Milford, and called the Milford quarry; the other 2½ miles west of New Haven, and called the New Haven quarry. They were wrought with considerable activity for several years, and furnished an abundance of very rich marble; but as the working of them was attended with heavy expense from the difficulty of obtaining blocks of large dimensions that were perfectly sound, and from the labor required in sawing and polishing, they were in a few years abandoned, and have for a long time been in a neglected condition. The experiment proved an unfortunate one, therefore, not from any deficiency of marble or its lack of beauty—for these were both fully admitted—but from a want of wealth and taste in the country to sustain the price.

It was perhaps an unfortunate thing that the whole of the marble afforded by these quarries was denominated *verde antique*, whereas but a small part of that furnished is entitled to this name.

The quarry at Milford is capable of furnishing abundant supplies of this highly valued marble (*i. e.*, the verde antique variety), although, from the circumstance that it occupies narrow and irregular seams among the veined marble blocks or slabs of any size, it must always be dear compared with pieces sawn as formerly, without any regard to its separation from the more common kind. * * * Whenever the attempt to work it is made, it is to be hoped that the experience of the past will prevent its use for monuments exposed to the weather, for besides the incongruity of its colors compared with the marbles usually employed for this purpose, it soon loses its lustre and emits color from the action of the weather on the grains of magnetic iron ore it contains.

The New Haven marble, though destitute of the accidental and in some measure classical value which pertains to the Milford variety, is nevertheless a beautiful thing for decoration. In vivacity of colors and the delicacy of their arrangement it is hardly capable of being surpassed. It may be described as a bluish gray or dove-colored limestone clouded with greenish yellow serpentine, the latter containing black grains and sheet veins of magnetic iron ore. The disposition of the colors is cloud-like, flamed, and veined. It polishes with difficulty in

* Report on the geological survey of Connecticut, by C. U. Shepard, 1837, pp. 101–103.

consequence of the magnetic iron it contains, which, though it heightens its beauty, unfits it for exposure to the weather." So far as the present writer is aware these quarries have not been worked since the time mentioned by Professor Shepard; *i. e.*, since a few years subsequent to 1811.

Delaware.—Serpentine of various shades of green is stated to occur about 6 miles northeast from Wilmington, New Castle County, and also to the westward, near the State line, where Brandywine Creek enters the State line from Pennsylvania.* So far as the Curator is aware it has never been quarried.

Maine.—A large bed of serpentine occurs on the northern end of Deer Isle, in Penobscot Bay, in this State. The rock is very massive, and of a dark green, almost black color, sometimes streaked and spotted by veins of amianthus and diallage crystals. It is indeed almost too dark and somber for ornamental work, but seems well adapted for general building purposes and very durable. A company was formed some years ago for working this stone, and who erected a shop for saws and grinding beds. A considerable amount of material was quarried, but the work was soon discontinued, and had not been resumed at the time of the writer's visit in 1884. The company seem to have fallen into the error of supposing that the stone could be used in long pieces and slabs suitable for window trimmings, door-posts, etc., for which, owing to its jointed condition, it is entirely unfitted. The deposit covers a nearly level area of many acres in extent, and within a short distance of the shipping wharf.

Maryland.—In the vicinity of Broad Creek, in Harford County, in this State, occurs a very large deposit of serpentine, which is described by Professor Genth † substantially as follows:

"The outcrop of the first or upper bed of green serpentine, of about 500 feet in thickness, can be traced by its outcrop almost the whole distance between the upper ford on Broad Creek and over the hill in a northeasterly direction to a ravine on the same creek, a distance of about 1,800 feet; it also crosses the creek in a southwesterly direction, but it has not been ascertained how far it extends. The outcrop of the second bed was measured on the top of the hill between the horseshoe of Broad Creek, and found to be about 180 feet, and it is very conspicuous on the west side of the creek. Its full extent was not determined. The rock is a variety of massive serpentine somewhat resembling *williamsite*, and shows sometimes a slightly slaty structure. It occurs in various shades, from a pale leek green to a deep blackish green, and from a small admixture of magnetic iron, more or less clouded; rarely with thin veins of dolomite passing through the mass. It is translucent to semi-transparent, exceedingly tough, and its hardness is considerably

* Geol. of Dela., 1841, p. 35.

† Geological Report of the Maryland "Verde Antique" marble, etc., in Harford County, Md., by Prof. F. A. Genth, 1875.

greater than that of marble." An analysis of the deep-green variety gave the following results:

	Per cent.		Per cent.
Silicic acid	40.06	Magnesia	39.02
Alumina	1.37	Water	12.10
Chromic oxide	0.20	Magnetic iron	3.02
Niccolous oxide	0.71		
Ferrous oxide	3.43		100.00
Manganous oxide	0.09		

Specific gravity 2.668, equal a weight of 166¾ pounds per cubic foot, or practically the same as granite. Specimens of this stone received at the National Museum admitted of a very high lustrous polish, the colors being quite uniformly green, slightly mottled with lighter and darker shades. It is not a true verde antique in the sense in which this name was originally employed. So far as can be judged from appearances, this is a most excellent stone, and admirably suited for interior decorative work.

About 6 miles north of the city of Baltimore, at a locality known as the Bare Hills, occurs an outcrop of a coarse light-green serpentine covering many acres. The rock is quite porous, of a dull light-green color, and unfitted for any kind of ornamental work, but admirably fitted for general building, especially in rock-faced and rubble work.

At the time of the writer's visit, in the summer of 1885, but a single quarry had been opened, and this was not at the time in operation. The material had been used with excellent effect in the construction of a school-house in the immediate vicinity. The stone occurs in the form of low rounded masses or bosses, and is regarded by Dr. G. H. Williams as an altered gabbro.* The supply is inexhaustible. Portions of the rock carry a very considerable amount of chrome iron, which was at one time mined here quite extensively. In the quarry the rock occurs in a very badly jointed condition, and the blocks are rounded and irregular. Firm blocks several feet in length can, however, be obtained, which cut up readily into sizes suitable for house walls and similar purposes.

The Museum has received from the farm of Mr. George W. Leakin, in this vicinity, samples of a fine dark-green rock, which took a fair polish, and perhaps might prove suitable for decorative work.

Massachusetts.—Serpentine exists in Massachusetts in great abundance, particularly in the Hoosac Mountain Range. "The most extensive bed occurs in Middlefield, in the southern part of the town. This bed can not be less than a quarter of a mile in breadth and 5 or 6 miles long. The colors of the rock are various and its hardness unequal. If wrought, it might supply the whole world. It yields both the precious and the common varieties. There is another bed in the same town, associated with steatite or soapstone. In the west part of Westfield is found another extensive bed of this rock, extending into Russell, of a much darker color, and containing green talc. This has been used in

* Bull. U. S. Geol. Survey, No. 28.

a few instances for ornamental architecture, and has a rich appearance when wrought.

Three beds of serpentine are found in Blanford and another in Pelham, in the southwest part of the town. The color of this last is dark, and the quantity of the talc is considerably large. A large bed occurs in connection with soapstone on the north side of Deerfield River, in Zoar, near the turnpike from Greenfield to Williamstown. Specimens from this place resemble those from the celebrated localities of this rock at Zoblitz, in Saxony." Two beds of serpentine exist also at Windsor, in this State.

"A locality of noble or precious serpentine has long been known to exist in Newbury, 2½ miles south of Newburyport, at an abandoned lime quarry called the "Devil's Den." Only small masses can be here obtained, but when polished they will compare with any in the world for beauty.*

Perhaps the most interesting and important bed of this rock that has as yet been found in the State is that at Lynnfield, in Essex County.† The bed has been traced from a point near the center of the town some 2 or 3 miles in a northeasterly direction. When first quarried the stone is said to be so soft that it can be cut with a handsaw and very readily turned on a lathe.

New Jersey.—A beautiful deep-green and oil yellow, often translucent serpentine, occurs, associated with dolomite, at Montville, in this State. Only pieces of small size are obtainable, and though of exceptional beauty the stone has never been utilized except for cabinet specimens.‡

New York.—At Moriah, in Essex County, in this State, there has been quarried from time to time under the name of ophite marble a peculiar granular stone consisting of an intimate mixture of serpentine and dolomite or calcite interspersed with small flecks of phlogopite. The rock varies from a finely granular granitic-appearing rock, consisting of about equal parts of serpentine and dolomite, to one in which the serpentine patches are some 2 or 3 inches or even a foot in diameter; The rock takes a good surface and polish, and by properly selecting the material and exercising judgment in cutting, these variations in texture can be made productive of very good effects.

This same stone is also found at Port Henry and Minerva, in the same county, and at Thurman, in Warren County.§

It is stated‖ that the largest and most valuable deposit of serpentine

* Hitchcock's Geology of Massachusetts, Vol. I, p. 158.

† Hitchcock's Geology of Massachusetts, p. 159.

‡ This serpentine has been recently shown to be derived from a non-aluminous pyroxene. Proc. Nat. Mus., 1888, p. 105.

§ Report of Judges, U. S. Cent. Ex., Vol. III, p. 158.

‖ Geology of New York, 1838, p. 205. The writer has recently shown that the Port Henry and Warren County ophiolites are altered pyroxenic limestones, Am. Jour. Sci., Mar., 1889.

in the State is found in the towns of Gouverneur, Fowler, and Edwards, in St. Lawrence County. The rock is said to be massive and sound, and remarkably free from the checks and flaws usually so profusely developed in rocks of this class. In Pitcairn, in the same county, there is also a fine deposit of serpentine of the variety commonly called precious. The calcareous spar is white or grayish-white, and forms a handsome background for the translucent serpentine. The quality of the rock is said to be excellent and free from natural flaws and fissures.

Serpentine also forms the main range of hills on Staten Island, and extends from New Brighton to a little west of Richmond, a distance of 8 miles. The rock assumes a variety of colors, from almost black to nearly white.

North Carolina.—The massive varieties of serpentine are found in many localities. The best appears to come from the neighborhood of Patterson, Caldwell County. It has a dark, greenish-black color, and contains fine veins of the yellowish-green fibrous and silky chrysotile, and admits of a fine polish; greenish-gray massive serpentine, also with seams of greenish and grayish white chrysotile is found at the Baker mine in Caldwell County, at which place are also found the varieties *marmolite* and *picrolite;* this last also occurs abundantly in the Buck Creek corundum mine, Clay County. Dark green serpentine has been observed in the neighborhood of Asheville, in Buncombe County, in Forsythe and Wake Counties. A grayish or yellowish green serpentine occurs in Caldwell, Wilkes, Surry, Yancey, Stokes, Orange, and Wake Counties, in the chrysolite beds of Macon, Jackson, Yancey, Mitchell, Watauga, Burke, and other counties. It results from the decomposition of the chrysolite.*

The writer has seen but a single sample of these rocks, and hence can express no opinion regarding their value.

Pennsylvania.—Serpentine, suitable for general building purposes, occurs in large quantities in the extreme southwestern portion of Chester County, near the Maryland line. There is also another large tract in the eastern part of the county and several smaller ones in the southeastern part, intervening between the two already mentioned. Quite similar tracts occur in the central part of Delaware County to the east of Chester, in the extreme southern portion of Lancaster County on the west, and in the southeastern part of Montgomery County, one of the largest of which is passed through by the Philadelphia and Reading Railroad near Mechanicsville. These serpentines are nearly altogether of a porous nature, light grayish-green in color and eminently adapted for purposes of general construction. As a rule they acquire a very dull and poor polish and are unfitted for the finer grades of ornamental work. In every particular they correspond closely with the serpentine of the Bare Hills, Maryland, already described. The quarries at the present time most extensively worked are located on what are known as

*Geology of North Carolina, 1881, p. 57.

the Chester Barrens, near the town of West Chester. Quarries were first opened here in 1790, and up to date upward of 500,000 cubic yards of material have been taken out. The rock, as usual, occurs only in a jointed condition, and blocks of large size can not be obtained; the largest yet quarried measured 3 feet square by 16 feet in length.

The principal markets for the quarried material are New York, Philadelphia, Baltimore, Washington, and Chicago, though it has been used in Philadelphia to a greater extent than elsewhere. The University of Pennsylvania, Academy of Natural Sciences, and about twenty churches in this city are of serpentine.

Quarries that have been worked in years past occur near the Maryland line (Rising Sun post-office), and in Media, Delaware County. The price of the rough stone at the quarries varies from 20 to 40 cents per cubic foot, and the cost of dressing varies from 5 to 15 cents per square foot of surface.* A beautiful deep lustrous green variety susceptible of a high polish and known as *Williamsite* was found in abundant small pieces during the working of the Fulton township chromite mines. Excepting as polished specimens for mineral cabinets the material was never utilized.

Although the Chester County stone has been upon the general market only about ten years it has already acquired an excellent reputation. To the writer it seems, however, that in the majority of cases very poor taste has been shown on the part of the designers, very many of the buildings being anything but beautiful from an architectural stand-point. The almost universal practice of using a light, yellowish-gray sandstone for the trimmings in houses of this material should also be condemned, since the contrast is not sufficient nor satisfactory.

The use of the stone in cities has not been long enough continued to furnish accurate data regarding its durability there, but it is stated that houses erected in the vicinity of the quarries one hundred and fifty years ago show the color of the stone to-day as fresh as when first quarried. The writer's personal observations are, however, to the effect that in a majority of cases many of the blocks exposed in a wall turn whitish, or at least fade to a lighter green. Such a change can scarcely be considered detrimental.

Vermont.—The bed of talcose slate that extends in a general northern and southern direction throughout the entire length of central Vermont bears numerous outcrops of serpentine or of serpentine in combination with dolomite, but which, so far as the writer is aware, have been quarried in but two localities, Roxbury and Cavendish. The quarry at Cavendish was worked very early, having been opened about 1835,† before there were adequate means of transportation of the quarried stone or there was any sufficient demand for so expensive a material. The

* See Geology of Chester County, Vol. C⁴, Second Geological Survey of Pennsylvania, p. 61, *et al.*

† Geology of Vermont, Vol. II, p. 778-9.

methods of working and polishing the stone were, moreover, so little understood that very poor results were obtained and the works were shortly discontinued as a consequence.

In Roxbury the American Verd-antique Marble Company early opened quarries and erected a mill for sawing. The business was pushed quite vigorously for a time, but owing to several causes, probably the same as the first enumerated, the works were shut down in 1858, and have not since been re-opened. A considerable quantity of the material was taken out for the interior decorations of the United States Capitol extensions, but for some reason, unknown to the writer, it was never used.

The Vermont stones are among the most beautiful of all our serpentines and the best adapted for all kinds of interior decorative work. The colors are deep, bright green, traversed by a coarse net-work of white veins. It is designated by Hunt* an ophiolite, and is stated by him to be a mixture of serpentine, talc, and ferriferous carbonate of magnesia. It acquires a smooth surface and beautiful polish, and it is a serious comment upon American taste that there is not sufficient demand for the material to cause the quarries to be re-opened. At Cavendish the railroad now passes within one-half mile of the quarry and good water-power is close at hand, while the Roxbury quarry is within 30 rods of the railway station. The rock lacks the brecciated structure characteristic of most foreign verd-antique, but compares more closely with the variety known as Verde di Genova than with any other with which the author is acquainted. Among the other localities in this State in which serpentine occurs may be mentioned Richford, Montgomery, Jay, Troy, Lowell, Middlesex, Wailsfield, Warren, Rochester, Ludlow, Windham, Wadsborough, and Dover.

Of the Lowell stone it is stated† that two ranges of serpentine occur, commencing near the headwaters of the Missisco and extending nearly to Canada. "For the richness and number of the varieties it would not seem possible that they can be surpassed, while their extent, amounting to 20 or 30 square miles, is beyond the possible demand of all future ages. They are exhibited in several precipitous ledges, which are easy of access and of being worked."

Concerning the locality at Troy, the same authority states: "Elegant varieties are numerous, among which are most conspicuous the very bright green noble serpentine, which covers most of the numerous jointed faces with a coat of one-eighth to one-half of an inch thick, and the spotted varieties. Numerous seams may render it difficult to obtain large slabs, but smaller pieces, suitable for a great variety of ornamental purposes, may be obtained, of great beauty and in any quantity."

* T. S. Hunt, on Ophiolites, Am. Jour. of Sci., Vol. xxv, p. 239; second series, p. 226.

† Geology of Vermont, 1861, Vol. I, p. 544.